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ON THE DEFENCES OF LEPIDOPTEROUS PUPÆ IN RELATION TO THE OVIPOSITION BEHAVIOUR OF CERTAIN ICHNEUMONIDÆ

by L. R. COLE

Anyone who has collected pupæ of Lepidoptera in the field knows only too well that from many of his finds will emerge ichneumon flies, some of which will have developed from eggs laid in the larvæ, others from eggs inserted into the pupæ. In this account I hope to draw attention to some of the defences of pupæ against the attempts of these insects to deposit eggs within them. I shall not be concerned with the concealment of the pupa or with its physiological reaction to the introduction of an egg, but with the course of events between its being discovered by an Ichneumonid and its being either penetrated by the ovipositor or abandoned unscathed.

With the diversity of pupation sites in the Lepidoptera is associated a wide variety of habitat preferences and searching behaviour in the Ichneumonidæ. A searching Ichneumonid of a given species will find a certain more or less restricted range of species of pupæ which evoke the series of actions leading to oviposition. These can be arranged in an order of vulnerability peculiar to that Ichneumonid's species. At one end of the scale will be those species of pupae that, though found and attacked, are impregnable, and at the other, those that always succumb. Between the extremes are those whose individuals are capable of delaying and sometimes averting their being stabbed by the ovipositor of the attacking female, even though their species may be regular hosts of that species of Ichneumonid.

Without further research it is impossible to assess the advantage to an individual pupa of merely delaying the consummation of an Ichneumonid attack. The obvious direct advantage is that an attack of long duration is more likely to be interrupted by some outside agent such as a predator of the Ichneumonid. Besides this, however, there is a practical justification for taking the power of prolonged resistance in a pupa as an indicator of the effectiveness of its defences. Females of an Ichneumonid species vary from time to time and from individual to individual in their ability to overcome pupal defences. A resistance by which a pupa delayed oviposition in the attack actually observed would perhaps have ensured complete success had the pupa been found and attacked by another Ichneumonid female, or by the same female at a different time. The outcome of an encounter between Ichneumonid and potential host is not a foregone conclusion but can be influenced by (a) external agents, (b) characteristics of the host individual, and (c) characteristics of the Ichneumonid female, mainly differences in size and persistence. Persistence is itself affected by many little-known factors, which might include, for instance, the condition of the ovaries, or the number and species of hosts successfully attacked in the past.

Despite the importance of the host's means of protection as a component of host selection in the wide sense (*vide* Salt, 1935), and despite the number of lepidopterous pupæ that are killed by Ichneumonid parasites, the nature and effectiveness of pupal defences in this direction have received very little attention. HINTON (1955), reviewing the known protective devices of endopterygote pupæ, makes no particular reference to the Ichneumonidæ. JACKSON (1937) mentions a female of *Pimpla turionellæ* (L.) [=*examinator* (F.)], capable of piercing a soft-cuticled pupa in 30 seconds, that remained for two hours drilling a hole in a pupa of the Geometrid *Selenia*

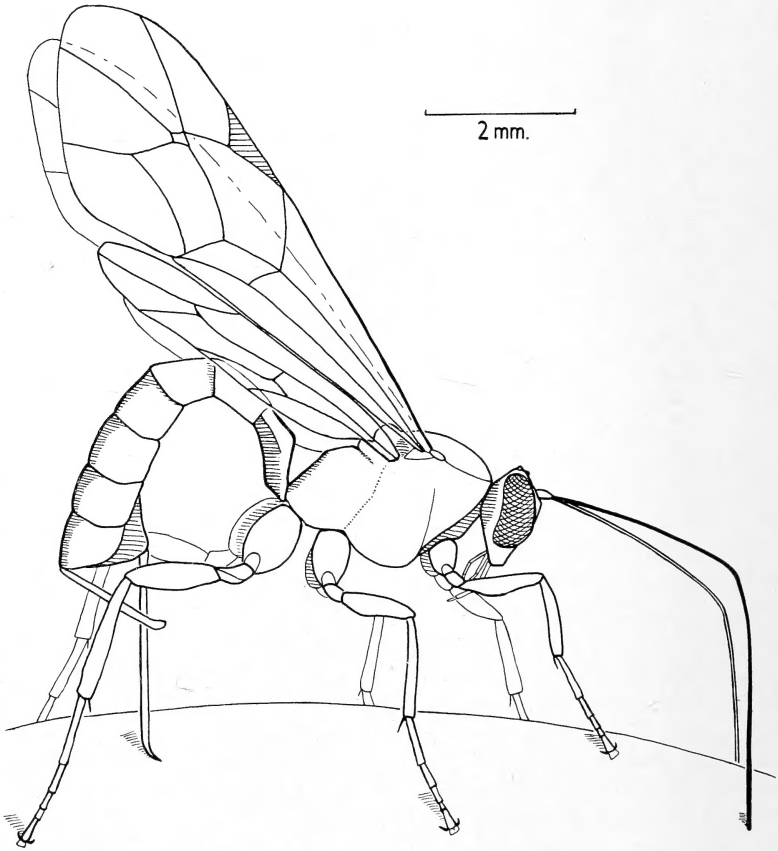

Fig.1. *Apechthis resinator* female about to pierce a folded leaf.

bilunaria (Esp.), and another that failed after repeated attempts to puncture a pupa of the Notodontid *Cerura vinula* (L.) though it succeeded in piercing the hard cocoon.

The Lepidoptera referred to below were encountered in the first place as known or suspected hosts during a biological study of three species of the Ichneumonid tribe Pimplini [=Ephialtini of some American authors]. They are to be found, either naked or in cocoons in folded leaves, in the places where these Ichneumonids search, viz., amongst the foliage of trees and undergrowth in woods and hedgerows. The Pimplini in question, *Itoplectis maculator* (F.), *Apechthis rufata* (Gmel.), and *A. resinator* (Thunb.), all operate in much the same way, by alighting on the pupa or on its cocoon and examining it with the antennæ, then flexing the abdomen and thrusting the stout ovipositor through the cocoon if present and into the pupa (Fig.1). In the field they attack a wide range of hosts. In laboratory experiments females of *Apechthis* would usually attack any of the Lepidoptera mentioned in this paper, while those of *I. maculator* were offered only Tortricids, which they accepted readily. The ovipositor in the genus *Apechthis* differs from that of other Pimplini in being decurved at the tip (fig. 1). The significance of this will be discussed later. Ovipositor lengths vary from 3.3 to 5.6 mm. in *Apechthis rufata,* 2.5 to 4.3 mm. in *A. resinator,* and 2.8 to 4.0 mm. in *I. maculator.*

It is clear from the mode of attack of these ichneumon flies that hard cuticles and thick cocoons are potentially valuable defences, as will be any feature of the pupa making the attacker's grip less secure or causing its ovipositor to slip. The cocoon may in fact be a liability, for it can provide an excellent foothold. While other predators must get inside it to reach the pupa, a Pimpline Ichneumonid can easily push its ovipositor through even a very hard cocoon.

Defences of Naked Pupæ

The first examples are chrysalids of three species of butterflies. They are freely suspended, without cocoons, so that Ichneumonids must alight on them in order to oviposit. Laboratory observations suggest that the females of *Apechthis* species are often unsuccessful against fully hardened chrysalids and that concealment is not the only means of defence for pupæ not enclosed in cocoons. If chrysalids of the Nymphalid *Aglais urticæ* (L.) were gently squeezed or stroked with a camel hair brush they gave a few sluggish movements of the abdomen. But the slightest touch of antenna or tarsus of an *Apechthis* female resulted in movements so violent that the Ichneumonid was often thrown into the air as soon as it had alighted. A persistent attacker was usually able to stab a newly formed pupa with the cuticle still soft, but when a pupa was more than 24 hours old the movements of the abdomen, so rapid as to be almost vibrations, together with the burnished surface of the cuticle, made it impossible to press the ovipositor against any part for more than a moment, or to get any anchorage with the tarsi. Only very large females, able to clasp their tarsi around the pupa, met with any success. Parasitization of the most intractable pupæ could, however, usually be secured in the laboratory by restricting their movements, either by removing them from their pads and laying them on the floor, or by holding them with forceps. The provision of a foothold for the Ichneumonid by covering the pupa with muslin still further facilitated the operation. This state of affairs recalls that described by PICARD (1922), who found that captive females of *Pimpla instigator* (F.), a species with oviposition habits similar to those of *Apechthis,* were usually unable to pierce suspended pupæ of *Vanessa* [=*Pyrameis*] *cardui* (L.) because of the rapid vibrations of the abdomen that were produced at the slightest touch.

The chrysalis of the Satyrid *Pararge ægeria* (L.) is a winter host of *Apechthis resinator* (Cole, 1957), and its cuticle is easily pierced by females of this species in its first 24 hours. Later the cuticle becomes very hard. Though the abdomen is, unlike that of the Nymphalids, capable of only slight movements, my attempts to get oviposition by *Apechthis* females in older pupæ often failed. When the attack was successful it was usually because the ovipositor had been thrust through the flexible cuticle between the fourth and fifth abdominal segments. Less often penetration was through the wing-case. The Ichneumonids would sometimes persist for half an hour or more, though they usually abandoned their attempts before this. The effectiveness of this passive resistance is due to the smooth, rounded surface of the cuticle, as well as to its thickness. The tarsi and ovipositor of the Ichneumonid slip continually, so that the necessary pressure cannot be brought to bear. In this connection a waxy bloom which appears on the surface of the pupal cuticle after 24 hours may help to prevent the adhesion of the tarsal pads. The importance of the smoothness of the surface was often demonstrated when, on my placing a previously abandoned chrysalis in a fold of muslin, the Ichneumonid's tarsal claws found anchorage, and the cuticle was pierced in a minute or two.

The chrysalis of the Pierid *Pieris brassicæ* (L.) is in contrast fairly easily pierced by captive females of *Apechthis.* Though its cuticle is thick it is also rough enough to afford an adequate grip for the tarsi. Moreover the movements of the abdomen are not sufficiently strong to dislodge the attacking female. According to PICARD (1922) females of *Pimpla instigator,* also, have little difficulty in ovipositing in this species.

EXPERIMENTS WITH COCOON-SPINNING TORTRICIDÆ

The examples given in the rest of this paper are all cocoon-spinners. The following three species of Tortricidæ pupate amongst foliage, usually spinning their cocoons in leaves that they have folded or fastened together. They are parasitized in the field by all three species of Ichneumonid, to which the pupæ fall easy prey when the cuticle is still soft. In casual observations the female Ichneumonids often became involved in prolonged struggles with the pupæ in their cocoons, suggesting that the pupæ in their exposed leaf-envelopes on the trees were not quite as helpless in face of attack as might be supposed. In early June, 1958, I carried out a series of small experiments to investigate the outcome of encounters between females of *I. maculator* and of *A. resinator* and pupæ of *Tortrix viridana* (L.).

Material. (a) Pupæ. Folded oak leaves containing cocoons and pre-pupæ of *T. viridana* were collected in Wytham Wood, near Oxford, and kept in plastic bags out-of-doors. The contents of each cocoon were examined twice daily through the anterior end, left unsealed by the larva. This made necessary some tearing of the cocoon so that, although the elasticity of the leaves returned the openings almost to their original sizes, the material as used was not quite in its natural condition. Further, some wilting of the leaves was inevitable, though surprisingly little in three days. The time of pupation of each individual was recorded so that pupæ of known age were available.

(b) Ichneumonids.

1. A rather small female *I. maculator,* caught flying in oak foliage on 25th May 1958. Wing length: 5.6 mm.; ovipositor length: 3.0 mm.

2. A medium-sized female *A. resinator,* from a chrysalis of *P. ægeria,* 2nd May 1958. Wing length: 7.5 mm.; ovipositor length: 2.8 mm.

3. A large female *A. resinator,* caught in oak foliage on 23rd May 1958. Wing length: 10.6 mm.; ovipositor length: 3.8 mm.

Procedure. The folded leaves containing pupæ of the required age were offered singly to the Ichneumonids, each of which was confined by itself in a glass cylinder of dimensions 17 cms. by 8 cms. The folded leaves were held near them with forceps. In all cases they readily accepted the offered hosts and began their attacks without delay. An attack was timed from the moment the female flexed her antennæ to examine the leaf until she either succeeded in penetrating the pupa, or left the pupa by walking or flying away, or was removed by the experimenter. The experiments extended over seven days, and no more than four pupæ were offered to each female in a day.

Results.

1. Of 12 pupæ with ages ranging from 2 to 5 days offered to *I. maculator* all survived without being stabbed. The attacks lasted from 1 to 2½ minutes. Three of these pupæ, removed from their cocoons immediately after being abandoned and offered again in a fold of muslin, were stabbed in 3, 1¾ and 4¼ minutes respectively.

2. Of 4 pupæ aged 24 hours or less offered to *I. maculator* 3 were stabbed, in 1, ½ and 2¾ minutes respectively. A fourth had not been pierced after 19 minutes, when the experiment was stopped.

3. All 9 pupæ aged from 2 to 5 days offered to the large *A. resinator* were stabbed, though 4 of them withstood the attack for over 2 minutes.

4. Of 7 pupæ with ages ranging from 2 to 5 days offered to the small *A. resinator* 4 had not been stabbed after 10 minutes, when the experiments were stopped. By this time the Ichneumonid had made between 15 and 24 attempts to impale each of them.

CONCLUSIONS. Remembering that only three individual Ichneumonids were used in these experiments and that the *I. maculator* was a small one of its kind, one may nevertheless conclude that the defences of the fully hardened *T. viridana* pupa free in its cocoon are capable of delaying an attacking female and can often frustrate its attempts, whereas young pupæ are easily overcome while their cuticles are still soft. It is evident also that the defences are less effective against *A. resinator* than against *I. maculator,* which apparently is rarely able to oviposit in hard-cuticled *T. viridana* pupæ unless an artificial foothold is provided. In the field, on four occasions I have seen *I. maculator* females attack soft pupæ of *T. viridana,* and each time the pupa was stabbed in less than thirty seconds. I have witnessed one attack on an older pupa in which a female of this species persisted for fifteen minutes, piercing the leaf over fifty times before impaling the victim. Both species of *Apechthis* are much scarcer than *I. maculator* in early summer, and I have not been able to observe their oviposition in *T. viridana.*

Watching these encounters, one soon realizes the great importance, after its hardness, of the pupa's agility. It is well known that by movements of the abdomen, which has four free segments in the male, the pupa of *T. viridana* works its way forward to protrude from the cocoon before the emergence of the moth. But throughout life the abdomen is capable of strong movements which cause the pupa to rotate or move about within its spacious cocoon. Now when the attacking *Apechthis,* say, has located with the antennæ the pupa through the enveloping leaf it quickly inserts the ovipositor in this place, but often suceeds only in scraping the pupa, not striking it squarely. At once the pupa wriggles out of reach of the probing ovipositor so that the Ichneumonid must withdraw its weapon, re-locate the pupa, and stab again. The pupa may even leave its cocoon and fall to the ground though if, as sometimes happens, it should become stuck half way out it is an easy victim. Sometimes, when the cocoon is spun in the half-eaten stub of a rolled leaf, there is not enough room for such manœuvres. But still the rotary movements may delay or prevent its being stabbed by causing the threatening ovipositor to slip. There is, however, a conflict between the requirements of a continuous thick cuticle and the mobility necessary in the first place to escape from the cocoon before emergence of the moth. A mobile abdomen must have

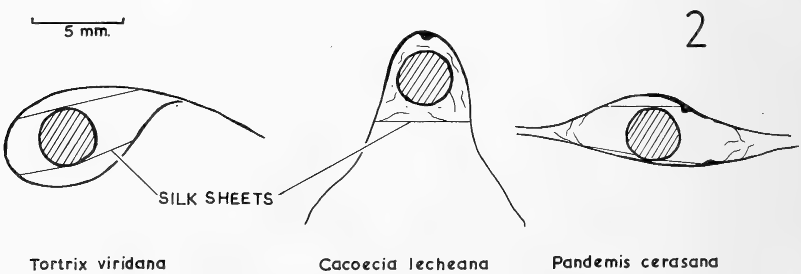

Fig.2. Sections across the cocoons of three species of Tortricidæ.

extensive areas of flexible cuticle between its segments and though the mobility can be turned to advantage as a means of taking evasive action, as described above, it may be that a smooth, completely obtect pupa would be even safer. In the experiments, if an ovipositor did penetrate the pupa it was almost always thrust through these flexible areas. The cuticle here is armoured with small polygonal sclerotized plates and can be completely covered by the overlapping edges of the segments on one side of the abdomen at a time (Fig. 3).

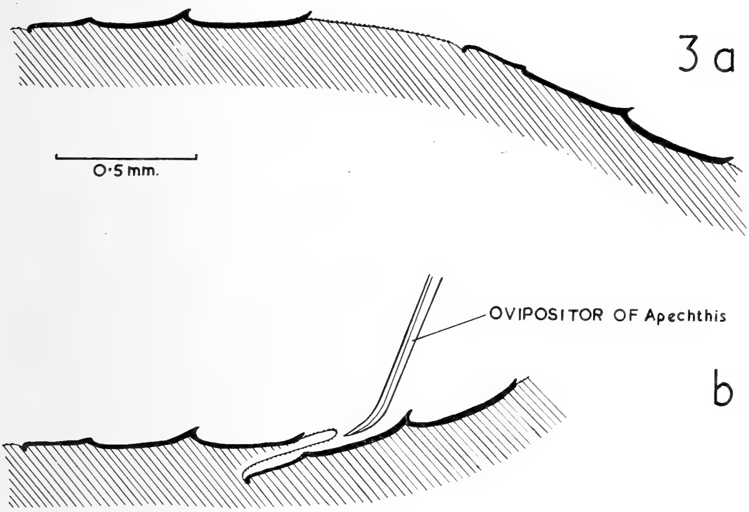

Fig.3. Longitudinal section of dorsal cuticle of pupa of *Tortrix viridana,* showing flexible ring between two abdominal segments. Abdomen flexed (a) ventrally, (b) dorsally.

This at least protects it from the thrusts delivered at right angles to the surface by the species of *Pimpla* and *Itoplectis,* which have straight ovipositors. It is much less effective, however, against the hook-tipped ovipositors of the species of *Apechthis,* which I interpret as an adaptation towards the inserting of the ovipositor between such overlapping segments (Fig. 3b). Females of *I. maculator* and *Apechthis* species tend to thrust forward when attempting to stab pupæ, and since they turn about frequently during the operation, at least some of the thrusts will be towards the anterior end of the pupa, so taking advantage of the direction of overlap of the segments. Now the more nearly parallel the ovipositor is to the surface of the pupa the more likely it is to penetrate. The decurved ovipositor tip enables its owner to press it forward almost horizontally without sacrificing depth of penetration. Although the leaf-envelope is very thin-walled and the cocoon a mere sheet, an ovipositor must be inserted perhaps two millimetres before it can press against the pupa owing to the way in which this is held in the middle of the chamber by the cocoon (Fig. 2).

The Tortricid *Pandemis cerasana* (Hübn.) [=*ribeana* (Hübn.)] spins a very flimsy cocoon, sometimes in a folded leaf, more often between leaves (fig. 2). The pupa is very active indeed and again seems quite impregnable, once fully hardened, to *I. maculator*. Four cocoons containing pupæ were collected in the field and offered singly to the larger *A. resinator* used in the *Tortrix* experiments, with the following results: —

1. The first pupa was stabbed after a struggle lasting 10 minutes, in which the Ichneumonid pierced the enveloping leaf 19 times. The pupa finally wriggled half way out of the cocoon, when the Ichneumonid mounted it and stabbed it at the junction of wing-case and abdomen.
2. The second pupa wriggled out of the cocoon and dropped to the ground after the *resinator* had pierced the leaf 6 times in 1½ minutes. The Ichneumonid continued to examine and stab the empty chamber.
3. The *resinator* female attacked the third pupa for 6 minutes, piercing the leaf 9 times before abandoning the attempt.
4. The female succeeded in stabbing and ovipositing in the fourth pupa in 2¼ minutes.

The Tortricid *Cacœcia lecheana* (L.) has in the pupal stage an even harder cuticle than has *T. viridana*. It is then capable of extremely vigorous rotary movements, and its cocoon differs from the two above in many respects (Fig. 2). The pupa is suspended in the centre of the triangular chamber by strands of silk. I have several casual records of captive females of the Pimplini unsuccessfully attacking the hardened pupæ, defeated, it seems by the hardness, activity and loose suspension.

Observations on Other Cocoon-Spinners

Salebria betulæ (Goez) (Phycitidæ) pupates amongst the foliage of birch (*Betula* spp.), suspending its cocoon in a web of silk incorporating several leaves. The diameter of the mass is such that a large captive female of *A. resinator,* removed after five minutes of thrusting its ovipositor into one of these webs, had barely touched the pupa. This species is probably an example of the one extreme of the scale of vulnerability, being unavailable to these Pimplini because of its extensive cocoon. (For comparison, in the Ichneumonid *Ephialtes inquisitor* (Scop.), which sometimes parasitizes the full-grown larva of *S. betulæ* in its web, the ovipositor is about 6.5 mm. in length.) The Pyraustid *Notarcha ruralis* (Scop.), too, seems fairly safe from attack by these Ichneumonids. It spins together the edges of a nettle leaf (*Urtica dioica* L.) and pupates in the pod so formed. In the laboratory an *A. resinator* female could easily reach the pupa with its ovipositor but was not able to pierce it. The smooth, unattached pupa simply rolled away. When the pod was compressed with forceps, however, the Ichneumonid soon stabbed it and deposited an egg, which completed its development in due course. Another *A. resinator* female was removed after five minutes of attempting to pierce a pupa of the Drepanid *Drepana lacertinaria* (L.), when it was evident that she had little chance of succeeding. This species spins a thin cocoon, usually in a folded leaf of Birch. The pupal cuticle, though rough, is very hard and is armoured at the three flexible abdominal joints with small sclerotized plates. In this and in the overlap of the abdominal segments the pupa resembles that of the three Tortricids, though it is less active. In contrast, the Œcophorid *Diurnea fagella* (Schiff.) seems to have no effective means of protection against the species of *Apechthis*. It is a winter host of *A. rufata* (Cole, 1957), pupating in autumn between thin sheets of silk in a chamber made by spinning two dead leaves together, either on the tree or on the ground. The pupa is capable of rotary movements, but its cuticle is thin and offers little resistance to a thrusting ovipositor. In the laboratory, pupæ of this species have always been parasitized within two minutes of being attacked by *Apechthis* females.

Evidently, there is scope for detailed studies in the morphology and behaviour of pupæ in relation to animals that attack them. Ichneumonids are particularly interesting in this respect since, unlike other predators, those species that oviposit in pupæ attack nothing else (except, sometimes, prepupæ), so that the relation between the adaptations of host and parasite will be especially close. Although most Pimplini parasitize a wide range of pupæ, some Ichneumonidæ are restricted to small groups of taxonomically related hosts. It would be interesting to compare the effectiveness of the host's defences against the more and the less specialized Ichneumonidæ. The subject is important, too, in the study of populations. As might be expected, pupæ are very vulnerable to Ichneumonidæ while their cuticles are soft. But in most examples it turns out that the Ichneumonid female must spend a surprising amount of time and energy in order to oviposit in older pupæ. If the host population all pupate together, the effective oviposition period of the Ichneumonids may be shortened, and so more likely to be affected by, for instance, weather conditions. However, a full investigation of these aspects awaits further advances in the study of Ichneumonid behaviour and physiology.

I am very grateful to Dr. C. L. Remington and Prof. G. C. Varley for their help in the preparation of this paper. The observations were made during my tenure of a Research Studentship of the Department of Scientific and Industrial Research.

Summary

Searching females of an Ichneumonid species attacking lepidopterous pupæ find a certain range of potential host species in which they will oviposit. Some of these are readily parasitized when found, while others always escape by virtue of their defences. Yet others may escape on some occasions only, and the success of attacks on pupæ in this category depends on the individual characteristics of the Ichneumonid female, as well as on the host and on external agents. The power of a pupa to delay an Ichneumonid attempting to oviposit in it can be used as an indication of the effectiveness of its defences.

The defences of the pupæ of ten species of Lepidoptera have been investigated by offering them to females of three species of Pimplini (Ichneumonidæ) of which these Lepidoptera are known or possible hosts. Hardness and smoothness of the cuticle, and sometimes activity, were important defences of the naked pupæ of butterflies. Hardness, activity and certain properties of the cocoons were important to three species of Tortricidæ. The species of Ichneumonidæ differed in their ability to pierce Tortricid pupæ. The defences of four other species of cocoon-spinning Lepidoptera were studied in less detail. It is concluded that some species of pupæ are very vulnerable to attack in their first few hours, but that after the cuticle has hardened Ichneumonid females must spend much time and energy if they are to deposit eggs in them. The main period of oviposition in such cases may be very short.

References

Cole, L. R., 1957. The biology of four species of Ichneumonidæ parasitic on *Tortrix viridana* L. [Abstract]. *Proc. Roy. ent. Soc. London* (*C*) 22: 48-49.

Hinton, H. E., 1955. Protective devices of endopterygote pupæ. *Trans. Soc. Brit. Ent.* 12: 49-92.

Jackson, Dorothy J., 1937. Host-selection in *Pimpla examinator* F. *Proc. Roy. ent. Soc. London* (*A*) 12: 81-91.

Picard, F., 1922. Contribution à l'étude des parasites de *Pieris brassicæ* L. *Bull. biol.* 56: 54-130.

Salt, G., 1935. Experimental studies in insect parasitism. III — Host selection. *Proc. Roy. Soc.* (*B*) 117: 413-435.

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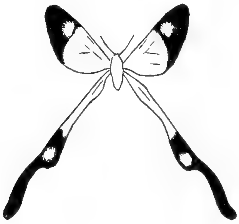

PRESIDENTIAL ADDRESS TO THE NINTH ANNUAL MEETING OF THE LEPIDOPTERISTS' SOCIETY

A quarter of a century has now elapsed since the time when I could claim with any justification to be a working Lepidopterist concerned with the systematics of the Rhopalocera. Though from time to time since then brief opportunities to return to this field have occurred, they have been rare. Under these circumstances I fear I cannot offer you an address of the kind to which you are rightly accustomed. With these few words of apology, let me turn to other fields.

An interest in lepidopterology arose early in the British Isles. I suppose the first Englishman for whom it can be claimed that he published a systematic synopsis of insects was EDWARD WOTTON (1492-1535). This was included in his *De differentiis animalium* (Paris, 1552). Though his work is generally considered to be a compilation based upon much earlier "authorities" (e.g. ARISTOTLE and others), careful perusal of his account of the insects shows it to contain at least a few personal observations. The Lepidoptera were included in the section dealing with "caterpillars and what develops from them." A much better known work is, of course, MOUFFET'S (MOFFET) *Insectorum sive Minimorum Animalium Theatrum* eventually published in 1634. The origins of this were contemporary with WOTTON who, indeed, had some part in it, and it suffered many vicissitudes, passing through several hands, before being printed in London thirty years after MOUFFET'S death. The original manuscript is preserved in the British Museum, and the very handsome original title page (which was not issued with the published work) is reproduced by MALCOLM BURR in *The Insect Legion,* and includes vignettes of GESNER, PENNY, WOTTON and MOFFET, each of whom, and in that order, contributed to this outstanding work. To this period there also belongs one other great figure, namely JOHN RAY (1628-1705), the brilliant son of a village blacksmith who renounced a career of the highest promise for the sake of religious scruples, and posthumously gave us as a result his *Historia Insectorum.* He might well be acclaimed as the 'patron saint' of the British naturalist; indeed to pursue the analogy, his name has already long been enshrined by naturalists in the works published by the Ray Society, which exists for no other purpose than the publication of annual volumes on the British fauna and flora. Publication, however, has already outrun the calendar for, though founded in 1844, in 1957 the one hundred and fortieth volume in the series was issued — a worthy monument.

Perhaps I might allude to one other seventeenth century figure, but for a very different reason. Lady GLANVILLE is commemorated in the popular name of one of our rarest British butterflies, the Glanville Fritillary (*Melitæa cinxia*), now exceedingly local and jealously watched over by the Insect Protection Committee of the Royal Entomological Society of London. MOSES HARRIS, who was responsible for introducing the name, recounted at the same time the well known story of the law-suit brought by Lady GLANVILLE'S heirs to set aside her will on the grounds of insanity. That three hundred years ago such opinions should be current is perhaps not altogether surprising. But what should one think of a very distinguished judge who within the last quarter of a century held in a British court that the collecting and study of butterflies (by J. J. JOICEY of the Hill Museum, in this particular instance) was evidence, if not of insanity, at least of some form of mental deficiency; or of the French spouse who, observing me and my son waving nets in the Pyrénées, remarked, on being assured that we were hunting butterflies, "Tiens! Mais ils ont l'air tout-à-fait intelligent!"

With the opening of the eighteenth century works began to appear of a more specialised nature. ALBIN'S *Natural History of English Insects* (1720); WILKES' *English Butterflies and Moths* (1747); *The Aurelian* (1766) and othe charmingly illustrated works of MOSES HARRIS who, on one of the title pages describes himself as "Secretary to the Aurelian Society"; DRU DRURY'S *Illustrations . . . . . of Exotic Insects* (1770-1782); LEWIN'S *Papilios of Great Britain* (1795); MARTYN'S *Psyche* (1797) and DONOVAN'S *Natural History of British Insects* (1792-1813) are examples. They are a delightful blend of art and science. A work of this period that is of particular interest to North American lepidopterists is the *Natural History of the rarer lepidopterous insects of Georgia,* by J. E. SMITH with JOHN ABBOT. PETIVER stands apart rather, and is largely a "carry-over" from the previous century, for his *Gazophylacium* is a dry methodical catalogue, of which the illustrations are not in the same class. His collection is in the British Museum (Natural History) and is the oldest extant entomological material of which I have any knowledge. The specimens bear numbers which correspond with those in the *Gazophylacium,* but many are now missing. Of particular interest to American lepidopterists perhaps is the fact that among these missing specimens there was the *"plexippus"* quoted first by LINNÆUS in his list of references: "Pet. Mus. 58. n. 527". The number is still there, but not the specimen. Its presence might have helped in the protracted argument as to whether the American Milkweed or the Oriental species with the white band on the forewing should carry the name, an argument only recently settled by the use of the plenary powers of the International Commission on Zoological Nomenclature.

What shall we say of the next century's British lepidopterists? In the first fifty-years it produced HAWORTH (to whom we owe most of our English names, which are more stable than their scientific counterparts), CURTIS, STEPHENS, the DOUBLEDAYS, EDWARD NEWMAN and STAINTON, all first-class entomologists but yet not quite up to the standard of the stars of continental Europe, whom they tended to treat rather as 'authorities' and to follow rather uncritically. LEECH and his particularly picturesque disciple SAMOUELLE also adorn this period. There had been, as MOSES HARRIS tells us, an Aurelian Society around the 1750's. Little is known of it, but scattered references here and there indicate that its spirit lived on, even if somewhat precariously, well into the next century. It is to SAMOUELLE, whose relatively successful attempts to popularise entomology did nothing to increase his own popularity with the Trustees of the British Museum (who employed him) that we owe the foundation of the oldest entomological institution still extant in the British Isles. This is the Entomological Club, founded wth three other entomologists in 1826 and still flourishing in spite of many ups and downs. The number of members was soon increased to twelve and later limited to eight, and at that level it has remained ever since. They met in each other's houses once a month, they started the *Entomological Magazine* (in 1832) the first purely entomological journal to be published in the British Isles; they formed a library and collections; they appear to have been largely instrumental in founding the (now Royal) Entomological Society of London (1833); and there is no doubt whatever that for at least half a century they gave enormous encouragement to the study of entomology amongst a wide circle of Londoners. Their collections soon proved an embarrassment and were given away or sold, and by the turn of the century they had become mainly a social club, the nature of their meetings being somewhat ambiguously indicated by the following extract from the minutes " . . . . This very enjoyable . . . . meeting came to a close in the late afternoon when those guests who required it were conveyed to the station and the remainder left in their own cars." Why they were left in their cars is not stated! However, the Club could do much better than this. In 1911 they instituted the annual Verrall Supper, in memory of one of their members, a function which must be unique. Each year some 200 entomologists sit down together and over a meal and afterwards "talk bugs" with old friends they may otherwise seldom meet; no subscriptions are asked for, yet they come in so freely that, although the Club set up a guarantee fund, it has never been called on. Quite recently, in the hope of still further justifying itself and advancing the study of entomology, the members of the Club have set up a British Trust for Entomology in the hope of giving encouragement in fields not at present covered by existing organisations.

But I fear I weary you. When I started these notes I had, I confess, little idea where they would lead me, and indeed I hardly know now. Some day, perhaps, somebody will write a history of our pursuit as it developed in the British Isles. There is so much of interest in it. Why was there such an outburst of enthusiasm in the early nineteenth century, with even a weekly journal paying its way? Why, around the 1850's, did purely entomological societies spring up all over the country, to last a few years and then die? Who were the men who inspired these activities? Why have the robust polemics of those early days been lost to us? In the end, though, is it worth while to delve laboriously into the past, however fascinating, rather than to look to the future where so much lies still to be discovered? Good hunting to all of you, and one word of advice. When you discover new facts, publish them, don't let them die with you as is the reprehensible custom of so many otherwise excellent lepidopterists.

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ASYMMETRICAL DEVELOPMENT IN AN ARGYNNID

by Paul Grey

Occasional minor departures from pattern symmetry are not especially rare in butterflies. Conditions in which either both forewings or both hindwings depart from normal coloration are seen fairly often, in both sexes. Occasional partial gynandromorphs are known, with a patch of the opposite sexual characteristics developed on one or more of the wings. Bilaterally symmetrical gynandromorphs are not so rare as might be supposed; I know of four specimens of *Speyeria* in this category. They occur in a ratio of 1 to 25,000 — 50,000 in wild populations, one would estimate. Misplaced pattern elements (the underside color appearing above, in patches, or on one or more wings, or forewing pattern running over to hindwing, for examples) are rare but still of record.

I have examined recently a female specimen of *Speyeria atlantis dodgei* taken by Ray Albright in Josephine County, Oregon, at 5000 ft. near Oregon Caves, August 13, 1958, which falls in no category familiar to me in this genus, and I would appreciate an explanatory note from anyone who can offer the rationale. The rather numerous conditions of asymmetry described by Ford, in *British Butterflies,* seem to offer no exact parallel to this particular specimen, afflicted as follows:

The left hindwing is well advanced in the usual argynnid aberrational pattern, that is, the band and marginal spotting below are replaced by large buff rays, the disk suffused solidly except for a few enlarged splotches replacing the usual spots. Above, the outer third of the pattern is replaced by buff raying as below, the inner two-thirds solid except for the enlarged and distorted black spotting, a facies entirely familiar to all who have seen the usual sort of "aberrations" found in this group, ordinarily accompanied by extreme melanism, particularly in forewings, but in this instance not especially melanic except for the blurred and enlarged spotting above.

Only the one wing is thus aberrant; the remainder of the insect is perfectly normal with the usual population facies at this geographical point, *i.e.,* running to small size, dirty and unaccented coloration, narrowed band and trace of silvering only in marginal lunules.

The occasional minor deformities of this nature, seen in one hindwing, usually consist of some crumpling or dwarfing with consequent pattern distortion rather easily attributable to damage on emergence, a mechanical interruption of perfect development. The fully symmetrical melanic aberrations of argynnids are often taken to be simply recessive, and population statistics indicate that explanation since they tend to recur in single localities. But how to account for this, perhaps partially developmental oddity? In one wing only it got a full dose and perfect expression of whatever produces the usual aberrant argynnid.

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[Ed. note: — A simple explanation is that this individual was heterozygous for the presumed recessive gene for the aberration and that a somatic mutation occurred very early in embryonic development, perhaps at the four-cell stage. This could have produced homozygous recessives in all the cells descending from the mutating cell, and of course in these the aberrational gene would be expressed. C. L. REMINGTON.]

[Alternatively, the chromosome carrying the normal allele might have failed to attach to the spindle at the same division and therefore have been lost. Tissue descended from the daughter cell lacking this chromosome would contain only the mutant allele. P. F. BELLINGER]

MORE PROBLEMS WITH *PROBLEMA* IN KANSAS (HESPERIIDÆ)

by P. S. REMINGTON

In a previous paper (1956) on Hesperiidæ of the vicinity of St. Louis, Missouri, I reviewed the uses of the name *Atrytone kumskaka* (Scudder), generally presumed to be a synonym of *Problema byssus* (Edw.). *A. kumskaka* had been recorded from Kansas in 1875 by SNOW, but the specimen was reported by FIELD (1938) to be *Atrytone logan* (Edw.). Both Dr. PAUL R. EHRLICH and KENT H. WILSON of the Entomology Department of the University of Kansas have recently verified that this specimen is actually a female *A. logan,* and they say that it now bears an additional label "determined by A. W. LINDSEY."

So then the question arises, what species did SCUDDER have in mind when he described *Atrytone kumskaka* in 1887? I believe I have discovered the answer to this question right in Chancellor SNOW's back yard, so to speak. It could scarcely have been *A. logan,* which he must have been familiar with, for EDWARDS had described *logan* in 1863, twenty-four years before, and we know that EDWARDS and SCUDDER corresponded and exchanged specimens.

In the summer of 1958 I received a National Science Foundation fellowship to study at the University of Kansas for eight weeks. On several Saturdays I went collecting around Lawrence, and between June 21 and July 12 I collected four males and eight females of *P. byssus* no more than five miles west of Lawrence. They were feeding on blossoms of milkweed and Pearly Everlasting, and I think I could have taken many more had I not been diverted by numerous fine specimens of the Regal Fritillary, *Speyeria idalia* (Drury). Only later did I realize the significance of my find.

The Kansas specimens average 3 mm. wider wing spread in the males and 4 to 5 mm. wider in the females than do Illinois or Florida specimens. Dr. EHRLICH has kindly reported that the genitalia of a male Lawrence *byssus* "compares very well with the figure published by LINDSEY, BELL, and WILLIAMS." Lawrence specimens tend to be a little more strongly marked, especially the females, and the band of spots across the upper side of the fore wing is wider and lighter in the females. Could it be possible that Dr. SNOW also collected some of these skippers around Lawrence and sent them to SCUDDER in the 1870's and that SCUDDER decided that they deserved a separate name? Evidently too some collector in Iowa sent similar specimens to SCUDDER. It would be interesting to search for *byssus* in Iowa in late June and early July and see if it can be rediscovered there. SCUDDER would not be the only writer who has given specific or subspecific names to western races of skippers which also occur further east. It is often true that the western representatives tend to be larger and of more robust appearance. EHRLICH and GILLHAM mention this in naming a race of *Atrytone conspicua* from eastern Nebraska. AVERY FREEMAN has done the same with *Hesperia leonardus* Harris and *H. metea* (Scudder) from the southwest.

To sum up, then, the *Problema* problem seems to me to have resolved itself into the facts that up to the present there are only two species known in this genus that has been erected for them: *bulenta* from North Carolina and Georgia, and *byssus* from the Southeast and the middle Mississippi Valley. The western representatives of *byssus* show some differences from Florida specimens, but genitalic comparison shows they are not separate species. SCUDDER did not make this comparison and gave the name *kumskaka* to the western specimens. This name is definitely a synonym of *byssus*. The habits of *byssus* show that, although it is a swift flyer, it is extremely local and so has not been widely observed or collected. Perhaps if more of us look carefully for it, we shall extend its range. Much remains to be learned about the biology of both species of *Problema* offering challenges to future students of skippers. So there are still problems of *Problema* to be solved.

References

Field, W. D., 1938. A manual of the butterflies and skippers of Kansas. *Bull. Univ. Kansas* 39, no. 10: 327 pp., 2 pls.

Remington, P. S., 1956. Some observations on the Hesperiidæ of the St. Louis area. *Lepid. News* 9: 190-195.

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AN ATTEMPT TO REAR *EREBUS ODORA* IN NEW JERSEY

by JOSEPH MULLER

Nobody likes to admit a failure, but being convinced that negative results may be of value to other lepidopterists I am communicating to members of the Lepidopterists' Society my experiences in rearing *Erebus odora* (Linné) in the hope that they will profit thereby. When I caught this female *Erebus odora* I had hoped that the title of this note would be "The Successful Rearing of *Erebus odora* in New Jersey," but that dream did not come true.

Nevertheless, having been urged by a brother lepidopterist to prepare these notes, I now hope that they will reach the eyes of someone who has had experience in rearing this insect and will be able to point out my mistakes, especially in the selection of the proper food plants. If luck is with me, I will perhaps catch another female next season.

Last summer on August 11th, for the third time in recent years, I took a female *Erebus odora*. It was a battered specimen, the primaries as well as the secondaries being almost half gone, but to make up for its condition it was extremely lively. The moth was put in a paper bag with a small piece of cotton soaked in sugar water. Each two days the cotton was resoaked. At the expiration of the first two-day period almost two hundred surprisingly small eggs were laid. The moth was then transferred to a second bag and the eggs cut from the first bag and placed in a jar. On August 18th, to my surprise, all eggs hatched. The larvæ were rather large considering the smallness of the eggs, and very lively, acting somewhat like geometrid larvæ.

With the appearance of the larvæ I thought my troubles were over, but soon found to my disappointment that they were only beginning. To select the proper food I first consulted "The Lepidoptera of Pennsylvania" by HARRISON M. TIETZ (1952), which had proven valuable before in similar circumstances. There the following food plants were mentioned: *Acacia decurrens, Cassia fistula, Ficus trigonata, Gymnocladus diocus, Pithecollobium unguiscate,* and *Saman* sp. In "The Lepidoptera of New York and Neighboring States" by W. T. M. FORBES (1920), Acacia alone was given as the food plant. Not quite satisfied with this list because of the scarcity of those plants in New Jersey, I inquired from three fellow collectors for suggestions. These proposed Papaw, Acacia, Virginia Creeper, Privet, and Urticaceæ (Elm, Hackberry, Hop, Nettle, and Fig). With this information I prepared four jars, one containing Elm and Hackberry, the second Virginia Creeper and Privet, the third Black Locust and Honey Locust, and the fourth Tulip Tree leaves and Hickory. The two hundred larvæ were divided equally in the four containers. The first day they did much moving around, as if searching for something, the second day their pace was slower and on the third day they merely rested on the sides of the container, becoming smaller, shriveling up and dying for lack of the proper food. All this time the larvæ were watched carefully for signs that something was being eaten, but only one appeared to have fed a little on the surface of the leaf of the Virginia Creeper. Two hundred larvæ — and healthy ones — were dead.

Opening the second paper bag I found to my surprise three hundred fifteen more eggs. This fact appeared to give me another chance. Removing the female to a third bag, again four containers were prepared. When the larvæ were hatched in a few days they were placed in them and the following plants added: Mulberry, Sumac, Honeysuckle, Wild Cherry, Oak, Catalpa, Osage Orange, and some leaves from unknown garden bushes. But the results were exactly similar to the first lot. After two days I got in touch with a botanist who helped me find two species of *Cassia* and some Kentucky Coffee Trees. One larva only ate the surface of a Còffee Tree leaf, but again they all perished.

Then my obliging female laid one hundred thirty more eggs, giving me still a third chance — like a new lease on life. These larvæ were put on Coffee Tree, *Cassia,* and Fig, three food plants upon which *Erebus odora* is supposed to feed, but again the results were negative and after three days all the larvæ were dead.

This female lived in captivity for nineteen days laying six hundred forty-five eggs from which emerged healthy, lively larvæ. Can anyone tell me why I failed to rear them? What is the food plant for *Erebus odora* in New Jersey? I am much puzzled.

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VANESSA ATALANTA TAKEN AT ATLANTIC CITY AT 2 A.M.

REMINGTON (1948) noted that more information was needed on the habits of Lepidoptera, including the location of night resting for diurnal species. Mrs. MATHER and I observed that *Vanessa atalanta* was rather common at Atlantic City, Atlantic Co., New Jersey, during the period 16 through 21 June 1957. We were surprised however to find two individuals resting on the boardwalk within about 50 feet of each other at about 2:00 A.M. on the morning of 21 June. They were easily approached and taken by hand.

Reference

Remington, Charles L., 1948. Lepidoptera biology — open for study. *Lepid. News* 2: 37.

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ESPECIALLY FOR FIELD COLLECTORS

(Under the supervision of FRED T. THORNE, 1360 Merritt Dr., El Cajon, Calif., U.S.A.)

BAITING PHILIPPINE BUTTERFLIES

by JULIAN N. JUMALON

In the Phillippines many interesting forms of butterflies can be taken with baits. Several natural baits present in the insect's habitat have been observed to be favored by certain species of butterflies, while baits artificially prepared and planted in places where these insects frequent, have also been found to entice them successfully, more especially those belonging to the family Nymphalidæ. The writer found an opportunity to work on the baiting method of collecting insects during several of the annual summer collecting and exploring expeditions carried out by the University of San Carlos of Cebu City. In these annual visits to various types of localities, he was able to take notes of the interesting results, and at the same time discover various kinds of jungle sauce piquants to which some butterflies make regular calls.

Earlier observations made in the island of Leyte disclosed the habit of a tawny *Charaxes* of locating heaps of civet-cat ordure. In many occasions, the same butterfly has been seen sitting comfortably before a heap of human excreta. Butterflies of this genus have a strong attachment to offensive-smelling things. *Charaxes fabrius*, an easier species to encounter in this city, where its favorite foodplant, the Camanchile tree (*Pithecolobium dulce*), abounds, is popuarly known as the "palahubog" (drunkard), because it has a penchant for tuba, the coconut wine. It is frequently seen near tuba stores, often unsteady in flight after one drink too many. Not infrequently it dashes against walls of houses, like a person who acts queerly after a drinking spree. It has even been seen several times chasing delivery trucks rushing tuba into the city for distribution to stores. Places where the tuba gatherers empty their bamboo tubes of ground mangrove bark, which is used for coloring the coconut sap, are fine spots at which to expect these butterflies. About three kinds of *Charaxes*, several species of satyrs and dusky nymphalids, two kinds of *Melanitis*, and the huge *Amathusia phidippus* of the twilight world, are among the regular patrons easily encountered atop coconut trees which are marked for the coconut wine production. Usually, coconut trees groomed for the tuba industry are towering domains of the acrobatic tuba sap harvesters, and are beyond the reach of the collector's net.

Out in Mindanao and Leyte islands, a tree called "haguimit" (*Ficus minahassæ*) sends down bushy clusters bearing thousands of succulent fruits which attract hundreds of insects when ripe. The overripe fruits form a thick layer on the ground and ferment, and this heap attracts the same or other types of visitors which prefer it stronger. On sunny days, dazzling *Ptychandra schadenbergi,* orange-striped *Euthalia, Clerome kleis,* several *Melanitis,* wood satyrs, occasional jungle danaids, and the mountain *Zethera thermæa,* can be seen elbowing each other on the broom-like spray, unmindful of the hundreds of droning bees and wasps and flies. A whole day may be profitably spent near the tree, where a fastidious collector can select his prizes from the ever-changing faces of winged visitors.

A shrub-tree thriving on the edges of forests and wooded hills, known locally as "anagasi," is the favorite parking place of a beautiful, rare *Neorina.* Parts of its trunk or branches which are grazed by carabaos or blazed by the farmer's bolo, secrete a sap which catches the nose of this shy nymph. Unlike other nymphalids, this blue-violet beauty alights upside down upon its vertical dining table. In their first encounter with this shade lover in Leyte in 1955, it took the writer and his son a whole week to collect the three specimens which were partial to a single tree. It was at home in the semi-twilight dimness of early morning and late afternoon of cloudy days. Yet, in Agusan last summer, several fine specimens were taken at an altitude of about two thousand feet on bright afternoons. In Mindoro, in 1956, at nearly four thousand feet elevation, a couple were encountered browsing contentedly in the foggy fringes of pigmy negrito trails. A friend collecting in southern Luzon reported encountering this butterfly upon the same tree, which is known there by the same name, hence its common name, the Anagasi butterfly. This woodland beauty has the habit of returning to its favorite glade again and again, oftentimes choosing the same perch with unerring accuracy.

A trick employed in Leyte in the early thirties, which the writer learned from two mountain boys, was the simple process of debarking a part of the hanagdong tree. He remembered that, with cat-like agility, the boys would climb the tree and cut a ring around the trunk about six inches in width and about three meters above the ground. Left for two or more days, the scorching April sun would work wonder with the sap. When revisited, the bait yielded scores of brilliant butterflies and huge black stag beetles. In the passage of years, the writer had forgotten the likeness of that tree, and had had no chance to repeat the trick. And the two boys have grown into young men and were killed by guerillas during the resistance, for faults for which, ordinarily, mothers would feel reluctant to whip their own erring children.

Scents were employed with certain results in the mountains of Zamboanga in 1954. Cheap perfumes were tried in a small gulley where handsome wood nymphalids were observed shying at our approach while they feasted on the fruits of the haguimit. A few drops of perfume placed upon a wad of cotton and hidden in a bell-shaped flower immediately created a stir. In a matter of seconds, a couple of Mindanao *Tanæcia* came and excitedly hovered around to locate the disturbing odor. In this case, Dana perfume was used. Spirit of anise, vanilla, and thinner were used in another portion of the woods with discouraging results, although once, in the city, a nymph was attracted to the strong fume from a newly opened can of thinner. A more interesting incident occured along a stream in Leyte when several butterflies and a skipper were attracted to the spilled liquid from a can of sardine and also of salmon. Once, in the same place, the writer's wet denim trousers was doggedly hounded by a tawny skipper, and even the pretty *Symbrenthis lucina* and a swallowtail were observed to appreciate something out of the wet hiking gear.

In Bohol Island, Rev. Fr. H. SCHOENIG of the University of San Carlos and the writer tried the conventional bait suggested in books. Stale beer, wine, molasses, sugar and mashed ripe fruits, were tried in various combinations at the foot of a well-wooded hill where previous visits disclosed an abundance of a variety of butterflies. Except for a battered *Zethera thermæa,* a *Symphædra panopus,* and a couple of grass satyrs, nothing eventful came. Sunshine was then intermittent as the day was generally cloudy. The party, however, did not pay much attention to their baits, as they had a greater thrill that day ambushing the huge males of the *Ornithoptera magellanus* which were remarkably wonderful as they repeatedly made sorties over the red lantana flowers beside a rice field close to the hills. Or, perhaps, it was the wrong bananas. Mashed cooked sweet potatos (camote) with sugar and molasses also failed.

Lately, with the University of San Carlos expedition to northern Mindanao (Operation *Papilio idæoides*), the same team resorted to baits in their last two days in the mountain of Agusan. With an over-supply of ripe bungulan bananas, a kind which remains green when ripe, it occurred to the party to try baiting forest butterflies despite their great success with nets. Response was immediate and rich, especially from the mountain's beautiful Brush-footed butterflies. At an elevation of over two thousand feet on a Mamanua (negrito) trail, tree trunks and outcropping roots were painted with the banana mash. Taken were an interesting, finely striped *Elymnias,* elegant blue *Adolias, Euthalia panopus, Clerome,* a jungle *Charaxes,* the wary *Tanæcia leucotænia,* and small brown satyrs. The climax however came when, on our last day, a huge, very rare *Zeuxidia* (*ottomana* ?) was seen sitting on the bait placed ona root along a side trail. Patient stalking enabled the writer to take the crepuscular beauty which first flew away and later returned and alighted on a tree trunk nearby. It was evident that several more kinds of retiring mountain nymphs could be taken with bungolan banana bait. For even the more elusive and beautiful violet *Zeuxidia* was seen near the area baited.

Observed to attract Lycænids are the tips of a leguminous vine common in mountain clearings known as coot. Fresh cane-trash strewn along forest trails invited the velvety blue *Adolias, Euthalia panopus, Clerome kleis,* and two species of *Tanæcia.* A very rare green-banded *Euthalia* identified only with tree-tops in the forest was taken upon the chopped tip of freshly cut rattan vine. Bark of logs scattered on the banks of a stream in the mountains of eastern Mindoro is favored by a rarely seen forest nymphalid. These formed colonies of sixes or more on the juicy bark and could be taken quite easily while absorbed in their feast. Bleeding parts of the Jackfruit tree and its fruits attract the *Doleschalia polibete* and *Charaxes fabrius.* But something different was seen to attract the mountain *Terias hecabe* of Leyte. On a round, slightly mossy stone about six inches in diameter beside a stream at about eight hundred feet elevation, nearly one hundred oriole-yellow butterflies sat, giving it an appearance of a stone upon which a painter poured a can of chrome yellow paint. Many s'milar stones scattered around were not patronized.

In the summer of 1956, with the Ethnological study team from the University of San Carlos in northern Mindoro, the writer had his most thrilling experience in "picking" butterflies. Rev. Fr. H. Schoenig, head of that expedition, discovered a sulphur spring just one kilometer away from the expedition's headquarters at Bagtu, a logging town some fifteen miles east of the capital. Here, a few square meters of sandflat beside a swift stream revealed a sight which will thrill even a less excitable collector. Squatting singly and in groups at various points, were trim *Papilio sarpedon, P. jason, P. antiphates, Hebomoia glaucippe, Appias domitia, A. albina, Leptocircus meges* with long quivering tails, and several other mountain butterflies. Wisps of smoke and steam curling in the early morning air caused traveling butterflies to swerve from their course and settle down on the moist, strange-smelling sand.

Between early morning and noon, butterflies kept coming to the spring. The kite papilios composed most of the visitors to the place. The writer, simply by sitting on a stone beside the most liked spot, took in one sitting around seventy perfect specimens. A dead *Papilio sarpedon,* placed on the spot with spread wings, would collect as many as a dozen individuals beside it. Allowed to stay for a while, the insects could be taken or picked with bare fingers or forceps. The party took around five hundred *P. sarpedon* alone. It was strange that several *Hypolimnas philippinensis* which kept passing a few feet over the spring were noted to pay no attention to the smell which excited other butterflies. Other species collected at the spring were a skipper, the rare *Papilio stratocles,* a Snout Butterfly, a huge *Neorina,* the casual *Papilio medon,* and *Symbrenthia lucina.* A party of Manila collectors was able to locate the spring six months later, but was disappointed because a flood in the early part of the rainy season washed the area, submerging it under a foot of water.

While many butterflies, in answer to their natural needs, can thus be lured with baits to enable the collector to make them his prey, there are however some which could be coaxed to come within the net's reach simply by one's playing upon their nature. Some butterflies here for instance, could be lured to a live decoy. Others respond with the same greediness to artificial butterflies. Call it jealousy, aggressiveness, or plain curiosity, but certain butterflies will readily dart toward such baits if placed conspicuously on their way. In fact most local butterflies which are active in the air possess that habit.

In the thirties, the writer took over one thousand males of *Catopsilia crocale,* using several live baits of both sexes, tied to a twig and jerked occasionally, in the small acacia grove where hundreds of males were gamboling and chas'ng egg-laying females. And in Zamboanga, four years ago, in a desperate last effort to bag a *Hestia* to enable the writer to represent the place in his series of these huge "ghosts", a piece of bristol board was torn into a crude shape of a butterfly. Tied to a long stick and dangled overhead, it finally attracted the jungle aristocrat. In this manner four were ultimately taken.

A new butterfly enthusiast, ALBERT LIAO, has recently developed a great fondness for the elusive and fleet *Papilio dædalus*. While one has to outrun JESSE OWENS, the sprinter, to enable him to get his first *P. dædalus,* this neophyte gets his weekly quota by the dozen merely by sitting calmly under the shade of the lantana bush and netting passing speedsters as they tarry over the decoy (a dead or fresh specimen) pinned to the red cluster of strong-smelling flowers. Another collector harvests scores of Orange-tip butterflies from the same area, using the same method.

It is a thrilling experience to observe a butterfly sailing in the sunshine and suddenly dart toward an alleged intruder upon its "domain." But for this peculiar habit of some butterflies, it would have deprived the writer and the most patient stalker, Mr. SAMUEL OCHOTORENA of the U. S. C., of the rare privilege of bagging several *Papilio medon* out in the unfriendly, rugged hills of northern Mindoro where these trim, high-soaring swallowtails are in their elements. It was incredible, but the white nets set to constant wig-wagging motion made these elegant teasers plummet earthward to investigate the apparently officious interlopers. No better guerdon could have replaced these space gambolers, which, together with several male *Papilio semperi* which prompted the pair of collectors to ascend the hills as their last assignment, served as a fitting climax to their most fascinating adventure in the strange land of the fast-vanishing tamarau.

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SUPPLEMENTARY NOTES TO RECENT PAPERS IN THE *NEWS*

SYMPOSIUM ON TAXONOMY OF LEPIDOPTERA: — W. HOVANITZ in his paper *"The role of genetics"* (Lepid. News 11 : 12; 1957) makes the following statement: — *"Colias hyale* and *Colias croceus* of Europe blend together in southern Russian territory and separate on the other side as two different species *Colias erate* and *Colias fieldi."* This appears to imply that *erate,* for example, is only *hyale* plus certain genes received from *croceus* and minus others lost to *fieldi.* Is there any real evidence that this is so? Would it not be more correct to say that a Western yellow and orange pair (*hyale* and *croceus*) meet a similar Eastern pair (*erate* and *fieldi*) in Southern Russia and there form a hybrid population? Personally I was not aware that the yellow and orange species were known to hybridize in Southern Russia, though I knew well that this area produced hybrids between *hyale* and *erate* and between *croceus* and *fieldi.*

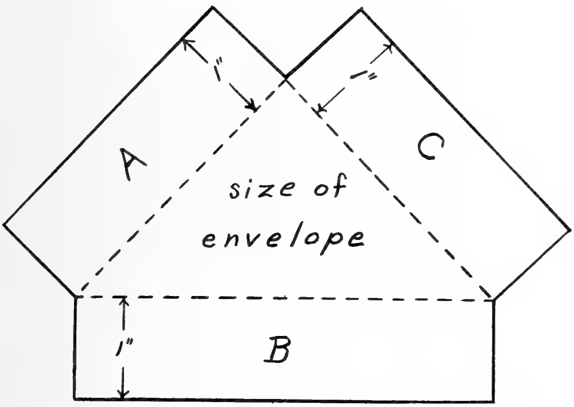
EARLY STAGES OF *EUTACHYPTERA PSIDII* (LASIOCAMPIDÆ): — The ova of the European *Lasiocampa quercus* L. and *L. trifolii* Esp. are always laid loose, so that the fact that the ova of *E. psidii* are laid in a similar manner is not so surprising. (*Lepid. News* 11: 100; 1957.)

OBTAINING OVA FROM RHOPALOCERA: — With reference to the remarks at the Seventh Annual Meeting of the Society (*Lepid. News* 11: 158-9; 1957) I have found that almost all species of Rhopalocera will lay freely if confined with fresh sprays of the food-plant in a screw-top glass jam jar illuminated by an ordinary table lamp. The lamp should be placed close enough to give a really bright light without an appreciable rise in temperature inside the jar. Many butterflies so confined will lay an adequate number of eggs almost immediately, so that the necessity of feeding is avoided. As regards the size of the jar, I have found the usual one pound size quite large enough for butterflies of up to about 2½ inches in wing expanse, with proportionately larger sizes for larger ones. In East Africa exposure to sunshine is almost always fatal as the temperature inside the jar rises to a lethal height.

LIGHT AND LIGHT TRAPPING: — I was surprised to read the remarks (*Lepid. News* 11: 161; 1957) on this subject. In England a 125 Watt Mercury Vapour Bulb used wiith a voltage of 200-250 is considered to be far and away the best, and has become almost standard. I use a similar lamp in East Africa with the greatest success.

STORING AND SHIPPING PAPERED LEPIDOPTERA: — With reference to Messrs. KENDALL's and THORNE's notes on this subject (*Lepid. News* 11: 168; 1957), I do not think that the old-fashioned triangular paper con be bettered. With this the specimen can be easily packed with its antennæ properly protected between the forewings, it can be extracted without any risk of breakage, it can even be relaxed without removing it from its paper and, if full data is written on the outside, the need for visibility is greatly reduced if not abolished altogether. Against these advantages the glassine envelope offers visibility only; the insect cannot be arranged inside with any ease, it is extremely liable to breakage when being taken out, the envelope does not take writing easily and the insect must be removed from the envelope for relaxing.

If the triangular papers are made in definite sizes they can be stored easily in triangular boxes made of thin card or stout papeer cut as per the diagram below.



Two similar pieces are cut. The flaps A, B and C are folded along the dotted lines, the two are fitted together and the flaps A and A and C and C are stuck together, leaving flap B open for the insertion of the papered specimens. I use boxes of a uniform height of one inch, *i.e.* the flaps are one inch in breadth. These boxes can be numbered and stored in large tins with naphthaline or paradichlorbenzene and a separate list maintained giving the contents of each numbered box.

If the actual triangular papers, and their triangular containers, are made so that short side of each is half the length of the long side of the next larger size, packing is still further facilitated. For folding the papers, I use rectangles measuring (in inches) 8 × 5, 5 × 3½, 4 × 2½, 2½ × 1¾ and 2 × 1¼. A sheet of paper 8 × 5, half the standard letter size, will make one envelope of size 1, four of size 3 and sixteen of size 5, or, by cutting an inch off the end, two of size 2 and eight of size 4.

I have sent consignments of papered insects from East Africa to several Society members, and they will, I think, agree with me on the merits of this packing.

D. G. Sevastopulo, P. O. Box 881, Mombasa, KENYA

A SWARM OF NOCTUID MOTHS IN SOUTHEASTERN KANSAS

On May 9, 1958, I was returning from a butterfly collecting trip in Southeastern Texas where I had spent the preceding week collecting *Papilio palamedes, P. troilus ilioneus, Atlides halesus,* and a number of other butterflies all in Harris County, Tex. All the way back to Kansas I stopped along the way wherever I encountered anything likely in the way of Lepidoptera. Stopping for breakfast one morning at Conroe, Texas, yielded a good catch of *Automeris io* and *Actias luna rubromarginata* at a roadside cafe in the pine and palmetto barrens. The weather in Texas was warm and humid. As we crossed Oklahoma in the Kiamichi Mountains we drove through intermittent downpours. In one place the highway was washed out over one of the normally dry washes in the Ouachita ranges and we had to detour miles out of our way through Fort Smith, Ark., to reach Kansas. We crossed the Kansas line at Baxter Springs at about eleven o'clock that evening. By this time we had left Oklahoma's storms behind us and the evening air at Baxter Springs was still, warm and humid with only a few flashes of lightning in the southern horizon. We stopped at the south end of Baxter Springs at a filling station for gas. I saw a sight that was more spectacular than any of the southern butterflies I had caught. There were swarms of noctuid moths flying about the gas station. There were thousands of them. We had to stop every few blocks to wipe the crushed bodies off our car windshield. As we drove down the main street of Baxter Springs there were so many moths flying around the street lights that the thoroughfare was darkened by their flights casting an eerie sight to the pavement below. Since I had my collecting equipment in the car I asked my driver to stop the car and I got out and netted a quantity of the moths. Since I have a rather extensive collection of the Noctuidæ I had no trouble identifying all of the species that made up the swarms. Over half proved to be the common Army Worm, *Pseudaletia unipuncta.* Fully a third of the remaining half were the common *Chorizagrotis introferens.* The remainder were a mixture of *Autographa brassicæ, A. ou, A. biloba, A. simplex, Plusia ærea,* and a few specimens of *Plusiodonta compressipalpis.*

Curiously enough members of other moth families did not seem to participate in their frenzied ranks. I searched very diligently for other moth species and found only one specimen of *Estigmene acræa* and a single specimen of *Isia isabella,* the "Isabella Tiger Moth", both Arctiids seated sedately on a Dairy Creme stand. They seemed independent of the noctuid hordes and made no attempt to join in their flight. It is thus doubtful that these two arctiid moths had any association with the noctuid flight. We reached Pittsburg, Kansas, where we spent the night before coming up to Ottawa and there were no inordinate flights of noctuids at all. These spectacular flights were apparently confined to the immediate Baxter Springs area. The flight took place on May 9th, 1958. There was no directional flight evident in the swarm, only an aimless flight about the lights. All the specimens were in good condition and looked freshly emerged and had not flown in from any major distance, in all probabilities. What factors were responsible for such a swarm I have not the remotest idea. I have never seen such a swarm of Lepidoptera personally before.

William H. Howe, 822 East 11th St., Ottawa, Kansas, U. S. A.

OBITUARIES

OTTO BUCHHOLZ (1874-1958)

OTTO BUCHHOLZ, a well known lepidopterist, died on the 14th day of September 1958 in the East Orange General Hospital, East Orange, New Jersey, two days before his 84th birthday. He was born in Hanover, Germany, the son of GUSTAVE and PAULINE BUCHHOLZ. He had two sisters.

During his entire life OTTO was interested in butterflies and moths. At the early age of ten he started his first collection in Germany. His daughter has today in her possession his first butterfly book entitled *Hermann's Raupen und Schmetterlings Jaeger* by Dr. E. REUTHER, 1877, which he used at that time and brought to the United States with him when he immigrated to this country without his parents at sixteen years of age. During the following years his collection grew rapidly and became at the time of his death the largest private collection of Lepidoptera in the United States.

OTTO BUCHOLZ married Wanda Held on the 2nd day of April, 1897. They had one child, a daughter, AGNES, now Mrs. HARRY EVANS of Roselle Park, New Jersey. One *Acronicta* form he named for his wife, who died after a long illness on November 30th, 1936 at Westfield, New Jersey. Thereafter he lived with his daughter and her family. At first they lived in Elizabeth, then Westfield, and for the past twenty years at Roselle Park, all in New Jersey. At all of these localities OTTO collected many rare species which no longer occur there because of the changes of environment caused by the growth and development of the country.

By profession OTTO was a mechanical engineer. He was employed for twenty-five years by the Aluminum Corporation of America at its Garwood, New Jersey, plant. He made at least one trip to Germany for that Company in connection with the opening of a new plant. Since his retirement in 1944, he devoted his entire time to his collection, spreading new acquisitions and respreading old ones, because he always sought perfection in all his material and some specimens in the course of time had become partly relaxed. When the family moved to Roselle Park, the top floor of the house consisted of a bedroom with a bath and a "bug" room larger than the other two combined. There he spent all his days and evenings when at home. The accompanying photograph shows him at his desk there; it was taken in 1949.

In the pursuit of his hobby, OTTO traveled through half of the forty-nine states in search of new specimens. His first cross-country trip was made over fifty years ago in 1907. Numerous other trips followed in rapid succession. All of these trips were made by car, loaded to the top with necessities for a collector planning to be away for many months. Generally he traveled alone and stayed in the chosen localities for the full season. Often he returned home with over 10,000 specimens neatly packed away in cigar boxes between layers of cotton. His favorite collecting places were the Florida Keys, the Carolinas, Okeechobee Swamp in Georgia, Virginia, and the Rio Grande Valley in Texas. Several trips were taken to each of these localities as well as to many others. His last trip was to California, when he was already in his seventies, with HERMANN WILHELM of Willimantic, Connecticut. OTTO was an excellent collector in the field and at his best as a field naturalist. His endurance was remarkable. Never seeming to tire, he competed easily with much younger men and outdid many of them.

With his mechanical training OTTO was very handy with tools. Most of his collection was contained in boxes about 12 × 16 inches which he made with great skill. In these the specimens were pinned on both sides. Even the cork used in these boxes was pressed by him. He made his own forceps and butterfly nets, also his light and bait traps which were quite original in design. Everything he made along these lines was most accurate and suitable for the purpose intended. Many fellow collectors are using his equipment today.

All of his specimens were spread and labeled in the most exact manner. Even for one not interested in Lepidoptera it was a pleasure just to look at his collection and see everything so neatly arranged and in such perfect order. No one was ever a better curator. His huge collection is estimated to contain about 130,000 specimens, with the butterflies alone accounting for almost ten percent of that number. All of these are housed in about four hundred double boxes and one cabinet with forty-eight large sized glass-covered drawers containing *Catocala* only, a genus in which he was much interested. In addition, his favorite groups were Sphingidæ, *Apantesis, Eubaphe, Acronicta, Graphtolitha* and *Papaipema*. A great number of species he reared himself and also inflated their larvæ. In the course of this work he discovered many lepidopterous food plants previously unrecorded in the literature.

His companions in the field in the earlier days were CHARLES RUMMEL, T. D. MAYFIELD, FREDERIC LEMMER, HENRY BIRD, GEORGE KELLER, and many others. Many members of the Newark Entomological Society took field trips with OTTO and visited him in his home, where they were always welcome to compare specimens or help themselves from his large accumulation of duplicates. Others visited him for his advice or information with which he was most liberal.

OTTO, with an amazing memory and a keen eye, was a mine of information. It is to be regretted that he published so little but it was his nature to collect, build a collection, and take care of it, and not to write. He imparted his knowledge freely to everyone who inquired. Several butterflies and moths were named after him, among them being:

Feltia buchholzi Barnes & Benjamin, 1929.
Pseudoboarmia buchholzaria Lemmer, 1937.
Plebeius icarioides buchholzi dos Passos, 1938.
Zale buchholzi McDunnough, 1943.
Strymon melinus buchholzi H. A. Freeman, 1950.
Atrytone conspicua buchholzi Ehrlich & Gillham, 1951.
Megathymus yuccæ buchholzi H. A. Freeman, 1952.

Also two generic names were proposed in his honor by BARNES and BENJAMIN: *Buchholzia* (1926) and *Eubuchholzia* (1929).

BUCHHOLZ was a Charter and Sustaining Member of the Lepidopterists' Society. He was also a member of the Brooklyn Entomological Society and a former President thereof, the New York Entomological Society, and the Newark Entomological Society of which he was also President for some years.

OTTO BUCHHOLZ was acquainted personally or by correspondence with most North American lepidopterists. He will be greatly missed by all of them who will remember him as a friend and good companion, always encouraging and inspiring.

His collection including 5 holotypes, 3 allotypes, and 551 paratypes has been sold by his daughter to the American Museum of Natural History and will be incorporated in the general collection of that institution.

My thanks to CYRIL F. DOS PASSOS of Mendham, New Jersey, for his help and additional information.

PAPERS BY OTTO BUCHHOLZ

1917. A new species of *Acronycta*. *Ent. News* 28: 183.
1926. Geo. J. Keller. *Journ. New York Ent. Soc.* 34: 293.
1951. *Mitoura gryneus octoscripta* n. var. *Bull. Brooklyn Ent. Soc.* 46: 78.
1957. A new species of *Papaipema* (Noctuidæ) from New Jersey. *Lepid. News* 10: 139-140.

JOSEPH MULLER, R. D. 1, Lebanon, N. J., U. S. A.

WILLIAM PHILLIPS COMSTOCK (1880-1956)

A full account of the life and entomological work of W. P. Comstock has been published elsewhere by C. F. dos Passos (*Journ. N. Y. Ent. Soc.* 64: 1-5; 1957). That account includes an excellent portrait and a bibliography listing the 32 published works of Mr. Comstock. Mr. dos Passos has kindly allowed us to summarize his biographical sketch; *News* readers needing fuller details are referred to the 1957 article.

Comstock was born in New York City on 1 March 1880. He lived most of his life in and near the city. He was educated at the Horace Mann School and then Columbia University, from which he received the B. A. degree in 1903. From about 1910 to 1932 he was in the construction business, but with the depression he gave it up and turned more fully to his life-long interest in the Lepidoptera. This had been fostered by his close friend F. E. Watson. From 1934 to 1937 he was Research Assistant in entomology at the Newark (New Jersey) Museum, and from 1937 to his death he was Research Associate in the Department of Insects and Spiders of the American Museum of Natural History. Aside from a 1920 paper co-authored with Watson, all of his publications appeared from 1909-14 and 1940-52. Many were on his favorite group, the New World Lycænidæ, and he wrote important taxonomic studies of the butterflies of the Antilles, *Anæa* (with F. Johnson), *Ascia,* and *Heliconius charitonius* (with F. M. Brown). At the time of his death his monograph of the genus *Anæa* and its near relatives was awaiting publication and has not yet appeared. This is the *magnum opus* of his life.

Mr. Comstock joined the Lepidopterists' Society in 1948; he was also a member of the New York (President 1943), Brooklyn, and Newark Entomological Societies.

His passing on 23 September 1956 in Neptune, New Jersey, came after a long illness.

Charles L. Remington

MINUTES OF THE NINTH ANNUAL MEETING OF THE LEPIDOPTERISTS' SOCIETY

The ninth annual meeting of the Lepidopterists' Society was held at the Department of Entomology, University of Kansas, Lawrence, Kansas, on 29-30 December 1958.

At 10:40 A.M., 29 December, Dr. ROBERT E. BEER, Acting Chairman of the Department of Entomology, welcomed the group to the University. He gave a short talk on the history of the Department, emphasizing its tradition of summer collecting trips. These trips have added tremendously to the fine Snow Entomological Collections. Dr. BEER discussed the interests of the present staff, and explained that the University of Kansas Department is oriented towards basic entomological research, while that of Kansas State College is oriented towards applied research.

Dr. PAUL EHRLICH made some announcements and thanked Dr. F. W. PRESTON and Mr. KENT H. WILSON for their tireless efforts on the preparations for the meeting. He explained that the original meeting notices had been lost by the freight company *en route* to Colorado Springs for mailing, and the resultant necessity of sending out a late "emergency" notice.

Mr. J. DONALD EFF, a member of the Society's Executive Council, presided over the business meeting. The Treasurer's report was read for Mr. HESSEL. The Society operated in the black for the year by a small margin. There was considerable discussion of the financial situation of the society. It was moved and carried unanimously that "it is the consensus of this meeting that if it is necessary the dues should be raised to $5.00 per year for Regular Members."

(The minutes of the morning session were compiled from notes taken by Mr. P. S. REMINGTON).

Dr. EHRLICH presided over the afternoon session. He read the Presidential Address for Mr. N. D. RILEY (see this issue), and then gave a brief introduction to the symposium on "The systematics of the skipper genus *Megathymus* and allies." Contributors to this very interesting session were Mr. H. A. FREEMAN, who spoke on the generic classification of the Megatymidæ, and Mr. D. B. STALLINGS and Dr. J. R. TURNER, who discussed a selection of species.

Following the symposium there was a lively round table discussion of "Modern techniques in systematics", with introductory talks by Mr. KENT H. WILSON on morphological studies, Dr. JOHN C. DOWNEY on biological studies, and Mr. H. V. DALY on quantitative methods.

After dinner Dr. PRESTON gave the group a demontration of the use of the University's IBM 650 Digital Computer. This was followed by demonstrations of the integumental anatomy of butterflies by Mr. WILSON and Dr. EHRLICH.

The morning session of Tuesday, December 30, was chaired by Dr. PRESTON. The following papers were presented:

1. "A Florida Lepidoptera collecting trip." WILLIAM H. HOWE, Ottawa, Kansas.
2. "Interesting aberrations collected in Colorado." RAYMOND J. JAE, Denver, Colorado.
3. "A quick field method for putting comprehensive data on envelopes." GEORGE W. BYERS, Dept. of Entomology, University of Kansas.
4. "The problem of *Problema.*" P. S. REMINGTON, St. Louis, Mo.
5. "Parasitism and its effect on polymorphism in the Lycænidæ." JOHN C. DOWNEY, Dept. of Zoology, Southern Illinois University, Carbondale, Illinois. (Invitational paper)
6. "The theory that Lepidoptera are able to remain as pupæ over 1-2- or 3 years." RAYMOND J. JAE, Denver, Colorado.
7. "The value of labels." KENT H. WILSON, Dept. of Entomology, University of Kansas, Lawrence, Kansas.

The afternoon of the 30th was occupied with an open house in the Entomology Department, lively trading of specimens, etc.

The Annual Banquet was held the evening of the 30th. Following the banquet, slides by F. W. PRESTON and A. B. KLOTS were shown.

The following members and guests were present: R. E. BEER, Mrs. R. E. BEER, R. BUCHMILLER, G. W. BYERS, H. V. DALY, K. DIXON, J. C. DOWNEY, J. D. EFF, Mrs. J. D. EFF, P. R. EHRLICH, Mrs. P. R. EHRLICH, MARIA ETCHEVERRY, H. A. FREEMAN, J. R. HEITZMAN, Mrs. J. R. HEITZMAN, W. H. HOWE, R. J. JAE, E. M. KINCH, N. MARSTON, J. K. NEWLIN, F. W. PRESTON, Mrs. F. W. PRESTON, P. S. REMINGTON, C. P. SLATER, D. B. STALLINGS, Mrs. D. B. STALLINGS, JACK STALLINGS, DEE STALLINGS, J. R. TURNER, K. H. WILSON, Mrs. K. H. WILSON.

Respectfully submitted,
PAUL R. EHRLICH
Secretary

REVIEWS

THE LEPIDOPTERA OF IRAQ, Revised Edition. By E. P. Wiltshire. 1957. 162 pp., 17 pls. (2 col.), 6 text-figs. Publisher: Nicholas Kaye, Ltd., London [available from E. W. Classey, 4 Church St., Isleworth, Mddx., England; price £2.5.0.].

For many years Mr. WILTSHIRE has collected and studied the Lepidoptera of Iraq intensively. In 1944 the Government of Iraq published his first edition of this work as an agricultural bulletin, and since that time the number of species definitely identified from Iraq doubled, more than 900 being known. A substantial number of these are species new to science, collected by Mr. WILTSHIRE and named primarily by H. G. AMSEL, C. BOURSIN, and WILTSHIRE himself. 136 species are butterflies, 302 Noctuidæ, 103 Geometridæ, 209 Pyralididæ, and the remaining 288 scattered among the smaller families. Obviously this is a disproportionate number of butterflies, as is usual for an area not yet thoroughly collected. No Micropterygidæ, Eriocraniidæ, or Hepialidæ have yet been found in IIraq, and WILTSHIRE relates this to the aridity of the Middle East. The number of Cossidæ is large (15), in comparison to such groups as Arctiidæ (16), Hesperiidæ (19), and Tortricidæ (19). Of course very many more of the last family doubtless will be found, but the Cossidæ will remain in larger proportion than in most other regious of comparable size.

In an interesting Introduction it is shown that about one-half of the species are found only in mountains, about one-quarter only in the plains (*i.e.,* below 1500′), and the remainder in both.

The text is principally a list of species, with brief comments on biotopes, phenology, foodplants where known, and the general distribution of each species. Ten new species and subspecies are described. The excellent plates include two in color and three in half-tone showing spread specimens of the ten new entities and a few other species. Finally there are twelv plates of line-drawings, mainly of genitalia, reproduced from AMSEL's plates which had been published in 1949 in the *Bulletin de la Société Fouad I d'Entomologie.*

C. L. REMINGTON, Hope Dept. of Entomology, Univ. Museum, Oxford, ENGLAND

THE BUTTERFLIES OF MISSISSIPPI. By Bryant Mather & Katharine Mather. *Tulane studies in Zoology,* vol. 6: pp. 63-109, 6 figures. [Price $1.00; available from: Meade Nat. History Library, Department of Zoology, Tulane University, New Orleans, 18, La., U.S.A.]

This paper is one of the finest annotated state lists of Lepidoptera that has ever been published and deserves to be used as a model for future lists for other state and provinces. The authors, scouring Mississippi for about ten seasons, produced a majority of the specimens themselves. They have gleaned additional records from every source they could discover. As a result, they present records of 122 species of butterflies from 189 localities in all of the 82 counties of the state. Only 13 of these species were not collected by the authors. The MATHERS have thus eliminated the largest void in the published knowledge of Nearctic butterfly geography, for the area between Georgia and Texas. Many new records for Alabama and Tennessee, mainly produced by CHERMOCK and ROEVER, are a valuable supplement to the Mississippi core. An appendix to the list of 122 verified species is an informative commentary on 41 additional species which can reasonably be expected in Mississippi. The total is therefore very large and reflects the wide faunal range, from the Upper Austral northeastern corner of the state (with such northern residents as *Melitæa gorgone, Incisalia augustinus, I. niphon, Colias philodice, Hesperia metea, Amblyscirtes vialis,* and *A. hegon*) to the semi-tropical Gulf Coast (with *Danaus gilippus, Heliconius charitonius, Pyrgus syrichtus, Hesperia attalus, Atrytone arpa,* and *Oligoria maculata,* etc.) and with special habitats such as the salt marshes (with *Panoquina panoquin* and probably *Brephidium pseudofea*).

In a future revision of this list it would be of great value to have two or three half-tone plates showing one or more crisp photographs of several species whose Mississippi form would be of unusual interest, such as *Strymon ontario, Mitoura gryneus, Incisalia henrici, Poanes yehl, Agraulis vanillæ, Melitæa gorgone, Limenitis archippus, Wallengrenia otho, Atrytonopsis* spp., and *Atrytone dion.*

Readers of the *Lepidopterists' News* will have seen the thorough population analyses by Mr. MATHER of some of the most interesting Mississippi species: *Papilio glaucus, Eurema daira,* and *Danaus plexippus.* Similar data on forewing length and seasonal variation are tabulated in the list for *Papilio cresphontes, Colias eurytheme, Phœbis sennæ, Eurema nicippe,* and *Poanes yehl;* it would have been most interesting if the authors had been able to provide such details for some other species such as *Anthocaris genutia,* and on the seasonal frequency of forms of *Polygonia interrogationis* and *Phyciodes tharos.*

The treatment of migrants has been carefully documented, particularly with *Vanessa cardui.* As is essential for this irregular species, the precise year of each record is given. When this is done in several other regional lists, a picture can be developed of the periodicity and extent of the migrations. For *Danaus plexippus* I fee lthere is still a large uncertainty about its summer residency: the discovery of larvæ in April, May, and even June does not prove that it is a permanent summer resident. Observations for July and early August will be necessary, and the precise locality is required for each date cited, especially for larvæ.

Foodplant records and life historynotes are almost entirely lacking.

One reason the MATHER paper is so significant is that numerous active specialists were freely consulted for the most difficult questions. The MATHERS have usually given the view of each authority, and in several instances a fascinating symposium of divergent views emerges, as for *Incisalia henrici, Colias eurytheme,* and *Limenitis archippus*. However, in a few other instances one wishes that equally full investigations had been made. Surely any grounds for retaining *Limenitis astyanax* as a race of *arthemis* are extremely weak, and ignore the biological evidence. The nomenclature is as current as possible. Fortunately, the confusions of the EVANS *Catalogue* did not get into the MATHER list.

The format is attractive and the paper carefully edited. The use of quotation marks rather than italics, to distinguish forms from subspecies is most welcome. This device, long followed in the *News*, reminds the reader of the fundamental difference in kind between forms and aberrations on one hand and subspecies and species on the other.

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A CENTURY OF PROGRESS IN THE NATURAL SCIENCES. California Academy of Sciences. x + 807 pp., illus. San Francisco, 1955. [Available from the Academy, Golden Gate Park, San Francisco 18, Calif., U. S. A.]

This volume, published in celebration of the centennial of the California Academy of Sciences, contains a series of essays on developments of the past century in various branches of science. Not all fields are covered, but most groups of insects are treated in individual essays by specialists; here the emphasis is on the development of modern classification. The excellent brief review on "Lepidoptera" by WM. T. M. FORBES is of course of particular interest; but to the lepidopterist the volume may be even more valuable for its summaries of groups with which he is less familiar. The essays on other groups of insects and on the classification of all groups of plants provide information which can hardly be found elsewhere in such convenient form. Reviews of progress in biography, paleontology, and conservation are also valuable, though these subjects have been treated more fully in other books. The scope of the essays is worldwide, but the book should be particularly interesting to Californians because of EWAN's introductory chapter on early naturalists in the state.

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RECENT LITERATURE ON LEPIDOPTERA

(Under the supervision of PETER F. BELLINGER)

Under this heading are included abstracts of papers and books of interest to lepidopterists. The world's literature is searched systematically, and it is intended that every work on Lepidoptera published after 1946 will be noticed here; omissions of papers more than 3 or 4 years old should be called to Dr. BELLINGER's attention. New genera and higher categories are shown in CAPITALS, with types in parentheses; new species and subspecies are noted, with type localities if given in print. Larval foodplants are usually listed. Critical comments by abstractors may be made. Papers of only local interest and papers from *The Lepidopterists' News* are listed without abstract. Readers, particularly outside of North America, interested in assisting with this very large task, are invited to write Dr. BELLINGER (San Fernando Valley State College, Northridge, Calif., U.S.A.). Abstractor's initials are as follows: [P.B.] — P. F. BELLINGER; [I.C.] — I. F. B. COMMON; [W.C.] — W. C. COOK; [A.D.] — A. DIAKONOFF; [W.H.] — W. HACKMAN; [T.I.] — TARO IWASE; [J.M.] — J. MOUCHA; [E.M.] — E. G. MUNROE; [N.O.] — N. S. OBRAZTSOV; [C.R.] — C. L. REMINGTON; [J.T.] — J. W. TILDEN; [P.V.] — P. E. L. VIETTE.

B. SYSTEMATICS AND NOMENCLATURE

Roepke, W., "*Attacus dohertyi dammermani* nov. subspec., and some notes concerning the genus *Attacus L.* (Lepidoptera Heterocera, Family Saturniidæ)." *Zool. Meded.*, Leiden, vol. 22: pp. 49-56, 2 pls. 1953. New ssp. from W. Sumba. Records names so far applied to populations of *A. atlas,* by localities, & suggests that most are individual variations; notes on a specimen of *A. crameri* from Flores. [P. B.]

Roepke, W., "Four lasiocampids from Java (Lepidoptera Heterocera)." *Tijdschr. Ent.* vol. 96: pp. 95-97, 1 pl. 1953. Describes as new *Gastropacha acutifolia* (Perbawattee); *MICROPACHA* (monobasic), *M. kalisi* (Mt. Ardjuno, Djunggo, 1500 m., E. Java). Redescribes *Taragama proserpina* (n. spp?), previously known only from New Guinea. [P. B.]

Roepke, W., "Some new or little known Lepidoptera from Indonesia and New Guinea. I." *Tijdschr. Ent.,* vol. 97: pp. 257-262, 1 pl., 4 figs. 1954. Describes as new: (Saturniidæ) *Actias mænas groenendaeli* (Mataloko, 1000 m., central Flores); (Nyctemeridæ) *Nyctemera regalis* (1200 m., central Flores), *N. floresicola* (Hua Besi, 700 m., central Flores), *N. timorensis* (Soë Timor); (Noctuidæ) *Taviodes javanica* (W. Java). Notes on *Nyctemera* spp., *Paranagia rufostrigata, Melipotis kebea borneensis,* & *Sarbanissa albifascia.* [P. B.]

Roepke, W., "The species of the genus *Spilosoma* Steph. in Java (Lep. Arctiidæ)." *O. S. R. -Publ.* no. 41: 7 pp., 1 pl. 1954. Describes as new *S. toxopei* (Wanasari, near Bandung, W. Java), *S. holophæum* (Tjibodas, 1400 m., Gedeh, W. Java), *S. xanthosoma* (Patuhawattie, 1750 m., W. Java). Annotated list of 12 other spp., with systematic notes. [P. B.]

Roepke, W., "The butterflies of the genus *Delias* Hübner (Lepidoptera) in Netherlands New Guinea." *Nova Guinea,* n. s., vol. 6: pp. 185-260, 4 pls. 1955. Describes as new *D. lecerfi cyclosticha* (Rattan Camp), *D. abrophora* (L. Paniai, 1750 m.), *D. geraldina siderea* (Araucaria Camp), *D. g. vaneechoudi* (Wissel Lakes, 1750 m.), **D. hypomelas fulgida* (Sigi Camp, 1500 m.), *D. h. lieftincki* (Ibele Camp, 2250 m.), *D. argentata* (Ibele Camp), *D. sphenodiscus* (Araucaria Camp, 800 m.), *D. cuningputi ibelana* (Moss Forest Camp, 2600-2700 m.; Ibele Valley, 2220-2300 m.), *D. aroa balimensis* (Balim Valley, 1650-1700 m.), *D. eichhorni antara* (Moss Forest Camp, 2700 m.), *D. e. germana* (Moss Forest Camp & Ibele Camp, 2250-2850 m.), *D. e. heliophora* (Arabu R.), *D. carstensziana alcicornis* (L. Habbema, 3300 m.), *D. leucobalia ericetorum* (L. Habbema, 3000-3250 m.), *D. catisa aurostriga* (Ibele Camp, 2250m.), **D. c. wisseliana* (L. Paniai, 1700 m.), **D. toxopei* (Ibele Camp, 2250 m.), *D. t. morosa* (Arabu R. Valley, 1800 m.), *D. nais holophæa* (Rattan Camp, 1200 m.), **D, zebra* (Ibele Valley, 2200-2300 m.), **D. mesoblema flavistriga* (Moss Forest Camp), *D. m. arabuana* (Arabu R., 1800 m.), *D. luctuosa archboldi* (Moss Forest Camp, 2700-2800 m.), *D. callista callipareia* (Ibele Valley, 2200-2300 m.), *D. hapalina amœna* (Ibele Valley, 2250 m.), *D. h. adnexa* (Arabu R., 1800 m.), *D. campbelli microleuca* (Lower Mist Camp, 1450-1600 m.), **D. phippsi* *wisseli* (Arabu R., 1800 m.), *D. rosamontana* (Ibele Valley, 2200-2300 m.), *D. kummeri fumosa* (Araucaria R. Camp, 800 m.), *D. ligata interpolata* (Sigi Camp, 1450-1500 m.), *D. alepa orthobasis* (Mist Camp, 1800 m.), *D. wollastoni bryophila* (Moss Forest Camp, 2700-2800 m.), *D. discus apodiscus* (Araucaria R., 700-800 m.), *D. catocausta nigerrima* (probably "headwaters of Andreae R."), *D. mariæ walshæ* (Ibele Valley, 2250 m.), **D. m. boschmai* (Arabu R., 1800 m.), *D. mira autumnalis* (Moss Forest & Ibelle Valley, 2200-2700 m.), *D. m. hiemalis* (above Arabu R. Camp, 2200 m.), *D. klossi chrysanthemum* (Moss Forest, 2600-3000 m.), **D. meeki hypochrysis* (several localities), **D. m. hypozantha* (Balim Valley, 1700-2000 m.), *D. parennia* (Araucaria Camp, 800 m.). Also names some "forms." The paper is based on an unfinished manuscript by Toxopeus, and the new names (except those marked with an asterisk) should apparently be credited to him. 53 spp. and numerous sspp. are recorded, with descriptive notes on those already known; distribution is discussed at length, and biology & flight habits are described when known. The extraordinary development of the genus in New Guinea is revealed by the fact that the collections on which this paper is based were made in only 2 rather small areas; the present total of 72 *species* in the island will very likely increase still further. [P. B.]

Roepke, Walter, "Weitere Untersuchungen über die südostasiatische Gattung *Trabala* Walk. (Lasiocampidæ)" [in German]. *Zeitschr. Lepid.,* vol. 3: pp. 143-150, 1 pl., 4 figs. 1955. Desribes as new *T. bhatara* (NE Sumatra, "Battakberge südl. Deli"), *T. sugata* (Mt. Maquiling, 50 m., Philippines). Briefly describes additional material of known spp. from China (especially *T. vishnou*) & Sumatra. [P. B.]

Roepke, W., "Some new or little known Lepidoptera from Indonesia and New Guinea, II." *Tijdschr. Ent.,* vol. 99: pp. 23-30, 2 pls. 1956. Describes as new: (Saturniidæ) *Actias selene vandenberghi* (Pangkalan Brandan, Sumatra); (Noctuidæ) *Apatele javanica* (Tjibodas, 1400 m., W. Java); *Elusa orion* (MacCluer Gulf, Bintuni Bay, R. Tisa, New Guinea); *PSEUDOSICCIA* (monobasic, Erastriinæ), *P. lichenaria* (Tjibodas, 1400 m., W. Java); *Sarrothripus javanus* (Mt. Lawu, central Java); *Hypætra modista* (Samarinda, SE Borneo). Notes on *Gadirtha cuprescens fakfakensis, Carea pryeri, Savara longipectinata, Anomis dealbata,* & *Hyblæa joiceyi.* [P. B.]

Ronninger, H., "Ein bisher unbekanntes Cecidium in Niederösterreich. Biologie und systematische Stellung des Erzeugers dieser Galle, der Gelechiide *furfurella* Stgr." [in German]. *Zeitschr. wiener ent. Ges.,* vol. 40: pp. 177-183, 4 figs. 1955. Transfers *furfurella* from *Gelechia* to *Caulastrocecis.* Redescribes adult & describes gall, on *Aster linosyris.* [P. B.]

Rosier, J. P., "Notes on Lepidoptera. 1. A new *Charaxes* from Java. II. Metamorphosis of some Javanese butterflies." *O. S. R.-Publ.,* no. 35: pp. 1-4, 4 figs. ?1953. Description of *C. scylax,* thought at the time to be unnamed. Describes early stages of *Poritia erycinoides,* on *Castanea argentea.* [P. B.]

Ross, Edward S., "Proposed use of the Plenary Powers to validate the generic name *Dictyoploca* Jordan, 1911 (Class Insecta, Order Lepidoptera) by suppressing the name *Dictyoploca* Krauss, 1911 (Class Insecta, Order Embioptera)." *Bull. zool. Nomencl.,* vol. 15: pp. 80-83. 1957. Requests conservation of former name & its type, *simla.* [P. B.]

Rougeot, P. C., "Description d'une nouvelle espèce de saturniide du Gabon et de ses premiers états" [in French]. *Bull. mens. Soc. linn. Lyon,* vol. 19: pp. 224-227, 3 figs. 1950. Describes as new *Tagoropsis genoviefæ* (Oyem, Gabon); describes larva & pupa. Distinguishes *Tagoropsis* & *Pseudantheræa* in early stages. [P. B.]

Rougeot, P.-C., "Description d'une nouvelle espèce de saturniide du Gabon" [in French]. *Bull. mens. Soc. linn. Lyon,* vol. 21: pp. 112-114, 3 figs. 1952. Describes as new *Micragone martinæ* (Oyem, Gabon). [P. B.]

Rougeot, P. C., "Sur les attacides éthiopiens décrits par Joh.-Christ. Fabricius" [in French. *Bull. mens. Soc. linn. Lyon,* vol. 26: pp. 187-188. 1957. Note on some species of Ethiopian saturniids described by Fabricius, chiefly *Bombyx irius.* [P. V.]

Rousseau-Decelle, G., "Contribution à l'étude des *Papilio* de la faune Indo-Océanienne" [in French]. *Bull. Soc. ent. France,* vol. 51: pp. 128-133. "1946" [1947]. Describes as new P. *epyades camilla* (Hoa Bihn, Tonkin), *P. ascalaphus haliaetus* (locality unknown). Names 17 "forms". [P. B.]

Rousseau-Decelle, G., & F. L. Johnson, "Note sur une sous-espèce nouvelle de *Charaxes* africain (Lep. Nymphalidæ)" [in French]. *Bull. Soc. ent. France,* vol. 62: pp. 151-153, 1 pl. 1957. Description of the ssp. *C. boueti ghanaensis,* a new ssp. from Vane, South British Togoland. [P. V.]

Rozhkov, A. S., "Larch and cedar races of *Dendrolimus sibiricus* Tshetw." [in Russian]. *Rev. Ent. URSS,* vol. 36: pp. 72-74, 1 fig. 1957. Genitalia characters. [N. O.]

Rungs, Ch., "Notes de lépidoptérologie maracaine (xv): Noctuidæ nouvelles" [in French]. *Bull. Soc. Sci. nat. Maroc,* vol. 25/27: pp. 328-332, 1 pl. 1949. Describes as new *Antitype boursini* (Bou Ouchane, 20 km. SW of Mogador, Morocco); *Cleophana chabordis mogadorensis* (near Mogador); *Amphipyra pyramidea berbera* (Ifrane, Middle Atlas, Morocco); also a new "form" of *Sesamia vuteria.* [P. B.]

Rungs, Ch., "Notes de lépidoptérologie marocaine (xvi): descriptions et notes critiques" [in French]. *Bull. Soc. Sci. nat. Maroc,* vol. 28: pp. 142-166, 2 pls. 1950. Describes as new *Euchloe tagis atlasica* (N. Middle Atlas, 1900 m.); *Melitæa aurinia ellisoni* (Ifrane, Middle Atlas, 1650 m.); *Euxoa hastifera marocana* "Boursin & Rungs" (Ifrane); *Dasypolia templi powelli* (Ifrane), *D. ferdinandi haroldi* (Ifrane); *Eumichtis susica* (Aïn Chaïb); *Sidemia dimorpha* (Aïl Melloul, S. of Agadir); *Caradrina (Paradrina) danieli* (Mogador-Safi Rd.); *Axia vaulogeri iblis* (Sidi Oueddar); *Ortholitha feliciaria hebes* (Ifrane); *Boarmia umbraria mimeuri* (Ifrane); *Selenia lunaria gamra* (Ifrane valley, 1550 m.), *Taragama regraguei* (Aïn Chaïb); also several "forms". Notes on variation, distribution, etc. of other spp. (Papilionidæ, Danaidæ, Noctuidæ, Geometridæ, Zygaenidæ, Cossidæ). [P. B.]

Rungs, Ch., "Un nouvel arctiide tunisien (Lep.)" [in French]. *Bull. Soc. ent. France,* vol. 56: pp. 99-101, 1 fig. 1951. Describes as new *Mœnas chneouri* (Sbeitla, central Tunisia); keys to separate sp. from *M. breveti* & *M. joycei.* [P. B.]

Rungs, Ch., "Deux nouvelles Cuculllianæ marocaines (Lep. Phalænidæ)" [in French]. *C. R. Soc. Sci. nat. Maroc,* vol. 18: pp. 137-139, 2 figs. 1952. Describes as new *Metopoceras driss* (Mestigmeur, NE Morocco); *Allophyes powelli* (Ifrane; larva on *Cratægus*). [P. B.]

Rungs, Ch., "Notes de lépidoptérologie marocaine (XVIII). Nouvelles formes et espèces rares du Maroc" [in French]. *Bull. Soc. Sci. nat. Maroc.,* vol. 31: pp. 75-92, 7 figs. 1952. Describes as new *Agrotis (Powellinia) baetica* "race" *variata* (Aït Melloul), *A. b.* "race" *mateui* (Rio de Oro, Poso Yerifia); *Ochropleura candelisequa zernyi* (Taanezoult); *Saragossa seeboldi maroccana* (Sangal); *Cucullia bubačeki nokra* (Mestigmeur); *Xylena lunifera buckwelli* (Ifrane, 1650 m.); *Apamea arabs boursini* "Powell & Rungs" (Oued Djdida); *Heterographa püngeleri occidentalis* (Maajez); *Toxocampa craccæ riata* (Bab Taka Pass, S. of Taza); *Phigalia buckwelli* (Ifrane, 1650 m.); *Parasa thamia* ("Vallée de l'oued Cherrat"); *Hypopta vaulogeri meirleirei* (N. of Sidi Srhir). Notes on identity & distribution of other Moroccan spp. (Pieridæ, Noctuidæ, Geometridæ, Cossidæ, Pyralidæ, Blastobasidæ, Gelechiidæ, Micropterygidæ). [P. B.]

Rungs, Ch., "Notes de lépidoptérologie marocaine (XXII). Nouvelles additions à la faune marocaine; descriptions; observations sur la répartition ou l'écologie de certaines espèces" [in French]. *Bull. Soc. Sci. nat. phys. Maroc,* vol. 36: pp. 277-298, 6 figs. "1956" [1957]. New additions to the lepidopterological fauna of Morocco, notes on the distribution or the ecology of some spp. with descriptions of new spp. & sspp.: *Ochropleura atlas* (Middle Atlas); *Xylocampa areola srira* (Aït Melloul); *Simyra albovenosa africana* (NW Morocco); *Cerura bifida beida* (near Agadir); *Notodonta ziczac reisseri* (Rif). [P. V.]

Sailer, Reece I., "Common names of insects approved by the Entomological Society of America." *Bull. ent. Eoc. Amer.,* vol. 1, no. 4: pp. 1-34. 1955. Lists economically important insects by common & scientific names; also gives approved common names for higher groups. Inadvertently validates the generic name *ANAGASTA* (for *Ephestia kühniella)* & possibly other new names as well. List of proposed additions. [P. B.]

Salmon, J. T., "New species of New Zealand Lepidoptera." *Trans. Roy. Soc. New Zealand,* vol. 83: pp. 573-576, 2 pls. 1956. Describes as new *Melanchra meridiana* (Portobello & Dunedin), *M. boldensis* (Bold Peak, Lake Wakatipu) (Noctuidæ); *Azelina gallaria venustula* (Little Barrier Island) (Geometridæ); *Bactra flammea* (Upper Hollyford Valley, 3,000 ft.) (Tortricidæ); & *Archyala homerica* (Homer Cirque) (Tineidæ). Photographs of types; genitalia not described or figured. [I. C.]

Sanford, Leonard J., & Neville H. Bennet, "New *Delias* from the central highlands of New Guinea (Lepidoptera, Pieridæ)." *Entomologist,* vol. 88: pp. 1-4, 1 pl. 1955. Describes as new *D. gilliardi* (Mt. Wilhelm, Bismarck Mts., 9500 ft.), *D. hallstromi* (Mt. Hagen, 7500-12,000 ft.); *D. mira roepkei* (Mt. Hagen), *D. doylei* (Kup, 5000-7000 ft.); all figured in color. [P. B.]

Schütze, Eduard, "Eupithecien-Studien I. (Lep. Geom.). Vier deutsche *impurata*-Rassen" [in German]. *Zeitschr. wiener ent. Ges.*, vol. 36: pp. 164-170, 1 pl. 1952. Describes as new *E. i. gremmingerata* (Wutach region, Black Forest), *E. i. badiniata* (Kaiserstuhl, Baden), *E. i. langeata* (Zschopautal, Saxony), *E. i. germanicata* (Edersee/Waldeck). Populations of this sp. are isolated; 3 of above races are said to breed true when reared under varying conditions (on *Campanula* spp.). [P. B.]

Schütze, Eduard, "Eupithecien-Studien II (Geometridæ). Zur Frage der Artberechtigung von *Eupithecia pyreneata Mab.*" [in German]. *Zeitschr. Lepid.*, vol. 2; pp. 177-187, 1 map. 1952. Distinguishes between this sp. & *E. pulchellata.* ♂ genitalia are indistinguishable, but there are differences in egg, larva, & adult; former sp. is confined to *Digitalis ambigua* & latter to *D. purpurea.* [P. B.]

Schütze, Eduard, "Eupithecien-Studien VII und VIII" [in German]. *Zeitschr. wiener ent. Ges.*, vol. 41: pp. 306-320, 328-339, 3 pls., 13 figs. 1956. Describes as new subgenus *DIETZEA* (type *E. semigraphata), E. (D.) semigraphata gravosata* (Gravosa, Dalmatia), *E.* (*D.*) *impurata thüringiata* (Blankenstein, Thüringen), *E.* (*D.*) *i. franconiata* (Pottenstein, Fränkischer Jura), *E.* (*D.*) *subumbrata iliata* (Gouldscha, Fergana), *E. (D.) limbofasciata* "Dietze spec. nov." (no evidence that sp. was described by Dietze) (Alexander Mts., N. Tibet), *E. (D.) orphnata ferghanata* (Gouldscha, Ferghana). Revises *semigraphata* group (*Dietzea*) wiith descriptive notes, especially on *E. pœcilata* & *E. exactata.* Notes on biology of spp. of this subgenus (larvæ on *Campanula,* or polyphagous). Descriptive notes also on *E. mesogrammata, E. lithogrammata, E. undulifera,* & *E. harenosa.* [P. B.]

Schulte, Adolf, "*Chiasma clathrata hönei* ssp. nov. (Lep., Geom.)" [in German]. *Bonner zool. Beitr.*, vol. 5: p. 156, 3 figs. 1954. Type locality Tapaishan in Tsinling, S. Shensi, 1700 m., China. [P. B.]

Schwingenschuss, Leo, "Eine für Osterreich neue *Zygæna* in Niederösterreich. *Peucedanophila (Zygæna)* [sic!] *cynaræ* Esp. und ihre Formen" [in German]. *Zeitschr. wiener ent. Ges.*, vol. 36: pp. 135-137. 1952. Describes as new *P. c. austriaca* (Theyernerhöhe, near Herzogenburg); notes on variation in sp. [P. B.]

Schwingenschuss, Leo, "Interessante Heterocerenformen aus meiner Sammlung" [in German]. *Zeitschr. wiener ent. Ges.*, vol. 39: pp. 218-219. 1954. Describes as new (very briefly) *Rhyacia candelisequa piemonticola* (Col di Sestriere, Piedmont); *Eupithecia egenaria amurensis* ("Radde am Amur"), *E. distinctaria piemonticola* (Col di Sestriere); *Minoa murinata lutea* (Tuapse, Caucasus, & Crimea; "Form (oder spp.?)"). Also names several "forms" (Notodontidæ, Geometridæ). [P. B.]

Schwingenschuss, Leo, "Nachträge und Berichtingungen zu den Lepidopterenfaunen des Libanon, Grossen Atlas, Irans und Neubeschreibungen" [in German]. *Zeitschr. wiener ent. Ges.*, vol. 40: pp. 225-231. 1955. Describes as new *Eupithecia spissilineata libanotica* (Lebanon); *Rhyacia candelisequa atlantivolans* (High Atlas); *Scotogramma pugnax atlantis* (High Atlas); *Eupithecia santolinata barbaria* (no locality); *Rhyacia elegans iranica* (Iran); *Auchmis comma demavendi* (Demavend, Iran); *Anaitis annexata iranica* (Iran). Some other new names may be valid (e.g., after brief description of Middle Atlas race of *Bryophila pyrenæa,* "Boursin wird diese spp. *tachdirta* benennen"). Also names several "forms". Systematic notes on papers by Zerny on Lepidoptera from Lebanon & from Atlas Mts., & by Schwingenschuss on Lepidoptera from Iran (citations incomplete). New entities very briefly described, without figures or mention of type specimens or type localities. One may pardon the author of this most unsatisfactory paper, since it was published after his death; it is hard to forgive the editor for permitting it to appear in this form. [P. B.]

Sevastopulo, D. G., "The genetics of East African Lepidoptera—VII." *Entomologist,* vol. 90: pp. 255-257. 1957. *Dasychira aprepes* reduced to "form" of *D. daphne* as a result of breeding experiments; 2 other "forms" named. [P. B.]

Sheljuzhko, Leo, "Über die Übertragung von Aberrationsnamen auf Subspezies" [in German]. *Mitt. münchner ent. Ges.,* vol. 46: pp. 291-303. 1956. Disapproves of elevation of names given to aberrations to subspecific rank, at least in cases where name was originally given to a form which is aberrant in the subspecies; thinks latter should receive new name. Discusses 4 cases in which aberrational name was elevated, thereby changing its meaning, & proposes new names for 2 sspp.: *Hypermnestra helios hyrcana,* & *Parnassius nomion irkutskensis.* The cases discussed are unfortunate, but by the present rules the new names are junior synonyms, respectively, of *persica* Rothschild & *dis* Bryk & Eisner (authorities for these names are the authors who first treated them as being of subspecific rank). [P. B.]

Shirôzu, Takashi, "Butterflies." *In* Kihara, H., ed., *Fauna and flora of Nepal Himalaya,* vol. 1: pp. 317-381, 4 pls., 77 figs. Kyoto: Fauna and flora research society. 1955. List of 16 Papilionidæ, 15 Pieridæ, 6 Danaidæ, 1 amathusiid, 21 Satyridæ, 39 Nymphalidæ, 5 Riodinidæ, 33 Lycænidæ, & 7 Hesperiidæ; with references, notes on distribution & habitat, & some systematic notes. Figures many adults & some ♂ genitalia (especially of Satyridæ & Lycænidæ). Names an aberration of *Byasa polyeuctes letincius.* [P. B.]

Shirozu, Takashi, "New or little known butterflies from the north-eastern Asia, with some synonymic notes. III." *Sieboldia,* vol. 1: pp. 229-236, 5 pls. 1955. Describes as new *Colias erate formosana* (Pianan-anbu, 1810 m., Taihoku Pref., N. Formosa); *Hestina assimilis shirakii* (Yuwan, Amami-Oshima), *H. japonica seoki* (Kyosho, Kiesho-nondo, S. Korea); *Bremeria nycteis pallescens* (Chung Chan, Manchuria). Places *Pantoporia hirayamai* as ssp. of *Tacoræa opalina.* [P. B.]

Shirozu, Takashi, "A new *Pithecops* from the Tsushima Islands, Japan (Lepidoptera, Lycænidæ)." *Sieboldia,* vol. 2: pp. 35-37, 1 pl., 5 figs. 1957. Describes as new *P. fulgens tsushimana* (Susuna-mura, Tsushima Islands; larvæ on flowers of *Desmodium racemosum).* Figures series of new & typical races. [P. B.]

Shirozu, Takashi, "An unrecorded thecline butterfly from Formosa (Lepidoptera, Lycænidæ)." *Sieboldia,* vol. 2: pp. 41-42, 1 pl. 1957. Describes as new *Wagimo slugeri insularis* (vicinity of Musha, central Formosa): [P. B.]

Shirozu, Takashi, "Two new subspecies of *Erebia niphonica* Janson from Honshu, Japan (Lepidoptera; Satyridæ)." *Sieboldia,* vol. 2: pp. 39-40, 1 pl. 1957. Describes as new *E. n. shibutsuana* (Mt. Shibutsu, Gumma Pref.), *E. n. sugitanii* (Kiso-Komagadake, 2950 m., Kisu Mts., Nagano Pref.). [P. B.]

Shirozu, Takashi, & Hideho Yamamoto, "Systematic position of the genus *Curetis* (Lepidoptera, Rhopalocera)." Sieboldia, vol. 2: pp. 43-51, 15 figs. 1957. Proposes new family CURETIDÆ for this genus; describes pupa & ♂ genitalia, & points out differences from Lycænidæ in all stages. Genus shows some riodinid characters & is regarded as transitional to "Nymphalides".. [P. B.]

Sieder, Leo. "Zweite Vorarbeit über die Gattung *Solenobia* (Lepidopt., Psychidæ-Talæporinæ). Gen. nov. *PRÆSOLENOBIA*. Subgen, nov. *Solenobia SOLENOBIA* Zeller. Spec. nov. *Sol. Brevantennia saxatilis*" [in German]. *Zeitschr. wiener ent. Ges.,* vol. 39: pp. 241-254. 1954. Describes as new *PRAESOLENOBIA* (type *Psyche clathrella); S. (B.) saxatilis* (Rattendorfer Alm, Karnisch Alps, 1100-1400 m.). Formally erects "typical" subgenus *SOLENOBIA,* selecting *S. manni* as subgenerotype; this is unfortunately impossible, since *manni* was not included in *Solenobia* when genus was erected (by Duponchel, not Zeller). Lists spp., with their distribution; describes ♀ of *S. manni;* repeats original descriptions of *S. clathrella* & *S. manni,* & Zeller's description of *Solenobia.* Notes on identity of some other spp. [P. B.]

Sieder, Leo, "Dritte Vorarbeit über die Gattung *Solenobia* (Lepidopt., Psychidæ-Talæporiinæ). Spec. nov. *Sol. Solenobia meieri.* Bericht 1954 über Solenobien" [in German]. *Zeitschr. wiener ent. Ges.,* vol. 40: pp. 4-9. 1955. Describes as new *S. (S.) meieri* (Gaberl, Styria, 1300 m.); larval cases mostly found on larch trunks. Records spp. collected in 1954. [P. B.]

Sieder, Leo, & Friedr. Loebel, "Wissenwertes über die Gattung *Epichnopterix* Hb. (Lep. Psychidæ)" [in German]. *Zeitschr. wiener ent. Ges.,* vol. 39: pp. 310-327, 1 pl. 1954. Repeats original descriptions of genus & some spp.; redescribes & figures central European spp. known to authors. *E. pulla* is stated to be the generotype, although *pulla* was not originally included in the genus and the name was not originally applied to the species for which it is used here; this action avoids drastic name changes, but is unfortunately illegal. [P. B.]

Sieder, Leo, "Erster Beitrag zu: 'Wissenwertes über die Gattung *Epichnopterix* Hb. (Lep. Psychidæ)'. *Epichnop. kovácsi* spec. nov." [in German]. *Zeitschr. wiener ent. Ges.,* vol. 40: pp. 157-164. 1955. New sp. described from "Budaörs Csiki-hegyek" (Hungary). Discusses distribution & phylogeny in genus. Gives list of European spp., with distribution & notes on larval cases. [P. B.]

Sieder, Leo, "Zwei neue *Talæporia*-Subspecies aus dem Pannonicum. *Talæp. tubulosa gozmányi* ssp. nov. *Talæp. politella szöczi* ssp. nov." [in German]. *Zeitschr. wiener ent. Ges.,* vol. 40: pp. 204-206. 1955. New sspp. described from "Bulgaria C. Stanimaka", & "Budaörs Csiki-hegyek" (Hungary), respectively. [P. B.]

Sieder, Leo, "*REISSERONIA* gen nov. (Lepidoptera, Psychidæ)" [in German]. *Zeitschr. wiener ent. Ges.,* vol. 41: pp. 162-170. 1956. Type of new genus is *Epic-*

nopterix tarneriella; genus also includes *E. hoffmanni* & *Rebelia nigrociliella.* Redescribes these spp. [P. B.]

Sieder, Leo, "Vierte Vorarbeit über die Gattung *Solenobia Z.* (Lepidopt., Psychidæ-Talæporiinæ). Die Nachuntersuchungsergebnisse der acht Typen van *Solenobia Sol. alpicolella* Rebel. *Solenobia Sol. meierella* spec. nov. Neue Solenobienarten aus der Schweiz (Dr. W. Sauter, Zürich)" [in German]. *Zeitschr. wiener ent. Ges.,* vol. 41: pp. 192-204, 218-225. 1956. Describes as new *S. meierella* (Kosmatica, 1500 m., Karawanken, Carinthia, Austria). Redescribes *S. alpicolella (=meieri* Sieder, *new synonym);* describes biology. Reproduces paper by Sauter (1954) describing Swiss *Solenobia* spp. Lists spp. of *Solenobia.* [P. B.]

Silver, G. T., "Separation of the species of arborvitæ leaf miners in New Brunswick (Lepidoptera: Yponomeutidæ and Gelechiidæ)." *Canad. Ent.,* vol. 89: pp. 97-107, 26 figs. 1957. Distinguishes *Argyresthia thuiella, A. aureoargentella, A. freyella,* & *Recurvaria thujaella,* in larval, pupal, & adult stages; points out differences in mining patterns. [P. B.]

Soffner, J., "Die mitteleuropäischen Phycitinæ (Mikrolepidoptera)" [in German]. *Mitt münchner ent. Ges.,* vol. 46: pp. 61-81, 42 figs. 1956. Key to 36 genera, based mainly on wing venation (figured). Describes characters of subfamily, & technique for examining venation.[P. B.]

Soffner, Joseph, "A new tortricid from Morocco: *Semasia lucasiana* sp. nov." [in German & English]. *Ent. Rec. & Journ. Var.,* vol. 69: pp. 192-193, 1 pl. 1957. Taken near Ifrane. [P. B.]

van Someren, V. G. L., "Revisional notes on *Lepidochrysops* (Lycænidæ: Lampidinæ) of Kenya and Uganda, with descriptions of new species and subspecies" *Journ. ent. Soc. southern Afr.,* vol. 20: pp. 58-78, 2 pls. 1957. Describes as new *L. pterou suk* (Lacheliba Suk, Kenya), *L. neonegus borealis* (N. Acholi, Madi Opei, Uganda), *L. budama* (Tororo Hills, Uganda), *L. jacksoni* (Tororo Hills), *L. labwor* (Karamoja, Aremo, Uganda), *L. lukenia* (Athi River Ridge (Kathini Ridge), Kenya), *L. elgonæ moyo* (NE Aberdares, Moyo Ridge, Kenya), *L. jansei* (Mbagathi Ridge, E. Ngong Hills, Kenya). Figures new entities, & nominotypical races of new sspp., in color (both sexes & both surfaces). List of 9 other spp. known from this area, with notes on distribution. [P. B.]

Sourès, B., "Contribution à l'étude des lépidoptères de la Tunisie. Famille Axiidæ (Cimeliidæ)" [in French]. *Bull. Soc. Sci. nat. Tunisie,* vol. 4: pp: 30-41, 4 pls. 1951. Describes & figures all stages of *Axia vaulogeri.* Notes on the other 5 spp. of this Mediterranean genus & family. Foodplants *Euphorbia* spp. [P. B.]

Sperry, John L., "Two apparently new geometrid species from the Southwest." *Bull. southern Calif. Acad. Sci.,* vol. 48: pp. 41-45. 1949. Describes as new *Racheospila noël* (Borrego, Calif.); *Chlorochlamys fletcheraria* (Organ Pipe Cactus National Monument, Arizona). [P. B.]

Sperry, John L., "Four South American geometrid moths apparently undescribed." *Bull. southern Calif. Acad. Sci.,* vol. 50: pp. 159-163. 1951. Describes as new *Callipia brenemanæ* (Yungas del Palmar, 2000 m., Bolivia); *Spargania randallæ* (Pudahuel, Chile); *Salpis clarkei* (Cajon del Maypo, Santiago Prov., Chile Cordillera, El Canelo); & a "form" of *Callipia constantinaria.* [P. B.]

Sperry, John L., "Notes on the genus *Glena* Hulst and description of new species. Lepidoptera, Geometridæ." *Bull. southern Calif. Acad. Sci.,* vol. 51: pp. 71-78, 13 figs. 1952. Describes as new *G. mcdunnougharia* (Granite Wells, San Bernardino Co., Calif.), *G. thomasaria* (S. Fork of Little Colorado R., White Mts., Arizona), *G. minor* (Montague Co., Texas); *"G. kirkwoodaria,* var.n." (var. of *G. interpunctata).* Notes on *interpunctata, quinquelinearia,* & *pexata.* [P. B.]

Stallings, Don B., & J. R. Turner, "Four new species of *Megathymus* (Lepidoptera, Rhopalocera, Megathymidæ)." *Ent. News,* vol. 68: pp. 1-17, 4 pls. 1957. Describes as new *M. alliæ* (15 miles W. of Cameron, Arizona; foodplant *Agave utahensis), M. judithæ* (Hueco Mts., Hueco, Texas, 5300 ft.; foodplant *Agave parryi*), *M. carlsbadensis* (head of Yucca Canyon, Guadeloupe Mts., Carlsbad Cavern National Park, New Mexico, 5470 ft.; foodplant *Agave parryi* & perhaps *A. chisosensis), M. florenceæ* (Davis Mts., Ft. Davis, Texas, 6200 ft.; foodplant *Agave* sp., young specimens). Notes on spp. of *neumœgeni* group. [P. B.]

Stempffer, H., "Note sur *Lysandra thersites* (Cantener) et *Polyommatus icarus* ab. *icarinus* (Scriba)" [in French]. *Bull. Soc. ent. Mulhouse,* 1947: pp. 41-44, 4 figs. Compares these very similar forms; gives localities for former [P. B.]

Stempffer, H., "Contribution à l'étude des Lycænidæ de la faune éthiopienne" [in French]. *Bull. Soc. ent. France,* vol. 56: pp. 119-128, 5 figs. 1951. Describes as new

Deudorix (Hypokopelates) tenuivittata (Ituri district, Irumu, Belgian Congo), *D. (Virachola) vansomereni* (Teita Hills, Kenya); *Hypolycæna amanica* (Amani, Usambara); *Iolaus bolissus gabonensis* (Port Gentil); *Epamera nolaensis* (Nola, Haute Sangha, Fr. Congo), *E. n. amanica* (Amani, Usambara); *Uranothauma vansomereni* (Makueni, 3500 ft., 80 miles S. of Machakos, Ukamba district, Kenya). Gives first description of ♀♀ of *Deudorix leonina* & *Anthene talboti*. Note on "form" of *Hypolycæna buxtoni*. [P. B.]

Stempffer, H., "Contribution à l'étude des Lycænidæ (Lep.) de la faune éthiopienne" [in French]. *Bull. Soc. ent. France,* vol. 57: pp. 114-121, 1 pl., 2 figs. 1952. Describes as new *Epamera æmulus apatosa* (20 miles S. of Mombasa); *Euchrysops jacksoni* (Madi Opei, N. Acholi, Uganda); *Termoniphas fumosa* (Chang, Cameroons) Describes ♀ of *Deudorix violetta.* Notes on *Liptena congoana, Syntarucus jeanneli, S. babaulti, Azania sitalces* (=*rubropuncta*). [P. B.]

Stempffer, H., "Lépidoptères récoltés par A. Barbezat au cours de l'expedition lyonnaise 1951 au Garhwal. II. Lycænidæ" [in French]. *Bull. mens. Soc. linn. Lyon,* vol. 21: pp. 181-184. 1952. Annotated list of 13 spp., with descriptive notes on *Albulina metallica* & related spp. [P. B.]

Stempffer, H., "Contribution à l'étude des lépidoptères Lycænidæ de l'Afrique équatoriale" [in French]. *Ann. Mus. Roy. Congo belge, Sci. Zool.,* vol. 49: 52 pp., 31 figs., 3 pls. 1956. Contribution to the study of the lycænids of equatorial Africa. Describes as new *Liptena flavicans æquatorialis, L. f. katera, L. stempfferi kigezi; Eresina bergeri, E. maesseni, E. katangana, E. saundersi, E. fontainei, E. rougeoti, E. theodori, E. conradti*; *TOXOCHITONA* (type species: *gerda* Kirby); *Epitola decellei; Deudorix kayonza; Epamera fontainei; Zeritis fontainei; Chloroselas overlaeti; Thermoniphas fontainei, T. kigezi, T. cærulea, T. albocærulea.* Notes on some other spp. [P. V.]

Stempffer, H., "Lycænides", in *Les lépidoptères de l'Afrique noire française* [in French]. *Inst. franç. Afrique noire, Initiations africaines,* vol. 14, no. 3: 228 pp., 331 figs. 1957. This volume of the series "Initiations Africaines", published by the Institut Français d'Afrique Noire, Dakar, is devoted to the Lycænidæ of West Africa, and intended, like the series as a whole, for amateurs. In spite of the great knowledge of the author and of the value of his study, I think that it will be difficult to determine correctly a lycænid from West Africa, for an amateur, with this book, chiefly because of the absence of keys of determination. This publication could have been a useful catalogue, if the author had been able to give the references to original descriptions and the synonyms. [P. V.]

Stempffer, H., "Un nouveau Lycænidæ (Lepidoptera)" [in French]. *Mem. Inst. franç. Afrique noire,* vol. 48: pp. 207-208, 2 figs. "1956" [1957]. Description of a new lycænid from the National Park of Niokolo-koba in Senegal, French West Africa: *Hypolycæna condamini.* [P. V.]

Stempffer, H., & N. H. Bennett, "A revision of the genus *Teriomima* Kirby (Lepidoptera: Lycænidæ)." *Bull. Brit. Mus.* (*nat. Hist.*), *Ent.,* vol. 3: pp. 77-104, 7 pls. 1953. Describes as new *BALIOCHILA* (type *Liptena aslauga), B. barnesi* (Minchi Valley, Manica, SE Trop. Africa), *B. neavei* (Mlanje, Nyasaland), *B. dubiosa* (Ochweni Forest, near Witu, Br. E. Africa), *B. nyasæ* (Mlanje, Nyasaland), *B. fragilis* (Meru, 6000 ft, Kenya), *B. minima amanica* (Amani, Tanganyika), *B. lipara* (Mlanje, Nyasaland), *B. singularis* (Durban, S. Africa); *CNODONTES* (type *Durbania pallida*), *C. vansomereni* (Migori Valley, 4200 ft., S. Kavirondo, Kenya). Redescribes *Teriomima,* the 6 spp. left in this genus, 5 spp. assigned to *Baliochila,* & the type of *Cnodontes*; gives present generic assignment of 22 spp. formerly placed in *Teriomima.* Revision based on ♂ genitalia, since external appearance is too variable for reliable determination. [P. B.]

Storace, Luciano, "Ropaloceri dell'Africa orientale—VIII. Su alcune Pieridæ, can descriziono di nouve forme (Lep. Rhop.)" [in Italian]. *Ann. Mus. civ. Stor. nat.,* Genoa, vol. 68: pp. 335-350. 1956. Describes as new *Colotis pleione antinorii* (Mahaluonz, Abyssinia); also several "forms". Records of 20 pierids from E. Africa, with notes on distribution & variation. [P. B.]

Storck, E., "Les Erebias français. Un essai de classification" [in French]. *Bull. Soc. ent. Mulhouse,* 1947: pp. 2-6, 1 fig. Presents suggested phylogeny (of living spp.), basing conclusions in large part on habitat & behavior. [P. B.]

Sugi, Sigero, "Notes on *Mocis ancilla* Warren (Noctuidæ, Catocalinæ)" [in Japanese; English summary]. *Trans. lep. Soc. Japan,* vol. 8: pp. 17-18, 4 figs. 1957. Confirms occurrence in Japan; compares *M. ancilla* with *M. annetta,* figuring ♂ genitalia. [P. B.]

C. MORPHOLOGY

Arnold, J. W., "The hæmocytes of the Mediterranean Flour Moth, *Ephestia kühniella* Zell. (Lepidoptera: Pyralidæ)." *Canad. Journ. Zool.,* vol. 30: pp. 352-364, 18 figs. "1952" [1953]. Describes & figures blood cell types, & describes their development & their frequency in different stages. Spheroidocytes, most abundant type in prepupal stage, serve then for fat accumulation. [P. B.]

Arvy, Lucie, "Histologie comparée de l'organe leucopoiétique juxta-alaire chez quelques lépidoptères" [in French]. *Bull. Soc. zool. France,* vol. 79: p. 165. 1954. Abstract.

Arvy, L., & L. Coupin, "Presentation d'un élevage de *Malacosoma neustria* (lépidoptère Lasiocampidæ) et d'anomalies du sang chez cet insecte" [in French]. *Bull. Soc. zool. France,* vol. 77: p. 230. 1952.

Avinoff, Andrey, "An analysis of color and pattern in butterflies of the Asiatic genus *Karanasa.*" *Ann. Carnegie Mus.,* vol. 31: pp. 321-332, 2 pls. 1950. Presents charts classifying color and pattern types; discusses evolution of some elements. A by-product of the revision of *Karanasa* by Avinoff & Sweadner. [P. B.]

Balazuc, J., "Une anomalie chez *Papilio podalirius* L. (Lep. Papilionidæ)" [in French]. *Bull. Soc. ent. France,* vol. 51: p. 149, 2 figs. 1947. Figures specimen with notched forewings, probably caused by tight pupal birdle. [P. B.]

Barth, Rudolf, "O órgão odorífero de um macho do gênero *Eriopyga* (Lepidoptera, Noctuidæ, Hadeninæ)" [in Portuguese & German]. *Mem. Inst. Oswaldo Cruz,* vol. 49: pp. 599-640, 8 pls. 1951. Describes scent organ on abdomen of ♂ *E. lamptera.* [P. B.]

Barth, Rudolf, "Esteudos sôbre os órgãos odoríferos de alguns Hesperiidæ Brasilieros" [in Portuguese & German]. *Mem. Inst. Oswaldo Cruz,* vol. 50: pp. 423-556, 14 pls. 1952. Describes general structure of scent scales in Hesperiidæ; structure of scent scales & wing areas which bear them in ♂♂ *Hylephila phylæus,, "Thymelicus" vibex, "Hesperia" syrichtus, Heliopetes arsalte,* & *Eudamus simplicius;* metathoracic scent organs of *"Chiomara" gesta, Diphoridas phalænoides, Pellica bromias, Pachis geometrinus, Myscelus epigona, "H." syrichtus,* & *H. arsalte;* & scent scales of ♀ *Ebrietas ecliptica.* Notes on sexual behaviour & use of scent by Hesperiidæ. [P. B.]

Barth, Rudolf, "Os órgãos odoríferos masculinos de alguns Heliconiinæ do Brasil" [in Portuguese & German]. *Mem. Inst. Oswaldo Cruz,* vol. 50: pp. 335-422, 9 pls. 1952. Describes location & structure of scent scales on wings of some spp. of *"Dione"* [*Agraulis*], *"Colænis"* [*Dryas*], *Eueides,* & *Heliconius.* [P. B.]

Barth, Rudolf, "Consideraçoes gerais sôbre os órgãos odoríferos sexuais dos machos dos lepidopteros" [in Portuguese & German]. *Mem. Inst. Oswaldo Cruz,* vol. 51: pp. 187-202, 1 pl. 1953. ♀ scent generally functions to attract ♂♂; ♂ scent, as a stimulus to mating. Notes constancy of type of scent organ in some groups of Lepidoptera, & species-constancy in fine structure. Scent organs of nocturnal Lepidoptera are in general more concentrated, complex, & evolved than those of diurnal spp. Figures types of scent scales in some Nymphalidæ. [P. B.]

Barth, Rudolf, "Estudos sôbre as placas das glândulas de cêra da lagarta de *Tolype serralta* (Lepidoptera, Lasiocampidæ)" [in Portuguese & German]. *Mem. Inst. Oswaldo Cruz,* vol. 51: pp. 262-275, 3 pls. 1953. Describes paired wax-secreting glands on under surface of 1st, 3rd, & 8th larval abdominal segments. [P. B.]

Barth, Rudolf, "O órgão odorífero abdominal do macho de *Caligo arisbe* Hbn. (Lepidoptera, Brassolidæ)" [in Portuguese & German]. *Mem. Inst. Oswaldo Cruz,* vol. 51: pp. 203-226, 5 pls. 1953. Describes scent organ on abdomen & apparatus for scent distribution on hind wing (♂). [P. B.]

Barth, Rudolf, "Orgãos odoríferos masculinos do algumas Syntomidæ Brasilieras (=Ctenuchidæ; Lepidoptera)" [in Portuguese & German]. *Mem. Inst. Oswaldo Cruz,* vol. 51: pp. 227-262, 7 pls. 1953. Describes small ♂ scent scale areas on foreleg of *Cosmosoma ignidersia* & on hind wing of *Androcharta diversipennis* (both of which mate in daytime), & complex scent organ of ♂ *C. auge* (which mates at night). [P. B.]

Barth, Rudolf, "Estudos histológicos das células glandulares dos insetos peçonhentos. I. Os órgãos urticantes da lagarta de *Automeris incisa* Walker (Lepidoptera, Hemileucidæ)" [in Portuguese & German]. *Mem. Inst. Oswaldo Cruz,* vol. 52: pp. 93-124, 8 pls. 1954. Describes urticating hairs & associated unicellular poison glands of larva. [P. B.]

Barth, Rudolf, "Estudos histológicos nas células glandulares dos insetos peçonhentos. II. Os órgãos urticantes da lagarta de *Megalopyge albicollis superba* Edwards (Lepidoptera, Megalopygidæ)" [in Portuguese & German]. *Mem. Inst. Oswaldo Cruz,* vol. 52: pp. 125-147, 4 pls. 1954. Describes hypodermal poison glands, automatic "pump", & urticating hairs of larva. [P. B.]

Barth, Rudolf, "Estudos sôbre os órgãos odoríferos de alguns Hesperiidæ Brasilieros. 2ª. parte: estudos histológicos" [in Portuguese; German & English summaries]. *Mem. Inst. Oswaldo Cruz,* vol. 52: pp. 261-285, 5 pls. "1954" [1955]. Describes scent organs of metathoracic apophyses of *Sebaldia busirus, Pellicia bromias, P. polyctor, Heliopetes arsalte,* & *"Hesperia" syrichtus.* Organs associated with hair pencils on hind tibia. [P. B.]

Barth, Rudolf, "O órgão odorífero do macho de *Mocis repanda* Fabr., 1794 (Lepidoptera, Noctuidæ, Sarrothripinæ)" [in Portuguese & German; English summary]. *Mem. Inst. Oswaldo Cruz,* vol. 52: pp. 287-314, 8 pls. "1954" [1955]. Describes structure & operation of scent organs on 1st & 3rd pairs of legs. [P. B.]

Barth, Rudolf, & José Lôbo Junquiera, "Estudos histológicos nas células glandulares dos insetos peconhentos. III parte: Sôbre as áreas glandulares da lagarta de *Sibine nesea* (Stoll-Cramer, 1781) (Lepidoptera, Eucleidæ)" [in Portuguese & German; English summary]. *Mem. Inst. Oswaldo Cruz,* vol. 52: pp. 497-516, 6 pls. "1954" [1955]. Describes poison apparatus of larva. Glands on 7th & 8th abdominal segments open by spiny projections of body wall, which break off & work their way into tissue of animal touching them. [P. B.]

Barth, Rudolf, "Estudos histológicos das células glandulares dos insetos peçonhentos. IV parte: As cerdas dos espinhos da lagarta de *Sibine nesea"* [in Portuguese & German]. *Mem. Inst. Oswaldo Cruz,* vol. 54: pp. 359-372, 7 figs. June 1956. Describes urticating spines on warty projections of larva, & associated poison glands (these are separate from structures described in last paper). [P. B.]

Barth, Rudolf, "Maennliche Duftorgane Brasilianischer Lepidopteren. 13. Mitteilung: Die Fluegeldruesen einiger Phægopterinæ (Arctiidæ)" [in German; Portuguese summary]. *An. Acad. Brasil. Cienc.,* vol. 28: pp. 321-331, 15 figs. 1956. Describes scent glands of *Melese cruenta, Bertholdia specularis,* & *Paranerita campos-portoi* (on forewing), & of *Automolis juvenis* (on hind wing). [P. B.]

Barth, Rudolf, "Maennliche Duftorgane Brasilianischer Lepidopteren. 14. Mitteilung: *Phellinodes zikani* Prout (Geometridæ)" [in German; Portuguese summary]. *An. Acad. Brasil. Cienc.,* vol. 28: pp. 333-340, 7 figs. 1956. Describes scent gland & hair pencil on fore leg. Summarizes distribution of scent organs of ♂♂ of 5 subfamilies of Geometridæ, each of which seems to have characteristic types. [P. B.]

Barth, Rudolf, "Maennliche Duftorgane Brasilianischer Lepidopteren. 15. Mitteilung: *Lampostrola pascuala* Schs. (Arctiidæ, Lithosiinæ)" [in German; Portuguese summary]. *An. Acad. Brasil. Cienc.,* vol. 28: pp. 341-355, 18 figs. 1956. ♂ has 3 types of scent glands: on hind wing, under 6th abdominal tergite, & under 7th abdominal sternite; all are described. [P. B.]

Barth, Rudolf, "Maennliche Duftorgane Brasilianischer Lepidopteren. 16. Mitteilung: *Metalobosia cuprea* Schs. (Arctiidæ, Lithosiinæ)" [in German; Portuguese summary]. *An. Acad. Brasil. Cienc.,* vol. 29: pp. 129-140, 16 figs. 1957. Describes abdominal scent organ of ♂. [P. B.]

Barth, Rudolf, "Maennliche Duftorgane Brasilianischer Lepidopteren. 17. Mitteilung: *Illice fasciata* Schs. (Arctiidæ, Lithosiinæ)" [in German; Portuguese summary]. *An. Acad. Brasil. Cienc.,* vol. 29: pp. 141-152, 15 figs. 1957. Describes ♂ scent organs on both wings & in abdomen. [P. B.]

Barth, Rudolf, "Os tubos abdominais dos machos de alguns Arctiidæ e Ctenuchidæ do Brasil" [in Portuguese; German summary]. *Mem. Inst. Oswaldo Cruz,* vol. 54: pp. 499-515, 21 figs. "1956" [1957]. Describes scent organ in form of bristle-bearing eversible tubes with glandular area, opening ventrally between 8th & 9th abdominal segments of ♂, in *Aclytia heber* & *Delphyre suffusa* (Ctenuchidæ), & in *Eucereon discolor* & *Galethalea pica* (Arctiidæ). [P. B.]

Barth, Rudolf, "Ueber die Hautdrusen des Maennchens von *Odozana obscura* Schs. Arctiidæ, Lithosiinæ)" [in German; Portuguese summary]. *Rev. Brasil. Biol.,* vol. 17: pp. 97-114, 24 figs. 1957. Describes 9 sets of dermal glands; 1 appears to be rudimentary, 2 probably secrete substances preventing evaporation or mingling of other secretions, & 6 produce sexual odors, perhaps all different & used in successive stages of courtship. [P. B.]

Beams, H. W., & Everett Anderson, "Light and electron microscope studies on the striated border of the intestinal epithelial cells of insects." *Journ. Morph.,* vol. 100: pp. 601-619, 5 pls. 1957. Study on larvæ of *Malacosoma.* [P. B.]

Bittner, A., "Untersuchungen über den Proventriculus der grossen Wachsmotte (*Galleria mellonella* L.)" [in German]. *Wiss. Zeitschr. Univ. Greifswald,* vol. 3: pp. 519-531, 9 figs. "1953/1954". Describes morphology, histology, & function of proventriculus. Bibliography of 149 titles on *G. mellonella.* [P. B.]

de Boer, S., "Bilateral gynandromorph van *Lymantria dispar* L." [in Dutch]. *Ent. Berichten,* vol. 13: p. 236, 1 fig. 1951.

Brunold, E., "Die Entwickung des weiblichen Genitalapparates von *Solenobia triquetrella* während des Puppenstadiums. (Vorläufige Mitteilung)" [in German]. *Revue suisse Zool.,* vol. 62: pp. 208-210, 4 figs. 1955. Preliminary account of development of ♀ genitalia. [P. B]

de Buen, Ana Maria, "Algunas observaciones sobre la citologia de las glandulas protoracicas de *Halysidota caryæ* Harr. (Lepidoptera)" [in Spanish]. *An. Inst. Biol.,* Mexico, vol. 20: pp. 465-472, 13 figs. 1949. Study of histology of prothoracic gland & changes in nuclear form during last 2 larval instars. [P. B.]

E. DISTRIBUTION & PHENOLOGY

Adamczewski, Stanislaw, "On faunistic changes caused by the war in Warsaw" [in Polish; English summary]. *Bull. ent. Pologne,* vol. 18: pp. 268-275. 1948. Gives some observations on the fauna of Warsaw (mainly Lepidoptera), made in the ruins of the city and its environs during World War II. [J. M.]

Allan, P. B. M., "*Sterrha serpentata* Hufnagel in England." *Ent. Rec. & Journ. Var.,* vol. 67: pp. 76-79. 1955. History of confusion over identity of this sp. [P. B.]

Allan, P. B. M., "The Middle Copper." *Ent. Rec. & Journ. Var.,* vol. 68: pp. 68-73. 1956. On possible surviving colony of *Lycæna virgaureæ* in Britain. [P. B]

Allard, H. A., & E. C. Leonard, "Animal life of the Cabin Mountain — Stony River Dam area." *Proc. W. Virginia Acad. Sci.,* vol. 24: pp. 31-35. 1953. Includes records of 23 spp. of butterflies. [P. B.]

Alberti, Burchard, "Notiz über *Hesperia armoricanus* Obthr. in Oberbayern" [in German]. *Zeitschr. Lepid.,* vol. 1: p. 126. 1951. *H. a. disjuncta* locally common in Bavaria. [P. B.]

Alberti, Burchard, "Eine Lepidopteren-Ausbeute aus Südost-Polen" [in German]. *Zeitschr. Lepid.,* vol. 2: pp. 51-58. 1953. Describes Zamosc area in SE Poland; annotated list of some 150 macros. [P. B.]

Amsel, Hans-Georg, "Die Deutsche Afghanistan-Expedition 1956 der Landessammlungen für Naturkunde in Karlsruhe" [in German]. *Beitr. Naturkundl. Forsch. Südwestdeutschland,* vol. 16: pp. 5-29, 3 pls., 1 map. 1957. Report of expedition; some notes on Lepidoptera. [P. B.]

"An Old Moth Hunter" [P. B. M. Allan], "*Hadena blenna* Hübner in England." *Ent. Rec. & Journ. Var.,* vol. 64: pp. 174-177. 1952. Perhaps a native, though local, sp. (not taken in 90 years); notes on biology. [P. B.]

"An Old Moth Hunter" [P. B. M. Allan], "A matter of coppers." *Ent. Rec. & Journ. Var.,* vol. 69: pp. 157-158. 1957. Notes recent northward spread of *Lycæna virgaureæ* in Europe; suggests that climate has changed enough to permit survival of this extirpated sp. in Britain at present. [P. B.]

Ander, Kjell, "*Paralispa gularis* Zell. (Lep. Pyr.), en för Sverige ny förrådsskadeinsekt" [in Swedish; German summary]. *Opusc. ent.,* vol. 16: p. 64. 1951. New Swedish record; a pest in candy factory. [P. B.]

Anonymous, "Immigrant insect records for the year 1951." *Proc. Hawaiian ent. Soc.,* vol. 14: pp. 537-538. 1952. Includes *Stenoptilia parva,* new to Hawaii. [P. B.]

Anonymous, "Immigrant insect records for the year 1953." *Proc. Hawaiian ent. Soc.,* vol. 15: p. 371. 1954. Includes *Blepharomastix acutangulalis,* new to Hawaii. [P.B.]

Anonymous, "*Cucullia fraudatrix* Ev., in N. O." [in German]. *Ent. Nachrichtenbl.,* Vienna, vol. 2, no. 3: p. 6. 1955. New record for Austria. [P. B.]

Anonymous, "Sammelanweisungen" [in German]. *Zeitschr. wiener ent. Ges.,* vol. 39: pp. 91-93, 133-135, 173-174, 206-208, 237-239, 269-271, 300-303, 364-368. 1954. Notes on where to find interesting spp. throughout the season in lower Austria. [P. B.]

Armitage, H. M., "Current insect notes." *Bull. Calif. Dept. Agric.,* vol. 44: pp. 164-166. 1955. Mentions the spread of the Oriental Fruit Moth (*Grapholitha molesta*) in California. [J. T.]

Ash, John, "Records of Lepidoptera from an area in Berkshire in 1949." *Ent. Rec. & Journ. Var.,* vol. 62: pp. 85-88, 93-96. 1950. 296 spp. of Macrolepidoptera recorded. [P. B.]

Augustin, J. L., "Capture de lépidoptères dans les Basses Pyrénées" [in French]. *Rev. Franç. Lépid.,* vol. 15: pp. 134-135. 1956. List of 'Rhopalocera' (only 4 'Heterocera' are cited) from the western Pyrenees. The nomenclature is generally old. [P. V.]

Aubert, Jacques-F., "Une géométride nouvelle pour la faune française: *Entephria* (*Cidaria* auct.) *contestata* Vorbr. (Note préliminaire)" [in French]. *Bull. mens. Soc. linn. Lyon,* vol. 21: pp. 226-227, 4 figs. 1952. New French record; figures holotype & allotype. [P. B.]

Badham, Russell, "Some records from the Lundi District, Southern Rhodesia." *Journ. ent. Soc. southern Africa,* vol. 17: pp. 86-89. 1954. Lists 57 butterflies from this area, and *Cyrestis elegans* (new to South Africa) from Transvaal. [P. B.]

Baeta Neves, C. M., "Deux especes nouvelles pour l'entomofaune portuguaise: *Evetria tessulatana* Stgr. (Lepidoptera — Tortricidæ) et *Cræsos septentrionalis* L. (Hymenoptera — Tenthredinidæ)" [in French]. *Bol. Soc. portuguesa Ciênc. nat.,* vol. 15: pp. 56-59, 1 pl., 3 figs. 1947. New records for Portugal. [P. B.]

Baeta Neves, C. M., "A propósito das últimas contribuções para o estudo da entomofauna de Portugal. Apontamentos para a sua bibliografia" [in Portuguese]. *Bol. Soc. portuguesa Ciênc. nat.,* vol. 16: pp. 107-133. 1948. Summary of work on insect fauna of Portugal since 1941, with bibliography. [P. B.]

Baker, B. R., "Burghfield Common today." *Ent. Rec. & Journ. Var.,* vol. 67: pp. 53-56. 1955. Present fauna of a well-known English locality. [P. B.]

Baker, B. R., "Light at Studland." *Ent. Rec. & Journ. Var.,* vol. 69: pp. 35-37. 1957. Late summer moth collecting on Dorset coast. [P. B.]

Balfour-Browne, Frank, "The aquatic Coleoptera of the western Scottish islands with a discussion on their sources of origin and means of arrival." *Ent. Gaz.,* vol. 4: pp. 79-127. 1953. Gives information suggesting that many Lepidoptera of these islands are recent or regular immigrants; strongly opposes Beirne's view that most of fauna must have arrived by land bridges. [P. B.]

Bank, G., jr., "Merkwaardige vlindervangsten in 1955 (Lep.)" [in Dutch]. *Ent. Berichten,* vol. 16. p. 138. 1956.

Barbezat, A., "Lépidoptères récoltés par A. Barbezat au cours de l'expedition Lyonnaise 1951 au Garhwal. I. Introduction et description de la région explorée" [in French]. *Bull. mens. Soc. linn. Lyon,* vol. 21: pp. 127-134, 1 map. 1952. General description of region & notes on butterflies at various stations on the Alaknanda River & its tributaries. [P. B.]

Barbotin, M. F., "Le bombyx processionnaire du pin dans le Morbihan (*Cnethocampa pityocampa* Schiff)" [in French]. *C. R. Sect. Sci. Congr. Soc. savantes,* 1951: pp. 79-83, 1 map. 1952. Note on range extension in France, biology, & control. [P. B.]

Baynes, E. S. A., "*Polychrisia moneta* Fabr., (Golden Plusia) in Ireland." *Ent. Gaz.,* vol. 4: p. 286. 1953. Second record; species perhaps newly established. [P. B.]

Baynes, E. S. A., "The Lepidoptera of Glenageary, Co. Dublin." *Ent. Gazette,* vol. 8: pp. 151-160. 1957. Annotated list.

Beirne, Bryan P., "Zoogeographical significance of distributional changes in British Macrolepidoptera." *Trans. Roy. ent. Soc. London,* vol. 107: pp. 117-123. 1955. Believes that long-term climatic changes are responsible for population fluctuations not attributable to human agency. Maintains that present ranges of Britsh species may properly be used to deduce origin and history in Britain of these species, since only about 3% are known to have undergone such fluctuations. [P. B.]

Benander, Per, "Elf für Schweden neue Kleinschmetterlinge (Lep.)" [in German]. *Opusc. ent.,* vol. 17: pp. 63-64. 1952. 11 new spp. of micros for Sweden (in *Coleophora, Bedellia, Elachista, Phalonia, Nemophora, Argyresthia, Euxanthis, Incurvaria, Monochroa*). [P. B.]

Benander, Per, "Catalogus insectorum Sueciæ. Additamenta ad pars VI. Microlepidoptera." *Opusc. ent.,* vol. 18: pp. 89-101. 1953. List of spp. & localities, supplementary to original catalogue of Swedish micros; 75 spp. are added, bringing Swedish list to 1470 (14 doubtful). [P. B.]

Bentinck, G. A., "Nieuwe en zeldzame Lepidoptera in 1953" [in Dutch; English summary]. *Ent. Berichten,* vol. 15: pp. 286-287. 1955. *Dioryctria mutatella* new to Holland. Notes on rare spp.; names "ab." of *Coleophora fuscedinella.* [P. B.]

Bentinck, G. A., "Vangsten van zeldzame Lepidoptera in 1954" [in Dutch; English summary]. *Ent. Berichten,* vol. 15: pp. 393-394. 1955. Records of rare spp. in Holland. [P. B.]

Bentinck, G. A., "Vangsten van zeldzame Lepidoptera in 1955 en enige faunistische mededeelingen" [in Dutch]. *Ent. Berichten,* vol. 16: pp. 139-140. 1956.

Bentinck, G. A., "Vangsten van zeldzame Lepidoptera in 1956" [in Dutch; English summary]. *Ent. Berichten,* vol. 17: p. 128. 1957.

Berezina, V. M, "Izmeneniya v sostave i chislennosti vrednoy pochvennoy entomofauny pod vlianiem preobrazovaniya Kamennoy stepi" [in Russian; Changes in the body and number of the injurious insect fauna as a result of the reconstruction of Kamennaya Step']. *Ent. Obozrenie,* vol. 32: pp. 3-14. 1952. Observations in Voronezh region; mentions *Euxoa tritici.* [N. O.]

Berger, L. A., "Mission E. Janssens et R. Tollet en Grèce (juillet-août 1953). Lepidoptera — Rhopalocera. Families: Papilionidæ, Pieridæ, Libytheidæ, Lycaenidæ, Hesperiidæ" [in French]. *Bull. & Ann. Soc. ent. Belg.,* vol. 91: pp. 349-352. 1955. Annotated list of 28 spp.; descriptive notes on specimens of *Parnassius mnemosyne athene.* [P. B.]

Berger, L. A., "Contribution à l'étude de la faune entomologique du Ruanda-Urundi. — Lepidoptera Heterocera" [in French]. *Ann. Mus. Congo Belge,* Tervuren, *Zool.,* vol. 51: pp. 440-441. 1956. List of a small collection of Macroheterocera from Ruanda-Urundi (Belgian Congo). [P. V.]

Bernardi, G., "Lepidopteres Pieridæ recoltes au Cameroun par C. de Raemy" [in French]. *Bull. Inst. franç Afr. noire, ser. A,* vol. 17: pp. 185-190, 3 figs. 1955. Annotated list of 5 spp.; discusses distribution of sspp. of *Pseudopontia paradoxa.* [P.B.]

F. BIOLOGY AND IMMATURE STAGES

Blair, K. G., "Some records of *Gelis* Thunberg (=*Pezomachus* Gravenhorst) (Hym., Ichneumonidæ)." *Ent. mo. Mag.,* vol. 87: pp. 194-195. 1951. Records various spp. as parasites of *Depressaria heracliana, Coleophora lutipenella,* and hyperparasites of some macrolepidoptera (primary parasites listed). [P. B.]

Blais, J. R., "The relationship of the Spruce Budworm (*Choristoneura fumiferana,* Clem.) to the flowering condition of Balsam Fir (*Abies balsamea* (L.) Mill.)." *Canad. Journ. Zool.,* vol. 30: pp. 1-29, 11 figs. 1952. Populations are larger on flowering trees, which are preferred for oviposition; they provide sites for hibernacula (in flower scars) & a succulent food source in early spring (staminate flowers). Larval development was accelerated when pollen was included in diet, & retarded if larvæ were forced to eat old growth exclusively. [P. B.]

Blanchard, Everardo E., "Descripcion de un himenoptero (Braconidæ) parasito de *Riculoides gallicola* sp. nov." [in Spanish]. *An. Soc. cient. Argentina,* vol. 154: pp. 78-80, 1 fig. 1952. Parasite reared from new sp. of tortricid described by Pastrana in adjoining paper. [P. B.]

Blest, A. D., "The function of eyespot patterns in the Lepidoptera" [in English; German summary]. *Behaviour,* vol. 11: pp. 209-256, 14 figs. 1957. Demonstrates that large eyespot patterns (such as those of *Nymphalis io*) release escape responses in birds, & that small eyespot patterns direct the attacks of birds toward themselves. The responses of the birds are innate; the former response, at least, may be suppressed after experience with edible butterflies which have eyespots. The protective value of eyespots, either in frightning predators or in directing their attacks to parts which are not vital, seems well established. [P. B.]

Blickenstaff, C. C., K. D. Arbuthnot, & H. M. Harris, "Parasites of the European Corn Borer in Iowa." *Iowa State Coll. Journ Sci.,* vol. 27: pp. 335-379, 9 figs. 1953. Lists numerous parasites of *Pyrausta nubilalis,* & discusses their status in Iowa, biological notes. [P. B.]

Blickenstaff, Carl C., "The nature of damage to field corn by the Corn Earworm, *Heliothis zea* (Boddie), and the Fall Armyworm, *Laphygma frugiperda* (A. and S.)." *Iowa State Coll. Journ. Sci.,* vol. 32: pp. 133-135. 1957. Abstract.

Blunck, H., "Zur Kenntnis des Massenwechsels von *Pieris brassicæ* L. mit besonderer Berücksichtigung des Dürrejahres 1947" [in German]. *Zeitschr. angew. Ent.,* vol. 32: pp. 141-171, 5 figs. 1950. Analysis of factors producing fluctuations in numbers of *P. brassicæ* and *P. rapæ*: weather, parasites of various stages. In the hot, dry summer of 1947 both species produced complete third generation in Germany. [P. B.]

Blunck, H., "Parasiten und Hyperparasiten von *Pieris rapæ L.*" [in German]. *Zeitschr. Pflanzenkrankh.,* vol. 58: pp. 25-54, 14 figs. 1951. Describes early stages & biology of *Apanteles rubecula,* & gives notes on 2 other parasites of *P. rapæ;* notes on parasitization of *Aporia cratægi.* [P. B.]

Blunck, H., "Zur Kenntnis der Hyperparasiten von *Pieris brassicæ* L. 4. Beitrag: *Gelis* cf. *transfuga* Först. 5. Beitrag: *Hemiteles simillimus sulcatus.* Die Metamorphose" [in German]. *Zeitschr. angew. Ent.,* vol. 33: pp. 217-267, 26 figs.; pp. 420-459, 43 figs. 1951; 1952. Morphology and biology of these hyperparasites attacking *Apanteles.* [P. B.]

Blunck, Hans, "Zur Kenntnis der Hyperparasiten von *Pieris brassicæ* L. 6. Beitrag: *Gelis corruptor* Förct. und *Gelis faunus* Först." [in German]. *Beitr. Ent.,* vol. 2: pp. 94-109, 3 figs. 1952. Morphology & biology of *G. corruptor,* parasite of *Apanteles;* lists alternative hosts, including Lepidoptera. [P. B.]

Blunck, Hans, "Über die Schlüpfzeit der Falter bei *Aporia cratægi* L. und *Pieris brassicæ* L." [in German]. *Zool. Anz.,* vol. 151: pp. 237-252, 10 figs. 1953. Adults of *A. cratægi* emerge at any time; in *P. brassicæ* there is a strong peak of emergence in morning hours. Time of emergence not controlled by light, temperature, or humidity; suggests that it is associated with greater ionization of air in morning. [P. B.]

Blunck, Hans, "Mikrosporidien bei *Pieris brassicæ* L., ihren Parasiten und Hyperparasiten" [in German]. *Zeitschr. angew. Ent.,* vol. 36: pp. 316-333, 15 figs. 1954. *Nosema polyvora* and other microsporidians attacking the *P. brassicæ* host-parasite complex. [P. B.]

Blunck, Hans & Margot Janssen, "Zur Kenntnis von *Hemiteles melanarius* Grav. (Ichn.). Ein Fall des Übergangs vom Ekto- zum Endoparasitismus" [in German; English summary]. *Zeitschr. Pflanzenkrankh.,* vol. 64: pp. 600-606, 2 figs. 1957. Describes biology of parasite of *Pieris brassicæ* & many other insects. [P. B.]

Bœhm, F., "*Lysandra hylas* ab ovo" [in French]. *Bull. Soc. ent. Mulhouse,* 1947: pp. 33-36. Describes early stages & rearing on *Anthyllis vulneraria.* [P. B.]

Boer Leffef, W. J., "Lepidopterologische opmerkingen" [in Dutch]. *Ent. Berichten,* vol. 14: pp. 361-362. 1953. Rearing notes on *Rhyparia purpurata,* & other miscellaneous notes. [P. B.]

Bogush, P. P., "Sexual activity and duration of periods connected with oviposition in the Beet Armyworm" [in Russian]. *Trudy Inst. Zool. Parasitol. Akad. Nauk Uzbekskoi SSR,* vol. 1: pp. 457-464. 1954. *Laphygma exigua.* [Not seen].

Bogush, P. P., "Parasites of the Cotton Boll-worm *Chloridea obsoleta* F. (Lepidoptera, Agrotidæ) in Turkmenistan" [in Russian; English summary]. *Rev. Ent. URSS,* vol. 36: pp. 98-107. 1957.

Boldaruev, V. O., "Parasity sibirskogo shelkopryada (*Dendrolimus sibiricus* Tshtv.) v Vostochnoy Sibiri" [in Russian; Parasites of Siberian lasiocampid in eastern Siberia]. *Ent. Obozrenie,* vol. 32: pp. 56-68, 3 figs. 1952. Lists 22 parasites (Hymenoptera & Diptera). Describes external characters of some of them. [N. O.]

Boldaruev, V. O., "Fertility and food specialization of the Siberian Moth (*Dendrolimus sibiricus* Tshtv.)" [in Russian]. *Zool. Zhurn.,* vol 34: pp. 810-821. 1955. [Not seen].

Bollmann, Hans-Günther, "Die Raupen mittleleuropäischer Pyraustinæ (Lepidoptera: Pyralidæ)" [in German]. *Beitr. Ent.,* vol. 5: pp. 521-639, 255 figs. 1955. Describes external morphology; gives keys to larvæ of subfamilies of Pyralidæ, genera of Pyraustinæ, & spp. of these genera. Describes larvæ of 47 of some 90 central European spp., and a few exotic spp. An impressive work. [P. B.]

Bonhomme, Ch., "Contrôle histologique du système nerveux des chenilles de noctuides paralysées par les ammophiles" [in French]. *Bull. Acad. Sci. Lettres Montpellier,* no. 78/81: pp. 32-34. 1952. Effects of wasp venom on central nervous system of noctuid larvæ (species not named). [P. B.]

Boucly-Urison, M., "La chenille de *Galleria mellonella* L. et son évolution entre deux mues successives" [in French]. *Bull. Soc. zool. France,* vol. 76: pp. 171-177, 3 figs. 1951. Describes changes in appearance & behaviour which take place in the course of a single larval instar. [P. B.]

Bourgogne, Jean, "Les lépidoptères" [in French]. *Nature,* Paris, no. 3194: pp. 175-181, 5 pls., 13 figs. 1951. Interesting popular account of biology. [P. B.]

Bourquin, Fernando, "Metamorfosis de *Syssphinx molina obtusa* Strassberger 1952. Lep. fam. Adelocephalidæ" [in Spanish; English summary]. *Acta zool. lilloana,* vol. 7: pp. 403-408, 1 pl., 2 figs. 1949. Describes & figures egg & larva; also figures adults & ♂ genitalia. Foodplant *Erythrina cristagalli.* [P. B.]

Bourquin, Fernando, "Nota sobre la metamorfosis de *Lineodes hamulalis* Hamps. (Lep. fam. Pyraustidæ)" [in Spanish; French summary]. *Acta zool. lilloana,* vol. 7: pp. 419-422, 1 pl., 4 figs. 1949. Gives figures of all stages & setal pattern of larva; foodplant *Cestrum parqui.* [P. B.]

Bourquin, Fernando, "Notas sobre la metamorfosis de *Aciptilia alternaria* Zeller 1874. Lep. fam. Pterophoridæ" [in Spanish; French summary]. *Acta zool. lilloana,* vol. 7:

pp 415-417, 1 pl., 1 fig. 1949. Gives figures of all stages & larval setal pattern. Foodplant *Echium plantagineum.* [P. B.]

Bourquin, Fernando, "Notas sobre la metamorfosis de *Arrhenophanes perspicilla* (Stoll) 1790 (Lep. fam. Arrhenophanidæ" [in Spanish; English summary]. *Acta zool. lilloana,* vol. 7: pp. 409-413, 1 pl., 3 figs. 1949. Describes & figures larva & pupa & figures adults. Larvæ live in cases attached to *Polyporus* sp. & made of fragments of the fungus, which is the probable foodplant. [P. B.]

Bourquin, Fernando, "Notas sobre la metomorfosis de *Chlanidoptera patagiata* Berg 1877. Lep. fam. Arctiadæ" [in Spanish; English summary]. *Acta zool. lilloana,* vol. 7: pp. 393-394, 1 pl., 3 figs. 1949. Describes & figures larva & pupa & figures adults; foodplant *Chloræa piquichen.* [P. B.]

Bourquin, Fernando, "Notas sobre la metamorfosis de *Cucullia heinrichi* Köhler 1949. Lep. fam. Cucullianæ" [in Spanish; French summary]. *Acta zool. lilloana,* vol. 7: pp. 401-402, 1 pl., 4 figs. 1949. Describes & figures larva & pupa & figures adult; foodplant *Lantana camara.* [P. B.]

Bourquin, Fernando, "Notas sobre la metamorfosis de *Eugliphys bridarolliana* Köhler 1949. Lep. fam. Lasiocampidæ" [in Spanish; French summary]. *Acta zool. lilloana,* vol. 7: pp. 385-391, 1 pl, 3 figs. 1949. Describes & figures all stages; foodplant *Ocolia acutifolia.* [P. B.]

Bourquin, Fernando, "Notas sobre la metamorfosis de *Heliconius phyllis* F. 1775. Lep. fam. Heliconiidæ" [in Spanish; French summary]. *Acta zool. lilloana,* vol. 7; pp. 395-399, 1 pl., 2 figs. 1949. Describes & figures all stages; foodplant *Passiflora cærulea.* [P. B.]

Bovey, Paul, "Un nouveau ravageur en Europe: l'écaille fileuse (*Hyphantria cunea* Drury)" [in French; German summary]. *Schweiz. Zeitschr. Forstwesen,* vol. 105: pp. 1-12, 2 pls., 1 fig., 1 map. 1954. European distribution, biology, & control. [P. B.]

Bowden, S. R., "Interrupted imaginal development: experiments on pupæ of *Pieris napi.*" *Entomologist,* vol. 88: pp. 107-108. 1955. Return of pupæ to cold storage after period at room temperature resulted in crippling of some adults. [P. B.]

Box, Harold E., "*Palpozenilla palpalis* (Aldr.), a tachinid parasite of sugar cane moth borers (*Castnia and Diatræa*)." *Proc. Hawaiian ent. Soc.,* vol. 14: pp. 485-490, 2 figs. 1952.

Brazzel, J. R., & D. F. Martin, "Behaviour of Pink Bollworm larvæ." *Journ. econ. Ent.,* vol. 48: pp. 677-679. "1955" [1956]. Studies in infesting cotton bolls with eggs of *Pectinophora gossypiella* showed that larvæ were cannibalistic, and that they could also, when newly hatched, move to other bolls and become established. [W. C.]

Brazzel, J. R., & D. F. Martin, "Oviposition sites of the Pink Bollworm on the cotton plant." *Journ. econ, Ent.,* vol. 50: pp. 122-124. 1957. Eggs mostly on vegetative parts of cotton plant for first 6 weeks; more eggs on vegetative than on fruiting part until August. *Pectinophora gossypiella.* [W. C.]

Brčák, Jaroslav, "*Hepialus lupulinus* L. škůdce konvalinek v prazských zahrádkach" [in Czech]. *Ochrana Rostlin,* vol. 23: pp. 236-238, 3 figs. 1950. Larvæ found in Prague as pests of roots of Lily-of-the-Valley. [J. M.]

Brčák, Jaroslav, "Motýli našich rašeliništ" [in Czech]. *Ochrana Přírody,* vol. 5: pp. 77-80. 1950. Gives some information about Lepidoptera of peatbogs in Czechoslovakia, without precise localities. [J. M.]

Breeland, S. G., "Winter studies on the Armyworm, *Pseudaletia unipuncta,* in Tennessee." *Bull. ent. Soc. Amer.,* vol. 3: p. 32. 1957. Abstract.

Bretherton, R. F., "The occurrence of double broods among moths in north-west Surrey." *Ent. Gaz.,* vol. 4: pp. 287-295. 1953. In Macrolepidoptera and Pyralidæ.

Broekhuysen, G. J., "The 'Potato Grub' (*Agrotis* sp.). A serious pest of potatoes on the island of Tristan da Cunha." *Journ. ent. Soc. southern Africa,* vol. 12: pp. 96-108, 3 figs. 1948. Biology and control of *Peridroma porphyrea.* [P. B.]

Brower, Jane Van Zandt, "Experimental studies of mimicry in some North American butterflies." *Nature,* vol. 180: p. 444. 1957. Shows effectiveness of mimetic resemblance of *Limenitis archippus* to *Danaus plexippus,* and of *Papilio troilus* & *P. polyxenes* to *Battus philenor,* using jays as predators. [P. B.]

Brower, Lincoln P., & Jane Van Zandt Brower, "Cryptic coloration in the anthophilous moth *Rhododipsa masoni.*" *Amer. Nat.,* vol. 90: pp. 177-182, 2 figs. 1956. Brightly colored noctuid is inconspicuous in its normal feeding position on flowers of *Gaillardia aristata* in Colorado. Authors demonstrate that moths at rest tend to assume the concealing position more frequently than chance would predict. [P. B.]

Brown, S. C. S., "The Spotted Flycatcher killing and eating a Red Admiral butterfly. (Lep.)" *Journ. Soc. Brit. Ent.,* vol. 3: p. 45. 1949.

Brown, S. C. S., "*Loxostege palealis* (Schiff.) (Lep., Pyraustidæ) carrying the pollenia of an orchid." *Ent. mo. Mag.,* vol. 90: p. 119. 1954.

Brown, S. C. S., "*Argynnis lathonia* (L.) (Lep., Nymphalidæ) attacked by a lizard." *Ent. mo. Mag.,* vol. 93: p. 31, 1 fig. 1957.

Buck, John, & Margaret Keister, "Host-parasite relations in *Agapema* pupæ." *Ann. ent. Soc. Amer.,* vol. 49: pp. 94-97. 1956. Notes on behavior of *Phorocera* sp. (Diptera) in *A. galbina.* Suggests that termination of diapause in host and parasite is linked, perhaps hormonally. [P. B.]

Bünzli G. H., & W. W. Büttiker, "Insects in Southern Rhodesian tobacco culture. Parts II-III. Insects occurring in the fields. Hymenoptera, Diptera." *Acta tropica,* vol. 14: pp. 236-250. 1957. Records parasites of *Gelechia* spp., *Agrotis segetis, Heliothis obsoleta,* & *Laphygma exempta,* & vespid predator on *Diparopsis castanea.* [P. B.]

Büttiker W. W. G., "*Drosica abjectella* Wlk. (Lepidoptera: Tineidæ) a predator on pineapple mealybug, *Dysmicoccus brevipes* Ckll. (Homoptera: Coccidae)." *Journ. ent. Soc. southern Afr.,* vol. 20: pp. 162-163. 1957. Notes on biology & distribution; larvæ ate up to 12 mealybugs each in last instar. [P. B.]

Buhr, Herbert, "Betrachtungen über die Wirtskreise von Parasiten. Bestehen zwischen den von oligophagen Cruciferen-Parasiten befallenen Substraten verwandschaftlich Beziehungen?" [in German]. *Ber. deutsche bot. Ges.,* vol. 65: pp. 419-426. 1953. Survey of host-plant range in *Pieris, Plutella maculipennis,* & other enemies of crucifers [P. B.]

Buhr, Herbert. "Die Frassbilder und weiteren Nahrungspflanzen der an *Vicia faba* L. lebenden Minierinsekten" [in German]. *Beitr. Ent.,* vol 3: pp. 258-278, 7 figs. 1953. Biology of *Cnephasiella obsoletana, Cnephasia alternella, C. interjectana, Aproærema anthyllidella* (Gelechiidae), and several Diptera; gives key to larvæ of the 3 tortricids; lists alternative foodplants. [P. B.]

Buhr, Herbert. "Interessante Minen an *Myosotis* und *Pulmonaria* aus Thüringen" [in German]. *Mitt. münchner ent. Ges.,* vol. 46: pp. 1-13, 6 figs. 1956. Notes on biology of *Colephora pulmonariella, Dyselachista myosotivora, Cnephasia wahlbomiana, C. alternella,* & *Cnephasiella pasivana,* mining leaves of these plants. [P. B.]

Burges, H. D., "Some effects of the British climate and constant temperatures on the life-cycle of *Ephestia cautella* (Walker)." *Bull. ent. Res.,* vol. 46: pp. 813-835, 5 figs. 1956.

Burmann, Karl, "Die Raupe und Puppe von *Oxyptilus kollari* Stt. (Microlepidoptera, Pterophoridæ)" [in German]. *Zeitschr. wiener ent. Ges.,* vol. 35: pp. 146-147, 1 fig. 1950. Describes larva & pupa; foodplant *Hieracium amplexicauda.* [P. B.]

Burmann, Karl, "Aus dem Leben eines hochalpinen Kleinfalters, *Plutella geniatella* Z. (Plutellidæ)" [in German]. *Zeitschr. Lepid.,* vol. 2: pp. 73-75. 1952. Foodplants *Draba aizoides* & perhaps *Cerastium.* Notes on biology & flight periods. [P. B.]

Burmann, Karl, "Die Lebensweise und Veränderlichkeit von *Orodemnias cervini* Fall. Beobachtungen vom Nordtiroler Fundplatz (Lepidoptera, Arctiidæ)" [in German]. *Mitt. münchner ent. Ges.,* vol. 42: pp. 162-184, 2 pls. 1952. Sp. spends most of its life under stones at high altitude (3000 m.); adults fly little. Author describes behaviour & biology, & lists parasites; also describes variation, naming 2 'forms'. List of 26 other Lepidoptera characteristic of this very inhospitable zone. [P. B.]

G. PHYSIOLOGY

Allan, P. B. M., "Some observations on the larval legs of *Stauropus fagi* Linn." *Entomologist,* vol. 90: pp. 211-216, 219-226, 1 pl. 1957. Discussion of movement & behaviour of larvæ with special reference to the greatly elongate prothoracic legs. [P.B.]

Amanieu, Michel, "Recherches sur les relations entre l'évacuation de la soie et l'accomplissement de la métamorphose chez les lépidoptères" [in French]. *Bull. Soc. Hist. nat. Toulouse,* vol. 90: pp. 257-286, 1 pl., 5 figs. 1955. Forced retention of silk by cutting or sealing duct of silk gland is fatal to larva; removal of gland or failure of silk production through starvation still permits normal metamorphosis. [P. B.]

Anderson, Lauren D., & Henry Nakakihara, "Effect of substrate color on Corn Earworm moth oviposition." *Bull. ent. Soc. Amer.,* vol. 3: p. 30. 1957. Abstract; *Heliothis zea.*

Anonymous, "Why insects change form." *Life,* vol. 32, no. 6: pp. 79-87, 23 figs. 1952. Figures of normal metamorphosis in *Hyalophora cecropia* and of some of Williams's experiments on control of metamorphosis. [P. B.]

Arnold, J. W., "Effects of certain fumigants on hæmocytes of the Mediterranean Flour Moth, *Ephestia kühniella* Zell. (Lepidoptera, Pyralididæ)." *Canad. Journ. Zool.*, vol. 30: pp. 365-374, 19 figs. "1952" [1953].

Asahina, Eizô, et al., "Resistance mechanism to frost injury of overwintering slug caterpillar (*Cnidocampa flavescens* Walker, Cochlidionidæ)" [in Japanese; English summary]. *Kontyû*, vol. 20: pp. 11-17, 2 pls. 1953. Freezing process seems to be the "extra-cellular freezing" and exerts no harmful effects on the caterpillar, even at —15° C. [T. I.]

Auclair, Jacques L., & Robert Dubreuil, "A simple ultramicromethod for the quantitative estimation of amino acids by paper partition chomatography." *Canad. Journ. Zool.*, vol. 30: pp. 109-113. 1952. Includes data on concentration of amino acids in blood of *Galleria mellonella* larvæ. [P. B.]

Auclair, Jacques L., & Robert Dubreuil, "Étude sur les acides aminés libres de l'hemolymphe des insectes par la méthode de chomatographie sur papier filtre" [in French; English summary]. *Canad. Journ. Zool.*, vol. 31: pp. 30-41. 1953. Data on blood amino acids of *Galleria mellonella, Phegethontius quinquemaculatus, Archips cerasivorana,* & *Malacosoma americana.* [P. B.]

Autrum, H., "Das Sehen der Insekten" [in German]. *Studium generale,* vol. 10: pp. 211-214. 1957. Summary of insect vision with special reference to perception of form. [P. B.]

Beck, Stanley D., "A bimodal response to dietary sugars by an insect." *Biol. Bull.,* vol. 110: pp. 219-228, 3 figs. 1956. Larvæ of *Pyrausta nubilalis* show positive response to sugar concentrations above .001 M, but negative response to lower concentrations. [P. B.]

Beckel, William E., & Howard A. Schneiderman, "Insect spiracle as an independent effector." *Science,* vol. 126: pp. 352-353, 2 figs. 1957. Closing muscle of spiracle of *Hyalophora cecropia* can respond to oxygen and carbon dioxide levels by contracting or relaxing in absence of any nervous connection. Normal innervation serves to coordinate activity of spiracles. Morphology of spiracle & associated structures described. [P. B.]

Bounhiol, J.-J., "Essai de localisation d'un centre de métamorphose imaginale chez *Bombyx mori* L." [in French]. *C. R. XIII^e Congr. intern. Zool.*: pp. 470-471. 1949. Study of metamorphosis in parts of pupæ cut transversely at various times after pupal molt. [P. B.]

Bounhiol, J. J., M. Gabe, & L. Arvy, "Données histophysiologiques sur la neuro-secretion chex *Bombyx mori* L. et sur ses rapports avec les glandes endocrines" [in French]. *Pubbl. Staz. zool. Napoli,* vol. 24, suppl. 1: pp. 52-53. 1954. Abstract.

Buck, John, & Margaret Keister, "Cyclic CO_2 release in diapausing pupæ — II. Tracheal anatomy, volume and pCO_2; blood volume; interburst CO_2 release rate." *Journ. Insect Physiol.,* vol. 1: pp. 327-340, 4 figs. 1958. Work done on *Agapema galbina* & *Hyalophora cecropia* pupæ. [P. B.]

Bückmann, Detlef, "A morphological color change controlled by molting hormone in Lepidoptera." *Biol. Bull.,* vol. 113: p. 326. 1957. *Cerura vinula;* abstract.

Bückmann, Detlef, "Die Wirkung des Metamorphosehormons der Insekten" [in German]. *Bericht über die Hundertjahrfeier der Deutschen Entomologischen Gesellschaft, Berlin*: pp. 238-249, 2 figs. Berlin: Akademie-Verlag. 1957. Review of current knowledge of hormonal control of insect metamorphosis. [P. B.]

Bückmann, Detlef, "Die Wirkung des Prothorakaldrüsenhormons als Farbwechselhormon bei Schmetterlingsraupen" [in German]. *Zool. Anz., Suppl. 20* (*Verhandl. Deutschen zool. Ges. in Hamburg*): pp. 220-225, 4 figs. 1957. The hormone "ecdyson" in low concentrations causes (normal) color change from green to red in abdomen of *Cerura vinula* larva ligatured at end of feeding period; higher concentrations produce metamorphosis of larval cuticle & change in shape of abdomen, but no color change. [P.B.]

Busnel, René Guy, & Andrée Drilhon, "Sur les ptérines de la chrysalide de *Pieris brassicæ* L." [in French]. *Bull. Soc. zool. France,* vol. 74: pp. 21-23. 1949. Two pterines found in pupa, bound to protein and probably acting as enzymes. [P. B.]

Butenandt, Adolf, "Über Wirkstoffe des Insektenreiches. I. Zur hormonalen Regulation der Metamorphose" [in German]. *Naturwiss. Rundschau,* vol. 7: pp. 355-358, 5 figs. 1954. Review of processes in endocrine control of insect metamorphosis; report of isolation of pure hormone (from *Calliphora,* but effective in saturniids). [P. B.]

Butenandt, Adolf, "Über Wirkstoffe des Insektenreiches. II. Zur Kenntnis der Sexual-Lockstoffe" [in German]. *Naturwiss. Rundschau,* vol. 8: pp. 457-464, 7 figs. 1955. Review of knowledge of sex attractants in insects. [P. B.]

Butenandt, Adolf, "Wirkstoffe des Insektenreiches" [in German]. *Nova Acta Leopoldina,* N. F., vol. 17: pp. 445-471, 13 figs. 1955. Describes purification and properties of metamorphosis hormone (ecdyson) and of sex attractant of *Bombyx mori.* [P. B.]

Callahan, Philip S., "Oviposition response of the imago of the Corn Earworm, *Heliothis zea* (Boddie), to various wave lengths of light." *Ann. ent. Soc. Amer.,* vol. 50: pp. 444-452, 4 figs. 1957. Greater numbers of eggs were laid, and greater numbers of adults rested, on surfaces illuminated with shorter wave lengths. No difference in response to normal and polarized light was observed. More eggs were laid on lighted surfaces than on plants. [P. B.]

Chino, Haruo, "Conversion of glycogen to sorbitol and glycerol in the diapause egg of the *Bombyx* silkworm." *Nature,* vol. 180: pp. 606-607, 1 fig. 1957.

Clark, Edgar W., "A review of literature on calcium and magnesium in insects." *Ann. ent. Soc. Amer.,* vol. 51: pp. 142-154. 1958.

Danilevsky, A. S., "Photoperiodism as a factor of formation of geographical races in insects" [in Russian; English summary]. *Rev. Ent. URSS,* vol. 36: pp. 5-27, 10 figs. 1957. Mode of adaptation of polycyclic "long-day" species, chiefly *Acronycta rumicis* & *Spilosoma menthastri.* [N. O.]

Denucé, J. M., "Microélectrophorèse des proteins de l'hémolymphe des larves de *Galleria mellonella*" [in French]. *Ann. Soc. Roy. zool. Belg.,* vol. 86: pp. 151-156, 3 figs. 1956. Study of protein content of blood and its changes in the late larval and prepupal stages. [P. B.]

Denucé, M., "Over de aanwezigheid van polyphenol oxidase in de hemolymphe van *Galleria mellonella*" [in Flemish]. *Arch. intern. Physiol. Biochem.,* vol. 65: p. 161. 1957.

Fodor, Paul J., "The specificity of the lipases and esterases contained in the larvae of the Silkworm (*Bombyx mori* L.)" [in English; German summary]. *Enzymologia,* vol. 13: pp. 66-72. 1948. Gives evidence that lower and higher esters are split by different enzymes. [P. B.]

von Frisch, K., "Wie Insekten in die Welt schauen" [in German]. *Studium generale,* vol. 10: pp. 204-210, 7 figs. 1957. Summary of structure & function of insect compound eye, with special reference to perception of different wavelengths and of polarized light. [P. B.]

Frost, S. W., "The insect repellent lamp?" *Ent. News,* vol. 67: pp. 261-263, 2 figs. 1956. Fewer insects attracted to yellow lamp than to white lamp. [P. B.]

Fukuda, Soichi, "Factors determining the production of the non-diapause eggs in the Silkworm." *Proc. Japan Acad.,* vol. 27: pp. 582-586. 1951. *Bombyx mori* eggs incubated in dark at 15° C. produce moths which develop without diapause; but if brain is removed from moth directly after pupation, eggs laid enter diapause. The factor producing diapause is produced by the subesophageal ganglion in the absence of the suppressing effect of the brain. [P. B.]

Fukuda, Soichi, "The production of the diapause eggs by transplanting the subesophageal ganglion in the Silkworm." *Proc. Japan Acad.,* vol. 27: pp. 672-677. 1951. Transplanting ganglion from *Bombyx mori* larvæ which would, as adults, lay diapausing eggs, to other larvæ which normally would not, results in laying of diapausing eggs by recipients. Subesophageal ganglia from *Lymantria dispar, Dictyoploca japonica,* or *Antheræa* larvæ were equally effective. [P. B.]

Fukuda, Soichi, "Function of the pupal brain and subesophageal ganglion in the production of non-diapause and diapause eggs in Silkworm." *Annot. zool. japon.,* vol. 25: pp. 149-155. 1952.

Fukuda, Soichi, "Determination of voltinism in the univoltine Silkworm." *Proc. Japan Acad.,* vol. 29: pp. 381-384. 1953. Evidences, from transplantation experiments, that brain stimulates production of egg-diapause hormone by subesophageal ganglion; in univoltine race this normally takes place and all eggs enter diapause. [P. B.]

Fukuda, Soichi, "Determination of voltinism in the multivoltine Silkworm." *Proc. Japan Acad.,* vol. 29: pp. 385-388. 1953. Presents evidence that in multivoltine races of *Bombyx mori* the production of egg-diapause hormone by the subesophageal ganglion is inhibited by the brain; in some races the occurrence of this inhibition depends on environmental conditions during development. [P. B.]

Fukuda, Soichi, "Alteration of voltinism in the Silkworm following transection of pupal œsophageal connectives." *Proc. Japan Acad.,* vol. 29: pp. 389-391. 1953. Shows that controlling effect of brain on production of egg-diapause hormone by subesophageal ganglion operates mainly by way of connectives. [P. B.]

I. TECHNIQUE

Adams, C. Vyvyan, "Preservation of lepidopterous larvæ and pupæ." *Turtox News,* vol. 32: pp. 214-216, 1 fig. 1954. Describes inflation technique for larvæ, and alcoholic storage following fixation. [P. B.]

Adams, C. Vyvyan, "A method of preserving Lepidoptera." *Turtox News,* vol. 33: pp. 122-124, 1 fig. 1955. Describes method of setting adults. [P. B.]

Adams, C. Vyvyan, "Papering, relaxing and treatment of grease." *Turtox News,* vol. 33: pp. 66-68, 1 fig. 1955. Useful notes on field technique. Recommends trichloroethylene for removing grease. [P. B.]

Amanshauser, Hermann, "Leuchten mit Ultra-Licht" [in German]. *Zeitschr. wiener ent. Ges.,* vol. 41: pp. 3-9. 1956. Describes advantages & disadvantages of several types of UV light. Recommends setting light before house wall or white sheet. Notes on attractiveness to different groups of moths. Annotated list of spp. taken in Salzburg. [P. B.]

Amiot, Ph., "Conseils pratiques pour l'élevage des chenilles" [in French]. *Bull. Soc. ent. Mulhouse,* 1956: pp. 25-28, 1 fig. 1956. Advice on rearing methods, in glass jars or in sleeves on foodplant. [P. B.]

Anonymous, "Field work." *Ent. Rec. & Journ. Var.,* vol. 67: pp. 241-244, 1 fig. 1957. Describes technique for pupa-digging. [P. B.]

Anonymous, "Field work." *Ent. Rec. & Journ. Var.,* vol. 70: pp. 22-25, 50-53. 1958. Notes on care of wintering pupæ. [P. B.]

Barth, Rudolf, "Métodos de trabalho no anatomia e histologia entomológica" [in Portuguese & German]. *Mem. Inst. Oswaldo Cruz,* vol. 51: pp. 95-186. 1953. Describes special procedures in preparing insect material for microscopic examination. Gives a list of especially suitable subjects for preparation, with recommended procedures. A very useful work, by a leading student of morphology of Lepidoptera. [P. B.]

Baynes, E. S. A., "Attracting insects by ultraviolet light." *Ent. Gaz.,* vol. 1: pp. 159-160. 1950.

Beirne, Bryan P., "Some notes on the design of light traps." *Ent. Gaz.,* vol. 2: pp. 259-262, 6 figs. 1951. Notes that funnel-type traps are relatively inefficient for light-bodied, slow-flying spp. Suggests a box-type trap with glass or plastic plates on all sides sloping in to narrow horizontal slits. [P. B.]

Bretherton, R. F., "The behaviour of moths at light traps: a comment." *Ent. Gaz.,* vol. 1: pp. 102-104, 1 fig. 1950. Criticism of Robinson's theories and light-trap technique; reply by H. S. and P. J. M. Robinson, pp. 105-107. [P. B.]

Bretherton, R. F., "Moth traps and their lamps: an attempt at comparative analysis." *Ent. Gaz.,* vol. 5: pp. 145-154. 1954. Comparison of catches at several types of ordinary and mercury vapor light traps (in different seasons), with reference to families and some individual spp. as well as total catch; mercury vapor lamp generally more productive, but there are exceptions. [P. B.]

Bryk, Felix, "Entspricht die heute übliche Spannstellung der präparierten Schmetterlinge den wissenschaftlichen Forderungen? (Lepidoptera)" [in German]. *Ent. Tidskr.,* vol. 74: pp. 69-74, 1 fig. 1953. The customary method of spreading destroys natural pattern without revealing all wing markings. Recommends spreading one hind wing to overlap the fore wing, which will make all surfaces visible. [P. B.]

Buck, F. D., "Black and white entomological drawings for reproduction." *Proc. Trans. south London ent. nat. Hist. Soc.,* 1954-55: pp. 160-179, 19 figs. 1956. Useful summary of techniques for line drawing and shading. [P. B.]

Burmann, Karl, "Spinnennetze und Bergseen als Fundgruben für die Lepidopterensammler" [in German]. *Zeitschr. wiener ent. Ges.,* vol. 37: pp. 10-14. 1952. Spiderwebs and the water surface in alpine ponds & pools are useful sources of specimens, valuable for distribution records if not for mounting. [P. B.]

Castle Russell, S. G., "Suitable killing agents." *Ent. Rec. & Journ. Var.,* vol. 64: pp. 150-151. 1952. Recommends pin dipped in oxalic acid solution. [P. B.]

Chamberlain, W. F., "An improved ethyl acetate jar for trap light collecting." *Journ. econ. Ent.,* vol. 49: p. 702. 1956. Instead of putting plaster of paris as a layer in the bottom of the jar only, the jar is rotated while plaster is still liquid, and a layer placed around the sides of the jar. [W. C.]

Clarke, C. A., "Breeding the Large Blue butterfly in captivity." *Ent. Rec.,* vol. 66: pp. 209-210, 4 pls. 1954. Useful notes on rearing the myrmecophilous lycænid, *Maculinea arion.* [P. B.]

Clarke, C. A., & P. M. Sheppard, "Hand-pairing of butterflies." *Lepid. News,* vol. 10: pp. 47-53, 3 figs. 1956.

Cloudsley-Thompson, J. L., "The design of entomological aktograph apparatus." *Entomologist,* vol. 88: pp. 153-161, 8 figs. 1955. Describes various types of apparatus designed to record the activity of individual insects under experimental conditions. [P. B.]

Dasch, Clement E., "Larval inflation technique." *Turtox News,* vol. 33: pp. 216-217, 3 figs. 1955. Recommends inflating by hypodermic needle connected to beach ball (for easy control of pressure), and drying in flask which has been preheated on sand bath. [P. B.]

David, W. A. L., "Breeding *Pieris brassicæ* L. and *Apanteles glomeratus* L. as experimental insects." *Zeitschr. Pflanzenkrankh.,* vol. 64: pp. 572-577, 3 figs. 1957. Describes technique for continuous mass rearing of this butterfly and its parasite. [P. B.]

Deay, H. O., & J. G. Taylor, "Preliminary report on the relative attractiveness of different heights of light traps to moths." *Proc. Indiana Acad. Sci.,* vol. 63: pp. 180-184, 2 figs. 1954. Recommends 2 traps, at ground level and at 12-16 feet on same pole, for survey work. [P. B.]

Dexter, Ralph W., "Another improved technique in making cyanide killing jars." *Turtox News,* vol. 31: p. 61. 1953. Recommends covering sawdust layer with absorbent paper before pouring in plaster. [P. B.]

Doull, K. M., "An electrified barrier for caterpillars." *Nature,* vol. 176: p. 842. 1955. Describes a method of preventing wandering of larvæ from an uncaged area. [P. B.]

Driesbach, R. R., "Preparing and photographing slides of insect genitalia." *Syst. Zool.,* vol. 1: pp. 134-136, 2 pls. 1952. Describes procedure beginning with removal of genitalia. Based on experience with psammocharid wasps. [P. B.]

Dufay, C., "Chasse de coléopteres et lépidoptères a la lampe a vapeur de mercure" [in French]. *Bull. mens. Soc. linn. Lyon,* vol. 19: pp. 44-45. 1950. Mercury vapor lamp reported to attract greater number of individuals than incandescent lamp of same power. [P. B.]

Dufrane, A., "Technique — contre la moisissure" [in French]. *Lambillionea,* vol. 54: pp. 89-90. 1954. Technical note on protection against moisture: alcohol, chloroform, and solution of paradichlorobenzene in carbon tetrachloride. [P. V.]

Fischer, Ch., "Quelques conseils pour faire pondre les femelles fécondés de papillons" [in French; summary in Esperanto]. *Bull. Soc. ent. Mulhouse,* 1947: pp. 58-60. Technique for inducing oviposition; particular habits of some families noted. [P. B.]

Friend, W. G., "A vibration-resistant instrument stand." *Canad. Ent.,* vol. 87: pp. 187-188, 1 fig. 1955.

Frost, S. W., "The Pennsylvania insect light trap." *Journ. econ. Ent.,* vol. 50: pp. 287-292, figs. 1957. Comparative captures of 12 varying types of light traps at State College, Penn. [W. C.]

de Giusti, Dominic, & Leon Ezman, "Two methods for serial sectioning of arthropods and insects." *Trans. Amer. micr. Soc.,* vol. 74: pp. 197-201. 1955. Describes fixation, embedding, sectioning, and section handling techniques suitable for insects, including larvæ of Lepidoptera. [P. B.]

Gozmány, L. A., "The examination of Microlepidoptera cœnoses mining on trees" [in English; Hungarian summary]. *Acta zool. Acad. Scient. Hungaricæ,* vol. 1: pp. 53-67. 1954. Describes a method of determining composition of leaf-mining communities by defoliating trees in fall and identifying the mines. This method gives more reliable information than adult trapping. Considerable information on the communities on *Quercus* spp., *Sorbus terminalis,* and *Frangula alnus.* [P. B.]

Gray, P. H. H., "An apparatus for the rapid sorting of small insects." *Entomologist,* vol. 88: pp. 92-93, 1 fig. 1955. Describes device for spreading out light-trap catch; insects are allowed to slide through inclined paper cylinder onto sorting plate. [P. B.]

Gray, P. H. H., "An apparatus for weighing small insects." *Lepid. News,* vol. 9: pp. 58-60, 1 fig. 1955.

Gray, P. H. H., "Mold-free relaxing bottles for Lepidoptera." *Lepid. News,* vol. 11: p. 54. 1958.

Green, G. W., W. F. Baldwin, & C. R. Sullivan, "The use of radioactive cobalt in studies of the dispersal of adult females of the European Pine Shoot Moth, *Rhyacionia buoliana* (Schiff.)." *Canad. Ent.,* vol. 89: pp. 379-383, 2 figs. 1957. Cobalt, applied to abdomen in glue solution, did not affect behaviour of animals and permitted their recovery after one to several days. [P. B.]

Haeger, E., "Aus meiner Lichfangpraxis" [in German]. *Bericht über die Hundertjahrfeier der Deutschen Entomologischen Gesellschaft,* Berlin: pp. 199-203. Berlin: Akademie-Verlag. 1957. Notes on light-trap technique, & on fauna of Mark Brandenburg. [P. B.]

J. MISCELLANEOUS

Akester, W. J., "A cross-pairing of *Dilina tiliæ* (L.) ♀ and *Laothoe populi* (L.) ♂ (Lepidoptera: Sphingidæ)." *Ent. Gazette,* vol. 7: p. 96, 1 pl. 1956. Without issue; pair figured. [P. B.]

Allan, P. B. M., "The 'trade' in the nineties." *Ent. Rec. & Journ. Var.,* vol. 69: pp. 274-277. 1957. Notes on dealers in Lepidoptera. [P. B.]

Amsel, H. G., "Erinnerungen an Carl Börner" [in German]. *Zeitschr. wiener ent. Ges.,* vol. 39: pp. 152-166, 1 fig. 1954. Memories of an outstanding entomologist. Concludes with some recent correspondence between Börner and Amsel, devoted mainly to the phylogeny of Lepidoptera. [P. B.]

"An Old Moth Hunter" [P. B. M. Allan], "A good year." *Ent. Rec. & Journ. Var.,* vol. 69: pp. 277-279. 1957. Collecting in Britain in 1898. [P. B.]

Beirne, Bryan P., "Some critical comments on the study of British Lepidoptera." *Ent. Gaz.,* vol. 3: pp. 197-212. 1952. Points out how much remains to be learned even in Britain, and suggests some particular lines of investigation, which would be worth while in other countries also. [P. B.]

Betz, J. T., "Que doit-on entendre par 'Rareté'?" [in French]. *Lambillionea,* vol. 56: pp. 82-88. 1956. Notes & discussion about the so-called "scarce species." [P. V.]

Bischoff, H., "Hundert Jahre Deutsche Entomologische Gesellschaft" [in German]. *Bericht über die Hundertjahrfeier der Deutschen Entomologischen Gesellschaft, Berlin*: pp. 27-43. Berlin: Akademie-Verlag. 1957. History of society. [P. B.]

Boursin, Charles, & G. Warnecke, "Bitte um Mitarbeit!" [in German]. *Zeitschr. wiener ent. Ges.,* vol. 41: pp. 209-210. 1956. Announcement of projected work on Noctuidæ of central Europe, and request for information on distribution of a first list of spp. ("Agrotinæ" & "*Bryophila*"). [P. B.]

Bradley, P. L., "An assemblage of arthropod remains from a Roman occupation site at St. Albans." *Nature,* vol. 181: pp. 435-436. 1955. Including *Arctia caja* puparium. [P. B.]

Brown, F. Martin, "The Wheeler expeditions to the southwestern United States, 1869-76." *Lepid. News,* vol. 9: pp. 124-126. 1955.

Brown, F. Martin, "Itineraries of the Wheeler Survey naturalists 1871 — Theodore L. Mead." *Lepid. News,* vol. 9: pp. 185-190, 1 map. 1956.

Bryk, F., "Wer hat Linnés *Papilio Deianira* erbeutet?" [in German]. *Ent. Tidskr.,* vol. 74: pp. 100-101. 1956. Question whether Schreber or Schaller collected type of *Pararge achine dejanira;* unimportant in itself, but casts doubt on correctness of Linnæus' identification of collectors and, therefore, of his localities. [P. B.]

Cass, L. M., "A unique association of two species of Lepidoptera." *Canad. Ent.,* vol. 89: p. 484, 1 fig. 1957. Egg of *Pieris rapæ* laid on larva of *Plutella maculipennis.* [P. B.]

Crane, Jocelyn, "Keeping house for tropical butterflies." *Nat. geogr. Mag.,* vol. 112: pp. 193-217, 32 figs. 1957. Popular account of New York Zoological Society work at Simla, Trinidad, on courtship behaviour and other aspects of butterfly biology; superb color photos of various stages, mainly Heliconiidæ. [P. B.]

Daniel, Franz, Hans Forcher-Mayr, & Josef Wolfsberger, "Aufruf zur Mitarbeit an einer Lepidopteren-Fauna von Südtirol" [in German]. *Zeitschr. wiener ent. Ges.,* vol. 41: pp. 326-327. 1956. Appeal for assistance in preparation of work on Lepidoptera of this region. [P. B.]

Diakonoff, A. N., "Obituary Alesandr Mikhailovich Djakonov." *Ent. Berichten,* vol. 17: pp. 114-115, 1 fig. 1957.

Diakonoff, A. N., "Aleksandr Mikhailovich Djakonov (1888-1956)." *Lepid. News,* vol. 11: pp. 55-56. 1958.

Eisner, C., "In Memoriam Felix Bryk" [in German]. *Ent. Berichten,* vol 17: p. 78. 1957.

Eisner, C., "Felix Bryk (1882-1957)." *Lepid. News,* vol. 11: p. 55. 1958.

Esaki, Teiso, "History of entomology in Japan. (1) The Yedo Era" [in Japanese]. *Shin Konchu,* vol. 5, nos. 8-12; vol. 6: no. 1; 35 pp., 21 figs. 1952, 1953. Many

accounts on the history of lepidopterology in Japan included. Excellent work by the outstanding author. [T. I.]

Esaki, Teiso, "A chat on the 'National Butterfly'" [in Japanese]. *Trans. lep. Soc. Japan,* vol. 4: pp. 1-4, 3 figs. 1953. *Papilio xuthus* gained 75 votes against 34 votes for *Sasakia charonda* (Nymphalidæ) in a ballot sponsored by *Zephyrus* (1936), but failed to obtain a majority. [T. I]

Esaki, Teiso, "Foreigners' collecting in Kyûshû" [in Japanese]. *Shin Konchu,* vol. 6, no. 3: pp. 2-7. 1953. Itineraries of J. J. Rein, G. Lewis, J. H. Leech, A. E. Wileman, H. Fruhstorfer, & F. Silvestri recorded. Chronology for 1690-1939 supplemented. [T I.]

van Eyndhoven, G. L., "Merkwaardige overwintering van Lepidoptera" [in Dutch; English summary]. *Ent. Berichten,* vol. 15: p. 223. 1954. *Scoliopteryx libatrix* & *Nymphalis antiopa* hibernating together. [P. B.]

Fiori, Attilio, "Graf Emilio Turati" [in German]. *Zeitschr. wiener ent. Ges.,* vol. 37: pp. 96-98. 1952. Obituary & bibliography of Italian lepidopterist. [P. B.]

Gerris, V., "Drinkende *Apatura iris* L." [in Dutch]. *Ent. Berichten,* vol. 14: p. 386, 1 fig. 1953. Photo of butterfly sucking moisture from stone, taken at 25 cm. distance. [P. B.]

Gothan, Walther, "Über den fossilen Kautschuk" [in German]. *Sitzber. math.-natw. Kl. deutsche Akad. Wiss. Berlin.* 1949. no. 4: 24 pp., 2 pls. 1950. Describes and figures lepidopterous scales and small larvæ, magnificently preserved in gum of Middle Eocene age. [P. B.]

Harford, Henry, "Moths of the arc." *Audubon Mag.,* vol. 58: pp. 168-169, 186, 1 fig. 1956. Reminiscences on collecting at street arc light. [P. B.]

Hemming, Francis, "My highest catch of butterfly species in a single day: Digne (France), 6th August 1926." *Lepid. News,* vol. 9: pp. 144-145. 1955.

Hoffmann, Emil, "Ignaz Schiffermüller" [in German]. *Zeitschr. wiener ent. Ges.,* vol. 37: pp. 57-65. 1952. Brief biography and discussion of his work on Lepidoptera, with a list of new entities described. [P. B.]

Hoffmann, Emil, "Bemerkungen über *Parnassius apollo* L. und *P. phoebus* F. (*delius* Esp.)" [in German]. *Zeitschr. wiener ent. Ges.,* vol. 41: pp. 97-105. 1956. Posthumous publication of miscellaneous notes: on geographic origin of *P. apollo,* habitats, size differences depending on foodplant, impossibility of exterminating a species by collecting, supposed close relationship between Saturniidæ & *Parnassius.* Reports larvæ of *P. apollo* with yellow, rather than orange, spots. [P. B.]

Huard, P., "Les vietnamiens et les insectes (1)" [in French]. *Terre et la Vie,* vol. 100: pp. 109-113. 1953. Gives recipes for *Bombyx mori* pupæ. Larvæ of *Brihaspa atrostigmella* also eaten in Indochina. [P. B.]

Iwase, Taro, "The Japanese butterflies: by whom, when and where, were they named scientifically?" [in Japanese]. *New Entomologist,* vol. 2: pp. 23-52, 2 figs. 1952. Short history of scientific discovery, divided into 4 periods: 1758-1854 (Nagasaki as a centre), 1854-1867 (Hakodate as another centre), 1869-1904 (Foreign residents active), 1905 — (indigenous lepidopterists active). [T. I.]

Janmoulle, E., "Une ancienne collection de lépidoptères revient au jour" [in French]. *Lambillionea,* vol. 57: pp. 43-45. 1957. Rediscovery of an old Belgian collection: the collection of Lepidoptera of J. Jacobs. [P. B.]

Kautz, Hans, "Die Häufigkeit der Lepidopteren" [in German]. *Zeitschr. wiener ent. Ges.,* vol. 36: pp. 138-141, 1 fig. 1956. Points outh that few spp. are really rare, apparent rarity being the reflection of our ignorance of their habits; also that adult stage is least numerous. Illustrates latter point with graph of yearly fluctuation in numbers of *Pieris brassicæ* (all stages). [P. B.]

Klimesch, [J.], "S. Le Marchand†" [in German]. *Zeitschr. wiener ent. Ges.,* vol. 39: pp. 17-18. 1954. Obituary.

Kromer, Erich, "Beobachtung einer Kopula zweier *Parnassius apollo*-Männchen" [in German]. *Zeitschr. wiener ent. Ges.,* vol. 42: p. 44. 1957. Fresh ♂ succeeded in grasping with claspers abdomen of worn, dark ♂. [P. B.]

Kusdas, [K.], "Emil Hoffman†" [in German]. *Zeitschr. wiener ent. Ges.,* vol. 39: pp. 369-372, 1 fig. 1954. Obituary & list of publications of Austrian lepidopterist. [P. B.]

Kusdas, Karl, "Erwin Kranzl†" [in German]. *Zeitschr. wiener ent. Ges.,* vol. 40: pp. 210-212, 1 fig. 1956. Obituary & list of publications of Austrian lepidopterist. [P. B.]

Lea, A., "A. J. T. Janse — a biographical sketch." *Journ. ent. Soc. southern Africa,* vol. 20: pp. 5-6, 1 pl. 1957. Introduction to issue dedicated to South African Lepidopterist; followed by list of his publications, compiled by L. Vári. [P. B.]

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A TRANSPARENT LIGHT TRAP FOR THE FIELD COLLECTION OF LEPIDOPTERA

by I. F. B. COMMON

In recent years significant advances have been made in the design of insect light traps, especially by ROBINSON and ROBINSON (1950). The superiority of the Robinson trap to the Rothamsted trap (Williams 1948) for the collection of the larger Lepidoptera was demonstrated by WILLIAMS (1951). Traps constructed to the Robinson specifications are now widely used and are available commercially.

Field use of a portable trap of this kind during the summer months in Australia indicated that Coleoptera, particularly Scarabæidæ, frequently predominated in the catches. When beetle catches were high, the Lepidoptera were often so severely damaged that identification was greatly impeded. A transparent trap has therefore been designed which tends to exclude Scarabæidæ, and automatically segregates from the remainder of the catch most of those which do enter the trap. In practice this trap has proved to be extremely efficient for the collection of most insect Orders, excepting Coleoptera, and the quality of the specimens collected has been consistently high.

FEATURES OF THE TRAP

As in the Robinson trap, the transparent trap (Fig. 1) is operated on the ground with the light source completely visible from above. However, sloping transparent "Perspex" sides and funnel (A) enable the light to be seen from all sides as well. For convenient use, the dimensions of the trap have been kept small. At the same time, the slope of the funnel is steep, ensuring that few insects come to rest in it without entering the trap. To achieve this, the funnel is an inverted truncate cone, 10 inch in diameter above and 5½ inch in diameter below. The lower opening has centered within it a small opaque cone (D) upon which the lamp holder is mounted. This prevents the escape of insects once they have entered the trap. The electric lead to the lamp passes through the bottom of the trap and up through a central cylindrical core to the lamp holder, thus eliminating shadows. Provision is made for rain water to be drained through the trap, but a transparent hood (G) can be fitted above the trap during heavy rain to protect both the lamp and the catch.

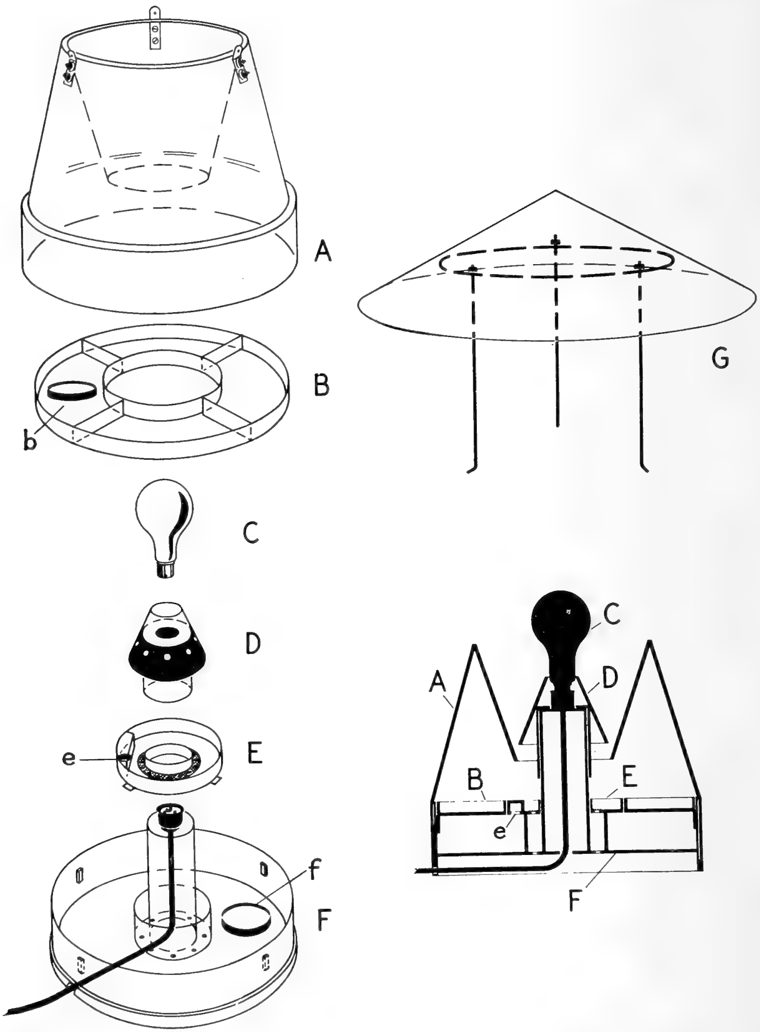

Fig. 1. Exploded view and vertical section of the transparent light trap.

In order to segregate the Scarabæidæ from the Lepidoptera, the trap is divided horizontally into an upper and a lower chamber by two shallow ring-like trays surrounding the central core of the trap. Upon entering the trap, all insects drop into the inner tray (E), but advantage is then taken of the behaviour of most scarabs to crawl rather than to fly. Whereas other insects tend to fly immediately after entering the trap, the scarabs crawl around the side of the inner tray and drop into the lower chamber (F) through the one (e) or two access holes provided. Most of the other insects, including Lepidoptera, remain in the upper chamber and drop into the outer tray (B).

The removable outer cover and the attached funnel are constructed of ⅛ inch colourless "Perspex." The remainder is made of 1/16 inch celluloid. The trap is transported when completely assembled, but can readily be dismantled to extract the catch, to charge two plaster of Paris blocks (b, f) with the killing agent, tetrachloroethane, or to clean the trap. In the field, it is normally operated with the 125 watt mercury vapour discharge lamp (c) recommended as a light source by Robinson and Robinson (1950).

Performance

Preliminary testing of the transparent trap suggested that the catches of Scarabæidæ were considerably lower than those in a Robinson trap with an opaque funnel, but that the catches of other insects were still satisfactory. The performance of the transparent trap was therefore compared experimentally with that of a similarly constructed opaque trap, using the method recommended by Williams (1951).

The two traps were operated for two hours immediately after dark on each of eight nights, each trap being tested four times in each of two comparable positions about 75 yards apart. The first four tests were on nearly consecutive nights in December, while the second four were on nearly consecutive nights in January. A Philips 160 watt blended lamp, which incorporates both a mercury vapour discharge tube and an incandescent filament, was used as the light source in each trap.

Table 1. GEOMETRIC MEANS OF INSECT CATCHES IN A TRANSPARENT AND AN OPAQUE TRAP.

	Transparent	Opaque	Significance
Total insects	942	1406	n. s.
Coleoptera	177	672	n. s
Scarabæidæ	77	475	$P < .05$
Total Lepidoptera	468	414	n. s
Microlepidoptera	324	237	n. s.

As might be expected, the catches in both traps varied greatly and, in order to avoid the overwhelming effect of very high individual catches, logarithms of the observations were used in the statistical analyses (see Williams 1951). The important difference between the two traps (Table 1) is shown in the catches of Scarabæidæ which, in the opaque trap, were so high on most nights that the softer-bodied insects were seriously damaged. The total catches of all insects in the opaque trap were higher than in the transparent, this difference being due to the Coleoptera. The difference between the catches of all Coleoptera approached significance at the 5 per cent level. The statistical analysis indicated that interchange of the position of the traps had no effect on the relative numbers of any insect group caught in the two traps.

The proportion of insects finding their way into the lower chamber varied significantly and markedly between insect groups. For all groups there was a significant increase in this proportion when two holes instead of one gave access to the lower chamber. Thus where Scarabæidæ are plentiful, two access holes are desirable to ensure a high quality in the bulk of the Lepidoptera, whereas one is sufficient where scarabs are less common. About 72 per cent of the Lepidoptera remained in the upper chamber when two access holes were provided, and this figure rose to about 87 per cent when one of these was closed. The percentage of scarabs remaining in the upper chamber similarly increased from 16 per cent with two access holes to 35 per cent with one access hole.

Table 2. GEOMETRIC MEANS OF INSECT CATCHES IN THE UPPER AND LOWER CHAMBERS OF A TRANSPARENT TRAP.

	One access hole			Two access holes		
	Upper	Lower	% in upper	Upper	Lower	% in upper
Total insects	939.7	203.7	82.2	479.0	307.6	60.9
Coleoptera	107.4	66.4	61.8	48.9	125.3	28.1
Scarabæidæ	16.4	30.4	35.0	19.2	104.2	15.6
Lepidoptera	533.3	82.3	86.6	257.0	97.7	72.5

DISCUSSION

In explaining the merits of the Robinson trap, ROBINSON (1952) pointed out that the shadow cast by the opaque funnel materially increased the insect catch. He stated that, as insects are positively phototactic only when their eyes are in the dark-adapted condition, those which fail to enter the trap on first approaching the light soon become light-adapted and no longer sensitive. Many of these settle in the area of shadow surrounding the trap, where their eyes again become dark-adapted. When further flight is attempted, these insects once more approach the light and are likely to be caught. Theoretically, this procedure may be repeated indefinitely until all the insects which approach the light source are captured.

This explanation might easily be true for Scarabæidæ and for some of the rapid-flying Lepidoptera. However, the efficiency of the Robinson trap for capturing the slower-flying Lepidoptera has been questioned both by BRETHERTON (1951) and by BEIRNE (1951). BEIRNE recognised that most slow-flying Lepidoptera approach a light source close to the ground and concluded that a box-type trap was more efficient than a funnel-type trap for these species. The great disadvantage of the box trap, like the Rothamsted trap, is that the light source is not visible from above. It therefore tends to exclude rapid-flying Lepidoptera altogether.

The present observations have shown that, when it is warm and windless, many Lepidoptera first land on the ground in the vicinity of the transparent trap and then approach it either at once or in a series of short flights close to the ground. When a light wind is blowing, they approach the trap chiefly up wind, in a series of short flights close to the ground or even by crawling along the ground. Most Scarabæidæ likewise usually land on the ground in the vicinity of the transparent trap and then usually crawl to the base of the trap, or approach it with a rapid low, somewhat circular flight. Most of the latter individuals usually strike the sloping sides of the trap and drop to the ground at the base. Seldom do they take to sustained flight again, but continue to crawl around on the ground at the base of the trap. When moths reach the base of the trap, they either crawl or flutter up the sloping surface and, once within the steep funnel, rapidly enter the trap. Some rest on the outside, but later are often disturbed by other crawling and fluttering insects and once more move up the slope towards the light source. Under all conditions, of course, some become immobilized in the vicinity of the trap, as observed by Robinson (1952).

The device described above for segregating Scarabæidæ from Lepidoptera can readily be adapted to the insect container of any light trap. It has been used successfully at Canberra for several years in a cylindrical celluloid container below a simple funnel-type trap.

Acknowledgments

The author is indebted to Mr. W. J. Rafferty and Mr. P. Fox for assistance in constructing the trap, to Mr. R. Straatman, Mr. M. S. Upton and Miss L. James for assisting in the sorting and counting of insect catches, to Mr. L. A. Marshall who prepared the line drawings, and to Mr. G. A. McIntyre for the statistical analysis.

References

Beirne, B. P., 1951. Some notes on the design of light traps. *Ent. Gaz.* 2: 259-262.

Bretherton, R. F., 1951. The behaviour of moths at light traps: a comment. *Ent. Gaz.* 1: 102-104.

Robinson, H. S., 1952. On the behaviour of night-flying insects in the neighbourhood of a bright light source. *Proc. Roy. ent. Soc. London (A)* 27: 13-21.

Robinson, H. S. & P. J. M., 1950. Some notes on the observed behaviour of Lepidoptera in flight in the vicinity of light sources, together with a description of a light trap designed to take entomological samples. *Ent. Gaz.* 1: 3-20.

Williams, C. B, 1948. The Rothamsted light trap. *Proc. Roy. ent. Soc. London (A)* 23: 80-85.

............, 1951. Comparing the efficiency of insect light traps. *Bull. ent. Res.* 42: 513-517.

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NOTES ON BUTTERFLY MIGRATIONS IN THE PENINSULA OF YUCATAN

by Eduardo C. Welling

Ever since I first began working on the fauna of the Yucatán peninsula, I have been aware of certain years conspicuous for migrations of butterflies and certain other insects. I herewith present a few notes on these observations.

As is well known, the vegetation of certain areas in the Neotropical region is determined not entirely by the average amount of rainfall over many years, but also the ability of that vegetation to resist certain dry- and wet-year periods. Therefore, in some places we might even find a comparatively raquitic flora which could be richer if unvariable yearly rainfall were present. But, as is the case, we find certain dry-year periods which tend to limit the development of the flora. These same dry- and wet-year periods appear to control the populations and relative abundance of many butterflies and other insects as well.

It is now apparent to me that most butterfly migrations occur here, at least in this peninsula, during these wet-year periods. The first year I noticed such migrations was in 1954. After having compared this year with 1955-56-57 and early 1958, I am of the opinion that it was a very wet year, and probably the tail end of a succession of wet-years. During May and June of that year, two great migrations were noticed. The first occured about the 14th to the 16th of May following a torrential downpour quite abnormal for that month. I had just returned to Chichén-Itzá from Uayémá, Yuc., where we had attended a fiesta. This migration consisted of just about everything imaginable, all flying at tree- and house-top level from south to north. Upon climbing up on the roof of my aunt's house, now pretty high up and at a good level with the branches of some tall trees immediately behind the house, I could get a good look at some of the things that were passing by, and also catch a few samples. Hundreds of pierids, especially *Anteos clorinde* Godart and *A. mærula* Fabr. passed by, the former seeming to have the apex of the primaries margined with a smoky gray color, rather unusual and quite different from the normal white-apexed form found all the rest of the year. Several *Papilio* also flew by, but as I did not know well the species during the first migration, I could not tell what they were. From atop the roof I also observed that many *Eunica tatila* H. S. and *E. monima* Cramer probably made up the bulk of the migration. A *Heliconius charitonius* Linné was caught as it stopped momentarily to inspect some leaves. Several red and orange butterflies were seen as well as various other small and medium sized things, but as I said, I was not well acquainted at that time with the fauna and could not take notes of those species which I could not catch for future reference. *Eurema* species and many *Libytheana carinenta* Cramer also were noted, as well as a single *Danaus* and a few Blues. Many Hairstreaks were noted, but after closer observation, they seemed to be swirling about the branches of the trees behind the house and not actually taking part in the migration. On the 16th of that month of May, at 5 o'clock in the afternoon, a great rainstorm came up and apparently put an end to the whole business, for the day after I saw not one butterfly engaged in what so many had been doing during the preceding days; at least not until the 18th, when once again I noticed *Anteos, Phœbis, Eurema,* and several nymphalids flying north along the Mérida-Valladolid road. On the 19th I believe the migration stopped for good.

The second migration that year was in the month of June, when in the afternoon of one day there suddenly appeared a large number of *Kricogonia lyside* Godart. This migration lasted only a few hours and was in a southerly direction. Perhaps only several hundred specimens were noticed, coming 3 or 4 at a time, in the place where I was. They were quite wary and difficult to catch, some of the difficulty arising from the fact that a strong wind accompanied them. The next four years were rather dry, being what we could probably consider a dry-year cycle. Of course there always was a certain amount of rainfall, but it was probably somewhat below the average. The season of 1957 was especially bad, not having rained for 2½ months beginning in mid-June to late August, in what should have been the height of the rainy season. It is curious to note that many species existed during these years in lesser numbers; even *E. monima* was almost completely absent if not extremely rare. No insect migrations of any sort were noticed during these years, except for a few local grasshopper plagues.

With the end of 1958, there began a marked increase of rainfall. Normally the rains cease here in the state of Yucatán about early October. However the months of October-December of that year were rather wet, with frequent rain squalls that lasted into March of this year, 1959. Most of these squalls were directly due to many "northers" that come down from the United States, which after crossing the Gulf of México and picking up much moisture, cause frequent rains along the hot lowlands of southern México. Then in May, many torrential rains fell over Quintana Roo and parts of Yucatán, giving at once a hint that we might be entering one of the wet-year periods. So far I have observed two migrations this year. The first was in Quintana Roo, between Santa Cruz, X-yatil, and Polyuc, on the 15th of May. Great swarms of *L. carinenta, E. tatila,* and *E. monima* were noticed flying at ground and tree-top level from north to south closer to the Carribean coast near Santa Cruz; and from northwest to southeast further inland at X-yatil and Polyuc. There were great numbers of them, perhaps as many as 1,000 passing by every minute per 100 feet of roadway. The whole migration covered the road for a length of about 50 kilometers.

The second migration was noticed on June 12th, from about Xocchel to Tahmek, Yuc., a distance of about 10 kilometers along the road. Here the only species were *E. monima* and *L. carinenta,* or at least these were the only ones I observed. They were both flying rather weakly, and were in worn condition, whereas the migration in Quintana Roo the month before consisted of fresh specimens in almost all cases. Here they were crossing the road at say 100 per minute for 100 feet of roadway. *E. monima* has since been common everywhere. I even took about 30 specimens at blacklight one night right here in the middle of Mérida.

Any further migrations that may possibly occur in the current season will be commented upon in the *Journal* at a later date.

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LARGE NUMBERS OF *NYMPHALIS CALIFORNICA* IN THE PACIFIC NORTHWEST IN 1959

Nymphalis californica Bdv. has been seen in very large numbers in several localities in the Pacific Northwest in 1959. My atention was first called to them on July 13 along highway 410 approaching Chinook Pass in Washington from the east. Considerable numbers of very worn, ragged specimens were flying along the road or resting where there was moisture, at 4,000 to 5,000 feet elevation. They had not been there June 30 and were practically gone by July 20. It was evident that they had come a long way. They could not have emerged locally, as I saw not more than two or three in that area in 1958.

On a trip to northern California late in July, I saw very few of this species. But returning by way of Crater Lake, Oregon, I encountered hundreds of them on August 4, flying about the rim of the lake, mostly going from north to south, perhaps just drifting with the wind. Many were lying in the road, having collided with cars. The elevation along the rim is about 7,000 feet.

On August 7, I drove to the summit of Mt. Spokane (elevation about 5800 feet) and began to see *californica* at wet spots along the road at 3,000 feet. The numbers reached a maximum at about 5,000 feet, where there were literally thousands of them, apparently flying aimlessly about or resting in the road where there was moisture. At one such spot I counted 50 in a square yard. At the summit they were also flying in considerable numbers, going in and out of the open door of the lodge, and sunning themselves on the bare rocks. Very few were on flowers. Mt. Spokane is northeast of the city of Spokane, about 425 miles from Crater Lake by airline.

On August 9 I was on Gisborne Mt., in the Priest River Experimental Forest in Bonner Co., Idaho, about 40 miles northeast of Mt. Spokane. Here there were only moderate numbers of *californica* at 4,000 to 5,000 feet.

All of the butterflies seen at Crater Lake, on Mt. Spokane and in Idaho were in fresh or nearly fresh condition. But in 1958 I was on Gisborne Mt. on July 20 and did not see any. So it is probable that in spite of the fresh-looking condition of this year's flight, they had come from some distance. But I have no information as to where they came from.

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POSSIBLE MIGRATION TENDENCIES OF *EREBUS ODORA* AND OTHER SIMILAR SPECIES

by Frank P. Sala

Having read the most interesting account of the experiences of Joseph Muller in his "An Attempt to Rear *Erebus odora* in New Jersey" (*Journ. Lepid. Soc.* 13: 17-18; 1959), the author was prompted to an answer, since Mr. Muller's problem seemed a manifestation of some thoughts the author has been investigating. The following are ideas and conclusions reached as a result of observing and collecting this species and others similar to it.

The author has had several meetings with *Erebus odora,* both here in southern California and years ago as a boy in the Rochester area of New York state. To attempt an answer Mr. Muller's question, "What is the foodplant of *Erebus odora* in New Jersey?", there probably is no foodplant for *E. odora* in New Jersey. How then does the insect get there, and why, one might ask. The author believes *E. odora* is a complete migrant visitor, and here are some reasons why.

In southern California, as along the Eastern Seaboard, *E. odora* is an occasional (probably annual) visitor. Here in southern California the insect generally undergoes one abortive generation, usually in the August-September period. Foodplants here are *Acacia delbotta* (principal foodplant) and other introduced ornamental Acacias along the coastal areas, and the native *Acacia greggi, Prosopis juliflora,* and *P. pubescens* of the deserts. *Erebus odora* is only a visitor here, however. Several factors contribute to this condition. First, *E. odora* has no diapause that the author has been able to note, passing continuously from generation to generation. Second, *E. odora* cannot tolerate frost, even fleeting freezes. The weather here in southern California, from November on, is subject to freezes at any time, and whenever they come, all activity of migrant tropical species such as *E. odora* is terminated for the year.

How then does *E. odora* come to be found here and in places like New Jersey and New York? The answer, in part, is in Mr. Muller's account wherein he says, "It (*E. odora*) was a battered specimen — but — extremely lively." This indicates a probable lengthy period of previous-to-capture imaginal life. The fact (as his account states) that it lived nineteen days in captivity allows for a probably three to four weeks or longer imaginal span. A long imaginal span is not unusual for many Lepidoptera, especially members of the Catocalinæ. The species of the genus *Catocala* all live many weeks of the summer imaginally, terminating imaginally also with the frosts of autumn. *E. odora* is in addition a strong flier, capable of long distance flights. Thus the major requirements for a migrator are present.

Little directed research has been done on the subject of migration, especially where the species are on the move singly. The author believes both *E. odora* and *Thysania zenobia* (taken in New York, but not yet seen here in southern California) are prime and spectacular examples of this category, surplus specimens leaving their normal habitat of Mexico and the West Indies during the chosen months of July and August to investigate northern areas.

It is significant that the weather patterns agree with this trend, perhaps even becoming the cause for it. Invading tropical airmasses push northward the farthest at this time. Along the Atlantic Seaboard the tropical storms and warm fronts lead the way. Likewise in the Central Plains. Along the West Coast, the northern edge of the tropical trade winds pushes the moist air from the Gulf of Mexico into the western deserts, causing sporadic and often heavy downpours, occasionally extending all the way to northern California and Nevada, along the eastern slopes of the Sierras. These airmasses possibly constitute the impetus for migration northward of hardier tropical species. In California, at least three Sphinxes, *Erinnyis ello, Pachylia ficus,* and *Erinnyis obscura* also wander in, along with several butterflies.

This account, which the author's investigations have led him to believe is the answer, in part at least, for misplaced species, is offered as food for thought. Certainly much additional effort is needed even to scratch the surface of problems like these. The author shall welcome specimen data, pro and con, and all thoughts, critical and other, as stimulus for further investigation and discussion.

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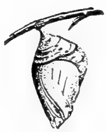

A NEW NAME FOR *PAPILIO ORION* CRAMER, A PREOCCUPIED NAME IN THE HESPERIIDÆ

by PADDY B. MCHENRY

Typhedanus crameri McHenry, new name, is proposed for *Papilio orion* (Cramer 1779) which is a homonym of both *Papilio orion* (Fabricius 1775) and *Papilio orion* (Pallas 1771).

No new name is required for *Papilio orion* Fabricius since it is a synonym of *Papilio odius* (Fabricius 1775) as pointed out to me by Mr. C. F. DOS PASSOS.

EVANS (1952) places this species in the genus *Typhedanus* Butler in his arrangement of the New World skippers.

References

Cramer, P., 1779 [1777]. *Pap. Exot.* 2: 92, pl. 155, figs. A-B.
Evans, W. H., 1952. *Cat. amer. Hesperiidæ* (2): 64, no. 1.
Fabricius, J. C., 1775. *Syst. Ent.*: p. 457, no. 60 and p. 485, no. 185.
Pallas, P. S., 1771. *Reise Russ. Reichs* 1: 471-472, no. 65.

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THE LIFE HISTORY OF *HERCULIA PHŒZALIS* (PYRALIDINÆ)

by JOHN ADAMS COMSTOCK

This species was orginally described by DYAR (*Proc. Ent. Soc. Wash.* 10: 108; 1908) from 13 examples: "Los Angeles Co., May, (A. Koebele); Los Angeles Co., Cal., (D. W. Coquillett); Santa Monica, Cal., (J. J. Rivers)." He noted that "Mr. Koebele's specimens are labeled old branches of *Cupressus* and fresh bark of orange." Dr. E. O. ESSIG (*Pan-Pacific Ent.* 1: 93; 1924) reports the species "taken in destructive numbers on Monterey Cypress at San Diego, California, June, 1924. The twigs were attacked and the cocoons, which occurred abundantly, were covered with frass and dead leaflets."

The Los Angeles County Museum collection contains examples collected at Santa Barbara, California, by CARL KIRKWOOD.

I first encountered *H. phœzalis* as larvæ in 1937, feeding on dead leaves of Lombardy Poplar, in Los Angeles. The leaves were held in an isolated crotch of the tree, and no damage to the bark or adjacent foliage was noted. Several examples were reared to maturity in the decomposing material after it was removed.

This year (1959) in Del Mar, California, I observed a large number of moths hovering over a compost heap which I had built up from dead leaves and small twigs of Monterey Cypress, Torrey Pine, Tecate Cypress, Eucalyptus, and *Adenostoma.*

This heap of rotting vegetation was not in contact with any living plant tissue. It represented three or four years of accumulation, and was heavily infiltrated with molds (fungi). It yielded large quantities of cocoons and many larvæ. The majority of the cocoons contained pupal cases that had given forth imagines in previous seasons, but a good percentage had viable pupæ.

From this investigation it was apparent that *Herculia phœzalis* is primarily a feeder on dead and rotting vegetation, including many species of plants, and that the reports of its damaging bark and live twigs was incidental to occasional close contact of infested compost with live plant tissues.

The larval habits and activities of *H. phœzalis* are apparently similar to those reported by DETHIER (*Can. Ent.* 74: 6-7; 1942) for a related species, *Herculia intermedialis* Wlk. *H. phœzalis* larvæ form fragile runways of loose silk mixed with frass, along which they travel, back and forth, while feeding. When disturbed, they wriggle backward, and drop on a strand of silk. They can be easily recovered by agitating the compost mass over a metal screen (¼ inch mesh).

EGG: Length approximately 0.75 mm. long by 0.5 mm. wide. In form, it is regularly oval. The entire surface is covered by an irregular reticulation. The color is lustrous pearl-white.

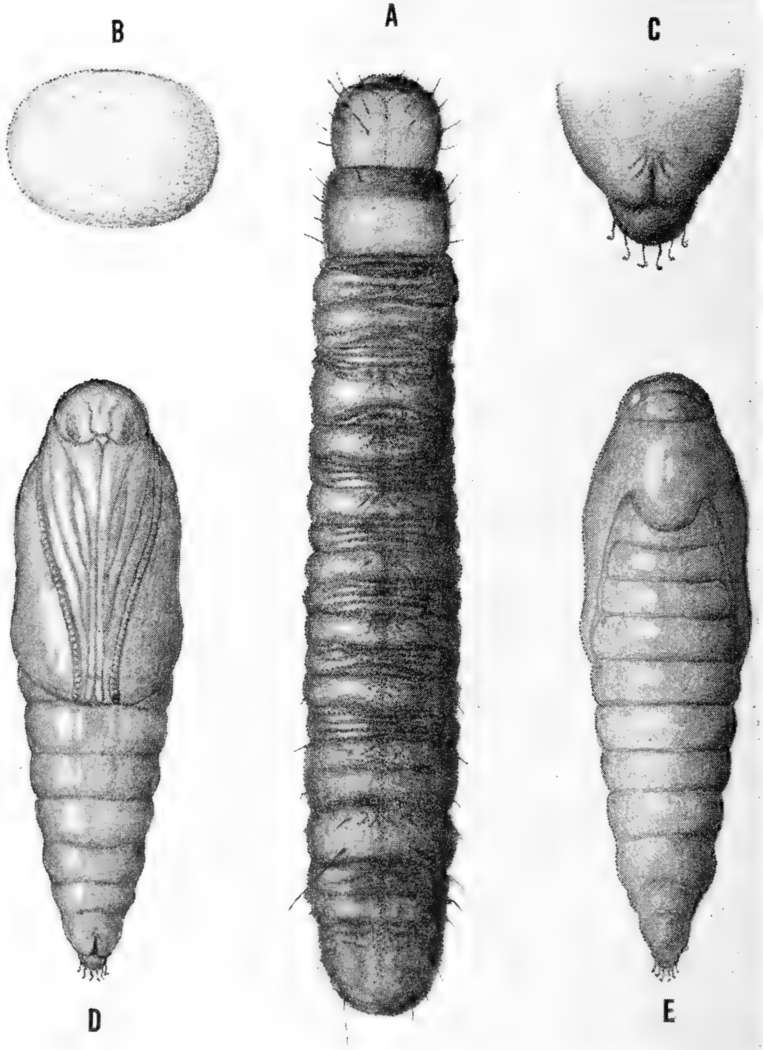

Fig. A. Mature larva, dorsal aspect, enlarged × 9. Fig. B. Egg, enlarged approximately × 45. Fig. C. Cremaster in ventral aspect, enlarged approximately × 35. Fig. D. Pupa, ventral aspect, enlarged × 10. Fig. E. Pupa, dorsal aspect, enlarged × 10. [Drawing by the author.]

MATURE LARVA: Length 15 mm. Head width 1.5 mm. The larval body is cylindrical, the head and first thoracic segment being slightly flattened and smooth, and somewhat narrower than the remaining segments.

The color is predominantly brownish-black, with a slightly lighter shade on the head and first segment, and a faint blotching of soiled yellow on the caudal area. There is a suggestion of a narrower longitudinal middorsal black stripe with an indefinite marginal band of a lighter shade, more noticeable on the caudal segments.

All of the body segments, except the head and first, are thrown into numerous transverse ridges and folds that are difficult to describe, but are accurately illustrated on the plate.

The legs are dull yellow, with black segmental junctures. The prolegs and anal prolegs are dull yellow, and the crochets, hyaline.

The spiracles are inconspicuous, and concolorous with the body.

The setæ are light yellow-brown.

PUPA: Length 7 mm. to 11 mm.; width, 2 mm. to 3.1 mm. The female pupæ are noticeably larger and more robust than the males. In shape, they are fusiform, with evenly rounded heads, and abdominal segments gradually tapering to a smaller rounded cauda. The antennæ extend to the distal margins of the wings, and the maxillæ are slightly shorter. The eyes are small, slightly protruding, and relatively close together. The spiracles are minute and inconspicuous. The cremaster is a rounded button, tipped with six recurved hooklets, in line latero-laterally, the longest about 0.1 mm. The hooklets recurve laterally.

The color of the pupa is a uniform glistening light yellow-brown, except for the darker eyes and tip of the cauda.

Herculia phœzalis being primarily a feeder on decomposing vegetation plays an important and beneficial role in converting this waste into fertilizer.

Possibly the occurrence of molds in the compost is a factor in their nutritional requirements.

Preserved larvæ and pupæ, and reared imagines, will be deposited in Peabody Museum of Natural History of Yale University.

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ON THE LIFE HISTORY OF *INCISALIA ERYPHON* (LYCÆNIDÆ) ON SOUTHERN VANCOUVER ISLAND

by George A. Hardy

Incisalia eryphon Bdv. is one of the first of the seasonal butterflies to appear in our district, being on the wing from March to May. In the spring of 1957 they were noticed in fair numbers early in April feeding on the catkins of *Salix mackenziana;* later in the month and in early May they were to be seen flitting and darting about the tips of the branches of the Lodgepole Pine *Pinus contorta* where they were busily mating or ovipositing. One or two females were confined over a twig of the pine on May 24, 1957. These had laid several ova at the base of the needles of new shoots by May 29.

The following observations were made: OVUM. Size 0.75 mm. by 0.50 mm.; a somewhat flattened sphere, depressed in the centre, dull due to coarse reticulations, chalky white. The larva escaped by a small hole on the side of the upper margin of the ovum. It did not eat the remaining part of the shell. The first ovum hatched on June 1, 1957, others in succession for the next day or two. 1ST INSTAR. June 1. Length 1.5 mm. Head light brown. Body onisciform, honey colour, lighter on the sides. The larva commenced feeding by eating a small hole through the sheath at the base of the needle and then it burrowed in to feed on the soft and succulent base. 2ND INSTAR. June 12. Length 5 mm. Colour a dark honey-brown, two lighter lines on dorsum, scattered long hairs with minute papillæ between. 3RD INSTAR. June 25. Length 8-10 mm. Head brown. Body apple green, subdorsals and spiracular lines cream colour, segments covered with a fine light brown pile. The larva feeds on the base of the needles, the part above the sheath dropping off as the base is consumed. Having finished one needle the larva moves to the base of the next, always first boring a hole through the hyaline sheath. 4TH INSTAR. July 1. Length 15 mm. Head as before. Body tapering slightly from head to anal segment. Colour a rich velvet green with the four cream stripes clearly indicated; a fine short, brown pile covers the segments. As the larva grows, it feeds openly on young needles, where the green colour broken up by the cream stripes renders it inconspicuous.

On July 20 the larva is now full fed measuring 20 mm. in length. Colour and markings as before. It has left the twig and sought a corner of the cage where first spinning a silken mat it anchored itself by the cremaster and a silken girdle round the thorax. Other larvæ pupated among the debris at the bottom of the cage, without any obvious fixation. PUPA. Size 10 mm. by 4 mm., dumpy, a uniform dark brown colour. A small tuft of short undifferentiated hairs replaces the more definite cremaster of most species of Lepidoptera. Head and abdominal segments covered with fine hairs which are absent on the thorax and wing cases; wing cases finely etched with numerous short feathered lines. Abdominal segments closely and finely punctuate. IMAGO. Emerged, March 26-28, 1958.

Provincial Museum, Victoria, B. C., CANADA

THE BUTTERFLIES OF MISSISSIPPI—SUPPLEMENT NO. 1

by BRYANT MATHER and KATHARINE MATHER

Information developed since "The Butterflies of Mississippi" went to press permits two species to be moved from the "probable or possible" list to the list of those known to occur and requires two of those listed as "known" to be moved to the probable or possible category. Thus there are still 122 species known to occur in Mississippi. Information on these four species is summarized below; the numbers are those used in the check list and in the annotated list:

37. *Strymon favonius* (J. E. Smith). *S. favonius* was included on the basis of a letter stating that a specimen had been found in the collection of the American Museum of Natural History. We have now examined this specimen and discussed it with Prof. A. B. KLOTS. It is *Strymon ontario. S. favonius* is therefore not yet known to occur in Mississippi. This specimen however extends the known range of occurrence of *S. ontario* in Mississippi from Hinds Co. in the central section to the Gulf Coast— Biloxi, Harrison Co.

88. *Erynnis baptisiæ* (Forbes). *E. baptisiæ* was included on the basis of two ♀♀ taken at Clinton, Hinds Co., on 8 and 9 June 1951. The one taken on 8 June was examined by Mr. JOHN M. BURNS of the University of California, together with 535 other specimens of various species of *Eyrnnis* from our collection, and determined to be *Erynnis zarucco*. Since the other specimen was taken at the same locality one day later, we assume that it too is *E. zarucco* and that *E. baptisiæ* is not yet known from Mississippi.

130. *Strymon kingi* Klots & Clench. We took two ♂♂, one each on 30 May and 1 June 1958 at Brownsville, Hinds Co. Both were resting on leaves in the shade along side a dirt road. They were examined at the AMNH by Prof. KLOTS and determined as *S. kingi.* These dates suggest that *S. kingi* occurs in central Mississippi at about the same time that it occurs in the Atlanta, Georgia, area since Mr. LUCIEN HARRIS JR. told us that it is most abundant there during the last week in May. This occurrence extends the recorded range by about 220 miles southwest from Sipsey, Walker Co., Alabama.

160. *Lerodea neamathla* Skinner & Williams. We took a male on 2 August 1958 at Ocean Springs, Jackson Co. It was examined by Prof. KLOTS at the AMNH, compared with EVANS' figure of the ♂ genitalia, and determined as *L. neamathla.* Ocean Springs is only about 45 miles from Mobile, Ala., the locality of the specimen figured by KLOTS (1951).

Two species may be removed from, and one added to, the list of those of which only a single Mississippi specimen is known. *S. favonius* is removed and *L. neamathla* added, as described above. *Amblyscirtes carolina* is removed since Mr. and Mrs. E. C. ROSHORE took a second specimen at Brownsville, Hinds Co., on 15 June 1958, very close to the locality where they took the previous specimen on 2 September 1957. These dates may be compared with the report by the CLARKS that there appeared to be three broods in Virginia: March-April, May-August, and August-September.

Numerous additions to the data for distribution of species in time and space could be recorded. The most recent is the record of the occurrence of *Euptychia hermes sosybia* in Mississippi in February (Raymond, Hinds Co., 28 February 1959).

A significant deletion from the data on distribution in time is the deletion of the September record given in Table 3 for *E. brizo brizo*. HUTCHINS (1933) reported: "*Thanaos brizo somnus* Lint. One specimen in State College collection determined by Dr. H. G. Dyar." Through the courtesy of Dr. HUTCHINS, we borrowed this specimen for determination. The label reads: "26 Sept 1928, Utica, Hinds Co., Miss., F. Lewis, feeding on *Daubentonia longifolia,* determined by H. G. Dyar." Before sending this specimen to Mr. JOHN M. BURNS, we had been unable to obtain a determination of it. Mr. BURNS advises: "The specimen, though very worn, clearly possesses a set of hyaline spots and is a *zarucco* ♀." With the correction of this error, the flight period of *E. b. brizo* in Mississippi is now confined to February, March, and April; and *E. b. somnus* may be deleted from the Mississippi list. The association with *Daubentonia* is consistent with the reference in KLOTS (1951) to *Sesbanea grandiflora* as a foodplant of *E. zarucco* in Cuba.

We have noted seven typographical errors in "The Butterflies of Mississippi," as follows:

p.69, col.2, item 10, for "*tucgeri*" read "*tuckeri*"

p.81, par.37, 3rd line from end, for "AMNM" read "AMNH"

p.85, par.53, 3rd line from end, for ""Septembre" read "September"

p.99, par.118, lines 3-4, delete "through July and September"

p.102, par.159, line 2, for "Klotz" read "Klots"

p.104, Table 3. line 59, for "*curytheme*" read "*eurytheme*"

p.105, Table 3, line 105, for "*alabamac*' read "*alabamæ*"

We plan to prepare additional supplements as further data are developed. We are compiling data on Mississippi moths with the hope of publishing at a future date. We would greatly appreciate any data that can be sent to us as well as comments, suggestions, and notation of other errors in "The Butterflies of Mississippi".

References

Hutchins, Ross E., 1933. Annotated list of Mississippi Rhopalocera. *Canad. Ent.* 65: 210-213.

Klots, Alexander B., 1951. *A field guide to the butterflies.* Houghton Mifflin Co., Boston, 349 pp.

Mather, Bryant, & Katharine Mather, 1958. The butterflies of Mississippi. *Tulane Stud. Zool.* 6: 63-109, 6 figs.

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FLUORESCENCE IN THE COLORS OF CERTIAN LEPIDOPTERA OBSERVED UNDER ULTRAVIOLET LIGHT

by LEONARD S. PHILLIPS

The type of light used for the following observations was a General Electric Purple X 250-watt lamp. This lamp is a weak source of ultraviolet since it is in the 3200-4000 Angström unit region. It was used because it was a simple convenient source, requiring no auxiliary operating equipment, except that it was placed in a reflector which could be held in the hand so that the lamp could be moved about freely. The bulb gets very hot since it must absorb much energy and for that reason it should be operated not more than five minutes at a time.

Certain colors or pigments in our North American Lepidoptera are more or less fluorescent under ultraviolet light. Some species are more so than others, whereas some show no signs of fluorescence. The fluorescence as observed in our Lepidoptera is not particularly brilliant especially as compared to some of the tropical and exotic species which show a very brilliant fluorescence when exposed to ultraviolet light. The intensity of the fluorescent color of our Lepidoptera for the most part is approximately the same as the colors are under ordinary so-called white light or daylight. Species with structural colors such as the Morphos and Uranias, as would be expected, definitely do not fluoresce. These observations are based on 3122 specimens and 1069 species which have been viewed under the ultraviolet light, all from the author's own collection.

The orange-brown colors which are found in the Nymphalidæ fluoresce in varying shades of red and red-orange from dull to bright. The dark markings do not show any visible signs of fluoresence. The silver-white spots on the undersides of our eastern *Speyeria* species appear pale silver-lavender under the black light. The reddish-brown markings in our western *Euphydryas* become bright red, and the white spots are creamy white. The orange-brown areas of the genera *Melitæa* and *Phyciodes* fluoresce a bright red color. *Polygonia satyrus* Edw. is a bright red whereas the other *Polygonia* are not so bright. The yellow border on the wings of *Nymphalia antiopa* L. becomes orange of about the same intensity as the yellow color under ordinary light. The blue spots are also blue under the ultraviolet. The red band across the wings of *Vanessa atalanta* L. is a very bright red under this light, and the white spots fluoresce white with a slight purple tint. *V. cardui* L., *V. virginiensis* Drury, and *V. carye* Hbn. are all bright red also with the orange areas fluorescing a brighter red.

The orange red spots on the undersides of the wings of *Limenitis astyanax* Fabr. become a very bright red, but the black-blue area shows no signs of fluoresence. The white band across the wings of *L. arthemis* Drury is a bright light purple. *Anæa floridalis* Johnson & Comstock, which is a red-colored butterfly ,shows up bright dark red.

The brown colors in the family Satyridæ fluoresce a dull reddish color. The yellow bands of the forewing of *Cercyonis p. pegala* Fabr. appear orange, whereas the yellow ocher colors of *Cœnonympha ampelos* Edw., and *C. ochracea* Edw. become a dark peach shade. Creamy white *C. california galactinus* Bdv. is a very lovely shade of bright pink under this black light.

Members of the family Lycænidæ do not show much fluorescence. The Theclinæ (Hairstreaks) are quite dull except for the species with red spots, which fluoresce red. The red areas in the Lycæninæ (Coppers) also fluoresce red. The colors found in the Plebeiinæ (Blues) are a purple-blue. The red band on the margin of the hindwing of *Plebeius acmon* Westwood shows a bright red fluorescence. In two specimens of *Glaucopsyche columbia* Skinner, the fluorescence was red-purple for the female and no change for the male.

The black and dark brown areas in the family Papilionidæ show no change under ultraviolet, but some of the other colors show interesting effects. In a series of several specimens of *Papilio polyxenes asterius* Stoll the yellow spots fluoresce yellow in some and orange-yellow in others. This same observation was also made in a series of specimens of *P. palamedes* Drury. Why this should occur remains a question at the moment. The yellow found in *P. cresphontes* Cramer turns orange, and the yellow of *P. zelicaon* Lucas becomes orange-yellow. The green color found in *P. troilus* L. appears the same under the ultraviolet light as under natural light, but the yellow-green marginal spots of *P. troilus ilioneus* J. E. Smith change to orange making it a very attractive looking butterfly. A series of over 24 specimens of *Papilio glaucus glaucus* L. *P. glaucus canadensis* R.&J. and *P. rutulus* Boisd. show a light yellow fluorescence in some specimens and dark yellow to orange-yellow in others. The blue color on the hindwing of the females of *P. glaucus* in the yellow-colored ones as well as the black-colored ones changes to a lovely bright purple. Both *P. marcellus* Cramer, which is black and white, and *P. eurymedon* Boisd., which is black and pale creamy white, look the same under the purple light as they look under ordinary light. The same holds true for *Parnassius clodius* Ménétriès.

The yellow colors found in the Pieridæ of both North America and other parts of the world fluoresce in varying shades of bright orange to bright red-orange. The orange colors turn to a deeper bright red-orange. The white colors appear a rather dull pinkish purple. An albino specimen of *Eurema lisa* Boisd. & Lec. from Florida fluoresced a pale blue. An outstanding example of color change was observed in a female specimen of *Pieris melete aglaope* Motsch. (f.vern.) from Japan, which is creamy white and black; it turned to a beautiful velvety rich bright red-purple burgundy color, the black markings being darker and the light area being a lighter color of burgundy. The male of this species was rather dull under the ultravoilet light.

The colors in our North American Hesperiidæ exhibit for the most part a rather dull fluorescence either reddish or reddish-orange. However, the following species show a bright red fluorescence: hindwing of *Ancyloxipha numitor* Fabr., forewing of *Polites vibex* Geyer, and the light areas of

Poanes viator Edw., *Copæodes minima* Edw., which is a bright orange color, looks like a little ruby jewel under the ultraviolet.

Now, turning to our North American moths, an interesting observation was made. There was a bright green fluorescence in the eyes of all moth specimens, the fluorescence being particularly brilliant in the eyes of the Sphingidæ, which glowed like little fire-flies. This has been reported by MERKER (1929a, 1929b). The eyes of the living Cecropia moth which emerged early from a cocoon did not fluoresce. The eyes of this same moth when freshly dead still did not fluoresce, but after the moth became dried, the eyes became green under the black light. The moth was then placed in a moist chamber and when fully relaxed the eyes again did not fluoresce, the fluorescence returning, however, when the moth became dried out again. Also it was noted that the eyes of dried butterflies were fluorescent, but not quite as brilliant as the moths. The wings of most species of the Noctuidæ are not particularly fluorescent, being somewhat dull reddish. The Catocalas, however, are very attractive under ultraviolet. *Catocala sappho* Strecker, which is light gray and dark on the forewing and black on the hindwing is a bright red-purple with dark markings. *C. relicta* Walker, which is white and black, is a bright pale purple on the white areas. The red and yellow colors fluoresce a bright red.

The very dark colored areas on the wings of our Saturniidæ do not seem to be fluorescent, but the red, yellow, brown, and reddish brown colors fluoresce in varying shades of bright red. The red colors found in *Hyalophora* (*Platysamia*) *cecropia* (L.) are especially bright red, particularly the red hairs on the thorax. The pale green of *Actias luna* (L.) does not fluoresce, but the purple-brown edges of the wings change to a very bright red. *Eacles imperialis* Drury, which is yellow with brown-lavender markings, shows an orange with brown-lavender fluorescence.

The red and yellow colors found in the Arctiidæ fluoresce red but not very brilliantly. However, all of the orange abdomens of about a dozen specimens of *Diacrisia virginica* Harris fluoresced a brilliant pale yellow, whereas the white wings were not fluorescent. The colors of the Sphingidæ fluoresce mostly in carying shades of red but with no outstanding brilliance. The eyes are particularly so, as previously noted.

Out of 203 specimens of the family Geometridæ only three showed fluorescence. The most vivid one was *Sabulodes lorata* Grote, which is a creamy white color with a faint brown line across the wings; it glowed a brilliant intense pale yellow-green under the action of the ultraviolet. *Mesoleuca gratulata,* Walker, which is black and white on the forewing and white on the hindwing was next in brilliance of fluorescence, being an intense black and white. The third specimen was *Xanthotype crocataria* Fabr., which is yellow with brown-lavender spots, fluoresced a bright red color. All of the other specimens were either red or reddish-purple but not especially brilliant, and none were outstanding.

The following species of tropical and exotic Papilionidæ are extraordinary in their brilliance of fluorescence; when viewed under ultraviolet, they actually glow like the light of a fire-fly:

Papilio alphenor Cramer ♂ (Philippines)—white spots intense pale green.
P. alphenor Cramer ♀—It is interesting to note that the white patch on hindwing does not fluoresce.
P. semperinus Haase (Philippines)—pink area becomes brilliant light red.
P. antiphulus philippus Semper (Philippines)—red spots on hindwing are brilliant red.
P. (Ornithoptera) rhadamantus Lucas ♂ (Philippines)—Hindwing golden yellow is brilliant golden yellow; same for *P.* (*Ornithoptera*) *helena hephæstus* Felder ♂ (East Indies) which is also golden yellow on the hindwing.
P. helenus nicconicolens Butler (India, Japan)—hindwing white patch is an intense pale green.
P. euchenor euchenor Guérin (New Guinea)—creamy white area is an intense pale yellow-green.
P. ambrax egipius Miske (New Guinea)—hindwing pale gray-blue patch becomes a very brilliant pale green.
P. polytes cyrus Fabricius (India)—white spots are pale green.
P. cynorta Fabricius (Africa)—white part glows pale blue.
P. gallienus Distant (Africa)—creamy white spots and band changes to pale green.
P. demodocus Esper (Africa)—light yellow markings and spots are a pale yellow-green.
P. mackinnoni E. Sharpe (Africa)—band of yellow spots are a bright pale green.
P. phorcas ansorgei Rothschild ♂ (Africa)—light green area glows pale green; the female is very dull under ultraviolet.
P. nireus lyæus Doubleday ♂ (Africa—brilliant blue band is an intense bright green.
P. bromius bromius Doubleday ♂ (Africa)—is the same.
P. rex Oberthür (Africa)—white spots are intense pale green.
P. menestheus lormieri Distant (Africa)—band of creamy yellow spots becomes brilliant pale green, and orange crescents on anal margin of hindwing glow bright red.
P. dardanus polytrophus R. & J. ♂ (Africa)—pale creamy yellow portion glows a very brilliant pale blue-green, whereas black markings do not glow at all; females are dull under ultraviolet light.
P. nobilis Rog. ♂ (Africa)—brownish yellow with reddish brown markings changes to bright red.

References

Giral, F., 1940. Pigmentos fluorescentes de insectos y bacterias. *Rev. Soc. Mexicana Hist. Nat.* 1: 243-254, 7 figs.

Lawrence, R. F., 1954. Fluorescence in Arthropoda. *Journ. Ent. Soc. S. Africa* 17: 167-170.

Merker, Ernst, 1929a. Die Pigmentverschiebungen in Netzauge der Insekten unter dem Einfluss von ultraviolettem Licht. *Zool. Jahrb.* 46 *(Abt. Allgem. Zool.)*: 297-374, 6 figs.

-----------, 1929b. Die Fluoreszens im Insektenauge, die Fluoreszens des Chitins der Insekten und seine Durchlässigkeit für ultraviolettes Licht. *Zool. Jahrb.* 46 (*Abt. Allgem. Zool.*) : 483-574, 2 pls.

Mottram, J. C., & E. A. Cockayne, 1920. Fluorescence in Lepidoptera. *Proc. Ent. Soc. London* 1920: xxxvi-xxxix.

Radley, J. A., & Julius Grant, 1935. *Fluorescence analysis in ultraviolet light.*

Rayleigh, Lord, 1930. The iridescent colours of birds and insects. *Proc. Royal Soc. (A)* 128: 624-641.

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CARADRINA MORPHEUS, A NEW RECORD FOR NORTH AMERICA OF A EUROPEAN MOTH (NOCTUIDÆ)

In 1954 while on a visit, I left with Dr. A. E. Brower at Augusta, Maine, two or three specimens of a Noctuid that I had taken at light on the balcony of my home in the city of Montreal, Prov. of Quebec. Dr. Brower did not recognize the species at the time and took them with him to Ottawa, Ont., on a trip at a later date and there, through the kindness of Dr. E. G. Munroe and Dr. D. F. Hardwick, they were identified as *Caradrina morpheus* Hufn., a common species in Europe—illustrated in Richard South's *Moths of the British Isles,* plate 151: number 5.

The captures listed below would indicate the establishment of this species in both eastern and western Canada. The seven records for British Columbia are all contained in the Canadian National Collection at Ottawa, and it is through the courtesy of Dr. Hardwick that I am permitted to include these western records.

Montreal, P.Q.:—♀ 19 June 1949; ♀ 2 July 1953; ♂ & 2 ♀♀ 30 June 1954; ♀ 2 July 1954; ♀ 9 July 1954; ♂ 8 June 1955; ♀ 20 June 1955; ♀ 3 July 1955; ♂ & ♀ 2 July 1956; ♂ 4 July 1956; ♀ 12 July 1956; 2 ♀♀ 14 July 1956.

New Westminster, B. C.:—♂ 12 July 1944 (Mrs. E. Seal).

Mission City, B. C.:—♀ 6 July 1953 (W. R. M. Mason); ♀ 9 July 1953 (Edith Mason); ♀ 11 July 1953 (W. R. Mason); ♀ 17 July 1953 (S. D. Hicks); ♀ 30 July 1953 (Edith Mason).

Kamloops, B. C.:—♂ 24 June 1955 (D. A. Arnott).

A. C. Sheppard, 5554 Coolbrook Ave., Montreal, P. Q., CANADA

FIELD NOTES

A RECENT RECORD OF *ANNAPHILA ARVALIS* (NOCTUIDÆ) IN BRITISH COLUMBIA

In the B. C. Provincial Museum Report for 1952, p. 26, is a note concerning the above species of moth, and expressing the doubt as to the exact locality in British Columbia from which it was recorded.

Since that time a specimen was taken by the writer on March 10, 1958, in Saanich, Vancouver Island, from which it is concluded that the Goldstream on the label on the original specimen was evidently the Vancouver Island place of that name. To my knowlegde, this is the first record for the species in British Columbia since 1903.

Annaphila arvalis Hy. Edw. (originally recorded as *Brephos fletcheri* in British Columbia lists) is known to feed on *Montia perfoliata* in the caterpillar stage. Hence it should be looked for where that plant is known to occur; though at the time of appearance of the moth, the plant is hardly above ground.

George A. Hardy, Provincial Museum, Victoria, B. C., CANADA

SOME SPHINGID RARITIES FROM THE FLORIDA KEYS

In August, 1958, my father Edwin and myself went to southern Florida to collect sphinx moths. We spent two days and nights on the Florida Keys where collecting was better than the mainland around Miami had been. On these subtropical islands we encountered a number of sphinx moths which were new to us. We collected four specimens of *Protambulyx carterii* Rothschild & Jordan at lights on Largo and Matecumbe Key. We took one fresh male of *P. strigilis strigilis* (Linné) on Plantation Key. Two fresh male specimens of *Madoryx pseudothyreus* Grote were taken on Key Largo as well as numerous specimens of *Xylophanes pluto* Fabricius, *Erinnyis ello* Linné, *E. alope* Drury, and *Herse cingulata* Fabricius. Collecting deteriorated noticeably as we kept driving southward, with nothing to collect on Key West.

Back on the mainland a perfect female *Pholus fasciatus* Sulzer was taken near Coral Gables and a female *Cocytius antæus* Drury was taken near Belle Glade. In the northern part of the state an *Isoparce cupressi* Boisduval was taken resting on a light pole at Crystal River and a *Lapara halicarniæ* Strecker was taken at Hilliard. Over 380 specimens of Lepidoptera were taken in all in the state, and we considered the journey very successful. It is my own belief that the majority of the sphinx moths taken on the Keys were representatives of an endemic population rather than "mere stragglers" because of their freshness. H. A. Freeman of Garland, Texas, and William E. Sieker of Madison, Wisconsin, kindly determined the sphingids.

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ESPECIALLY FOR FIELD COLLECTORS

(Under the supervision of FRED T. THORNE, 1360 Merritt Dr., El Cajon, Calif., U.S.A.)

FIRST IMPRESSIONS OF THE TROPICAL FORESTS OF SOUTHEASTERN BRAZIL AND THEIR LEPIDOPTERA

by E. P. WILTSHIRE

Before leaving England for Rio de Janeiro, I had noted that several subscribers of the Lepidopterists' Society inhabited that city; some of these were private citizens, others employees of at least two scientific institutions. A rapid glance at Seitz, *Macrolepidoptera of the World,* Vol. 5, had shewed me that the neighbourhood of Rio was a favourite collecting ground for Lepidoptera. It looked as though I should not be able to make any valuable scientific discoveries during a stay of a few years there, but that my outlook would be broadened.

Now, after a year at Rio, during which all too little time could be spared for entomology, I venture to summarise my impressions of the Lepidoptera of the city and its neighbourhood and of general conditions affecting their life and their study, in the hope that these may interest readers outside Brazil. They fall into the following subject headings:

The study: state of knowledge.
The butterfly industry.
The habitat: state of botanical knowledge.
Representation of groups of Lepidoptera.
Characteristic patterns, including *mimetic* and melanistic; extreme adaptations.
Phenology.
Character of the fauna.
Breeding, catching, and keeping.

THE STUDY OF LEPIDOPTERA AND THE STATE OF KNOWLEDGE

Rio is a city of about three million inhabitants. It is the federal capital of one of the largest countries in the world. Brazil's area is in fact greater than that of the U. S. A., and its population around sixty million souls. The city possesses the world's most beautiful harbour, surpassing Hong Kong and San Francisco scenically. Tropical forests, rich in dazzling butterflies and teeming with multitudes of less conspicuous forms, hem the city in on several sides and can be reached by car in half an hour from the city's centre. Air travel is the usual way of visiting parts of Brazil beyond the immediate vicinity of the place of one's residence.

The Sierra Estrela, Petropolis, southeastern Brazil.

Several biological publications are produced regularly by Brazilian institutions, providing a forum for publications of the local naturalists. Taxonomic works on Lepidoptera appearing in these are of a high quality. The number of amateur naturalists however is too low to permit the existence of periodicals catering, as in some parts of the world, especially for them. The city of Rio possesses several entomologists, both Brazilian and foreign, with a good knowledge of the butterflies and moths of the neighbourhood based on many years' experience and study, but none have a detailed knowledge of more than a few families; this is because of the great richness of the fauna, the multiplicity of species, the lack of any popularising or comprehensive work like that of SOUTH's for the British Isles, and the fact that the volumes of Seitz for the American Noctuidæ and Geometridæ have not been and can never be completed. The Seitz volumes, as far as they go, despite their incompleteness and obsolescence, are indispensable for local students; nothing else comparable is available. The Noctuidæ and Geometridæ are hardly better known than the Pyralididæ and Micros. The types, which must be inspected to identify correctly most of the Lepidoptera one may catch in Brazil (for one cannot rely on an identification based only on Seitz) are mostly to be found in London and Washington, particularly London. In these conditions the local workers are to be congratulated on their actual achievements; their friendly co-operation with visiting entomologists is also noteworthy. At the present rate of study and in view of the great number of forms I think that a hundred years of taxonomic study must elapse before Brazil's Lepidoptera can be as well known as those of Europe today. Until a general survey of the whole fauna is published, most generalisations can only be tentative, and the spread of the study in Brazil will be retarded. Lepidoptera, moreover, are better known than any other order of insect. How ridiculous therefore were the comments which one already used to hear thirty years ago, to the effect that taxonomists had completed their studies of the world's insects and entomologists should therefore turn to other aspects (non-systematic) of their subject. What can be achieved on incomplete foundations?

THE BUTTERFLY INDUSTRY

As soon as one steps ashore at Rio, one meets *Morpho* wings, displayed in the windows of curiosity shops. These dazzling blue giant butterflies provide Brazil with a minor industry and article of export. Many shops shew trays of various sizes; some have detached wings arranged in mosaics or forming part of some picture, and these are tasteless products; others on a white cotton field under a sheet of glass, shew a selection of whole (or whole, except for the abdomen) set butterflies; these offend the taste less; a third type of butterfly-curio on sale, and indeed the rarest, is a vertical transparent glass screen representing a leafy branch on which may be perched four or five choice butterflies. As international and local tastes improve, a further development of this third line seems to promise the most attractive product of the butterfly industry.

The butterflies of the genus *Morpho*, used for the above purposes, and for export to dealers all over the world are mostly produced by German professionals in Southern Brazil, *e.g.* Santa Catharina, some 500 miles distant. No other genus is demanded in such numbers; but one sees in the tray selections and screens many other beautiful forms of butterfly, and even a few moths. In order to cope with orders of thousands at a time, these professionals, of course, breed the Morphos. This practice would appear to guarantee the survival of the species so used, unlike the case of the Bird of Paradise, threatened with extinction by the feather industry. Yet all agree here that Morphos are less abundant in the Rio district than formerly.

THE HABITAT; STATE OF BOTANICAL KNOWLEDGE

Rio is situated on the coast just north of the Tropic of Capricorn. Rain may fall in any month of the jear; and the average annual rainfall is 43″ and more in the mountains. There is no frost at sea level but a cooler season (May-August) during which heat-waves are not unknown, is called "winter" by the inhabitants and not without reason, as wild life responds in a marked way. The climate is thus tropical but not equatorial. The adjacent mountains have peaks hardly exceeding six thousand feet; the typical mountain forests are those situated between one and three thousand feet, at cloud-level.

In the plain, no forest remains, the habitats being either cultivation, marshland, mangrove swamps, or dunes. In the mountains there are various forests under official protection, including those adjajcent to the city of Rio. The mountains of this neighbourhood are, characteristically, towering granite domes, often forming chains, and except where the bare rock is too steep for any soil, were once completely forested. Parts of them are now still forested even where unprotected; other parts have been built on, or cultivated, or converted to pasture. The Rio climate produces a very humid type of tropical forest, particularly at cloud-level, composed of many different species of tree, most of which bloom at a definite season profusely; these trees cannot however be said to have a tree-top layer with a biocœnosis distinct from that at ground level, as has been reported from flatter tropical forests, *e.g.* the Amazon and Guiana. Owing to steep gradients, all biocoenoses are partly intermingled. The trees are covered with epiphytes and creepers, such as orchids, bromeliæ and woody lianas, and at ground level too there is a wealth of creepers such as Passion-flower, and herbs and shrubs. The tree-trunks of almost all species are covered also with lichens and algæ; some of these are red; but the greenish-white lichens are the more expansive and give the forests around Rio their characteristic pale-trunked appearance, almost approaching that of a birch-wood. The Notodontidæ are especially characterised by cryptic coloration for rest on this type of background. In the immediate vicinity of Rio the number of species of native trees is about four hundred, to which must be added about one hundred introduced kinds in parks and plantations. There is no popular work to aid in identifying these trees, let alone the herbs which must be equally numerous. Whether he seeks known larvæ on a given foodplant or wishes to describe and publish original observations, the lepidopterist's task is thus rendered harder.

Representation of Groups

To compare strictly the number of species in each family in the local fauna is difficult, as a complete list does not exist, and different methods of sampling must be used for different families. Groups attracted to mercury vapour light, which is the most productive means of capture, will appear to outnumber those not so attracted, *e.g.* the diurnals, in proportion not corresponding to the true.

The total number of species of Lepidoptera in the vicinity of Rio is not yet ascertainable but my impression is that it is tenfold that of southern Europe, and twenty or thirty times as many as in the British Isles (about 2200).

The Noctuidæ (=Phalænidæ) are by far the most numerous family, in richness of species, and in it the Quadrifids outnumber the Trifids. The family appears to be three times as numerous as the next most numerous groups coming to light, the Geometridæ and Pyralididæ. These two seem to outnumber by similar proportions the next most numerous groups, the Arctiidæ, Notodontidæ, Sphingidæ, and Saturniidæ, which are however better known, having attracted more attention because of their size or colouring. It is regrettable that the most numerous are the least known.

The relative number of species in different groups must not be confused with the number of individuals of a single species. At certain seasons and places, the enormous numbers of one species (*Cosmosoma teuthras erubescens*) to light, gives the impression that the Syntomidæ outnumber all other groups; at other seasons and places, the Pyralididæ. Among the day-fliers the appearance during a short flight season of countless individuals of *Actinote pellenea* makes the Acræinæ (Nymphalidæ) seem the most numerous butterfly group in Rio.

Characteristic Patterns, Including Mimetic and Melanistic

It is commonly said that tropical Lepidoptera are larger and more brilliantly coloured than temperate ones.

It is a fact that there are larger forms in the tropics; and Brazil indeed has the species with the largest wing-span in the world (the Noctuid moth *Thysania agrippina*). This moth, however, is cryptically marked as in the Holarctic genus *Boarmia,* so as to be inconspicuous when resting on tree trunks.

It is also a fact that many Brazilian forms have peculiar colour patterns and others have more brilliant hues than are ever seen in temperate latitudes. The butterflies that combine great size and wonderful colouring are indeed unforgettable sights and some of them are common. Though not in the majority, they are with some reason considered characteristic. But Brazil, and other tropical places, are inhabited by countless small, dull forms as well. There are Brazilian Nolinæ, and Eupitheciinæ with a similar pattern to the Holarctic species and even smaller. The Epiplemidæ, an almost exclusively tropical family consisting entirely of rather small, delicate, cryptically coloured moths (only distinguishable by their venation from Geometridæ or Drepanidæ) which fly by day in shady places or at sunset around bushes in the mountains near Rio, are the very converse of what the word "tropical" suggests. Although at least one species of Pyralid is as big as a large Hawk-moth and has usually been mistaken for one, I have never elsewhere bred out such minute leaf-miners as I have near Rio. The Satyridæ also have smaller, duller, grass-feeding ground-flying forms than any in Europe. In the Noctuidæ the Brazilian "Wainscots" (*Mythimna, Leucania,* etc.) are similar to Holarctic forms but if anything smaller; this may be because tropical forest conditions give less scope for the evolution of graminivorous types than the Palearctic and Nearctic regions with steppes and grassy mountains.

Thus around Rio one finds patterns typical of temperate forms side by side with characteristic Neotropical patterns; but it is remarkable that in Brazil patterns do not indicate affinity to the same extent that they do in the Palearctic Region, where one can guess without much fear of error that a white butterfly is a Pierid, and a blue a Lycænid; but not so in Brazil.

We may call the representation of a similar pattern in unrelated groups "convergence" and may regard it in such places as Brazil where it is so common, in some cases as the result of identical environmental influences on different stocks over a very long period.

More has been written about mimicry than other forms of convergence, probably because of the conspicuousness of the characteristic patterns; but the district of Rio contains as remarkable examples of cryptic convergence as of mimetic-aposematic convergence.

On mimicry the remarks, on the genus *Heliconius,* of Dr. SEITZ on p.373 of vol. 5 of his great work are still very apt and one cannot do better than summarise them:

The acrid-smelling Argynnid *Heliconius narcæa* has a pattern, form and flight which render it indistinguishable on the wing from a number of Danaidæ, which are also distasteful, including *Melinæa æthra, Mechanitis lysimnia* and *Ceratinia euryanassa.* Another Argynnid, in a closely related genus, *Eueides dianassa,* also mimics *Heliconius narcæa* perfectly; less closely related are the females of *Eresia eunice* and of the Pierid *Perrhybris pyrrha* and the day-flying females of certain Pericopid and Castniid moths which also mimic the black, yellow, and orange pattern of the above-named butterflies, with which they fly on the outskirts of the city and in the forests around Rio, so that a collector cannot catch a series of any one species without taking some of the other species too. As though sure of the protection afforded by their odour or taste the *Heliconius* and Danaid models fly in open places with a slow, straight flight, often assembling in groups or alighting on flowers and are not shy nor are they hurt if the thorax is pressed or the wings rubbed; possible foes must be familiar with their appearance, taste, and smell, and the colours thus become a warning-uniform which the less distasteful mimics profit by wearing.

Dr. SEITZ' observations are still very true but I might add that since his time these warning colours have become adopted, of course unconsciously and coincidentally, by the city's buses or "lotaçoes" which are considered the most dangerous element in its fast-moving traffic and are given a wide berth by other road-users.

It may surprise readers familiar with recent work on industrial melanism to hear that melanism occurs in the forests of Brazil. It is quite unassociated with industry. There are of course many dark spots in the tropical forests where sooty coloration is an advantage. One presumes these melanistic species choose such spots for resting.

Many families contain a minority of melanic species in various genera; in the Geometridæ I have noticed one or two polymorphic species whose varieties range from pale to blackish. One of Brazil's largest species, the migrant Noctuid *Erebus odora* L. is melanistic in the male sex and would seem to be an advanced type of organism; but other melanic forms seem more primitive.

In the family Saturniidæ, which in Brazil is comparatively numerous and characteristic, some species are large and richly coloured, and highly specialised in some ways, despite the primitive venation of the family; but others are small, dull, and with a melanic tendency; for instance, in the genus *Hylesia* which is typically mouse-coloured, some species are melanic except for the abdomen which seems to preserve the brown ancestral colouring, concealed by the sooty black wings when in the normal resting position. The genus *Automeris,* generally characterised by the vividly coloured central eye on the hindwing, contrasting with a cryptically coloured forewing, has one atypical species *(A. inornata* Walker) where the eye is almost covered with a melanic suffusion. Can one deduce that recently the survival-value, for this species, of the bright eye-warning has proved less than that of a complete melanic cloak? Or is it a primitive melanic form in the early stages of evolving a bright eye, that has changed less rapidly than its relatives in the same environment? Observation of resting habits and breeding experiments would both seem required to answer such a question.

Melanism of a different type is also quite common in day-fliers, and indeed many diurnals in unrelated families shew this tendency. Their melanism may be aposematic or cryptic.

The Hesperiidæ, which are richly represented around Rio, are largely melanic and cryptic. Most of the *Papilio* forms, both of the group with yellow pigmentation and that with red, are strongly melanic. Among the latter group is a form perfectly reproduced in a quite different genus; the predominantly black wings are marked on the upper sides with smaller white and red central patches. Other melanic butterflies have the black upper-sides narrowly banded with metallic blue. The effect of most of the foregoing is cryptic, it being very difficult to follow such forms with the eye when in flight between patches of bright sunlight and deep shade in the depths of the forest.

However the combination of a black upper-side with an orange or yellow cross-band would seem to be aposematic. Insects so marked fly fearlessly and slowly through the glades and are not hard to follow or catch; some of them are doubtless distasteful to predators. This pattern occurs in some Rhopalocera but is borrowed by many Heterocera and those having it are day-fliers. To do justice to this subject a long special article profusely illustrated in colour would be necessary; failing this, the reader who wishes to get an impression of the facies of the Lepidoptera around Rio can hardly do better than turn to the LIFE International magazine number of Nov. 24, 1958, though the melanistic and inconspicuous forms are mostly omitted from the fine illustrations there given.

One may conclude with the generalisation that a tropical fauna, to judge from that at Rio, is characterised not so much by larger and more brilliant forms but rather by greater extremes of all kinds, and by a greater richness, both of variety and numbers.

PHENOLOGY

The Lepidoptera around Rio vary phenologically much the same as do those of subtropical and temperate climates; some species are multivoltine, and the life-cycle of these is as a rule shorter than that of temperate species; others are bivoltine, others univoltine; some have a short adult appearance, others are more spread; some have rigidly short pupal periods of 15 days, while in others individuals of a single generation vary in this period between two weeks and five months. In some species hibernation is obligatory and occurs in the larval stage, though only some of the foodplants lose their leaves: among such is *Morpho laertes* whose scarlet, hairy big-headed caterpillars hibernate in gregarious masses resembling a fruit and suspended from a twig. Local entomologists also tell me that some individual pupæ of other species may hatch after two or three years.

The Sphingidœ and large Saturniidæ are on the wing in large numbers in the warmer months but are little seen to light during the cooler; the smaller Noctuidæ, Geometridæ and Pyralidiidæ, however, appear in fair numbers to light even when the giants are not to be seen. At sea-level and up to at least a thousand metres' height, no month in the year passes without one seeing Lepidoptera flying, particularly the day-fliers, but there is a marked increase in numbers in September and a maximum of species and individuals is on the wing in December-April.

CHARACTER OF THE FAUNA

The Neotropical has very few species in common with the Palearctic, somewhat more with the Nearctic and Paleotropical faunæ. The three species which I have noticed in and around Rio and also come across in the Old World are: *Peridroma saucia, Nomophila noctuella, Hymenia (Zinckenia) recurvalis (-fascialis)*. All three are known to migrate and the last is a root-crop pest, but doubtless they reside and are well-established as well in Brazil as in the Old World.

Common genera are somewhat more numerous than species but the fauna as a whole, to one coming from the Old World, has a bizarre and unfamiliar aspect. Some of the most characteristic groups of the Palearctic Region, *e.g. Zygæna, Agrotis, Argynnis,* are virtually absent while others have closely related vicariants *(e.g. Phyciodes* representing *Melitæa). Vanessa* and *Mythimna* (*Leucania*) are genera with distinct but similar species.

The predominance, among the Noctuids, of the Quadrifinæ over the Trifinæ, already mentioned, characterises of course both Neotropical and Paleotropical Faunæ.

Characteristic, that is virtually endemic Neotropical groups, are, among others, the Morphinæ, Heliconiinæ, Megalopygidæ, Mimallonidæ and in the Noctuidæ, the Diopsinæ.

As already mentioned there is no lack, around Rio, of small, not highly specialised forms; but one is also struck by the extreme length to which specialisation and adaptations have gone. As regards size and brilliance, the Morphinæ are unsurpassed; their social habits are moreover highly developed. As regards length of tail of hind-wings, many families have extraordinary dimensions. Hind-wing lobation as a secondary sexual character with vein-reduction characterises several Arctiid genera, and aberrant hindwings characterises quite a number of small Geometridæ. Larvæ with extremely urticating and large elaborately branching spines are not easily forgotten; remarkable masses of scales and hair-fringes on adults' legs, wings, and bodies, combined with an unusual pose in the natural resting position, often serve as a perfect cryptic device, whose existence it is impossible to guess from a conventional mounted museum specimen and which can only be illustrated by the living animal.

Many of these specialisations occur in groups, *e.g.* the Hesperiidæ and Saturniidæ, whose neuration is comparatively primitive and whose Palearctic representatives lack them. The Neotropical fauna might therefore be described as consisting to quite a large extent of highly specialised and advanced representatives of comparatively primitive groups, with a penetration of rather generalised, small northern types; though one might argue that some, at least of the latter, e.g. the Nolinæ, are descendants rather of an almost cosmopolitan early fauna which are not particularly favoured or stimulated by present conditions in Brazil.

It is usual to attribute the extravagant specialization of tropical life to the pressure of the struggle for existence over a very long period between forms where climate provides little or no obstacle to dispersion and multiplication.

The facies or general appearance of the Brazilian lepidoptera finds, perhaps, its most similar counterpart in tropical S. E. Asia. The wide separation and barriers between these two regions suggest that environment rather than affinity may account for the resemblance, which of course is superficial.

Breeding, Catching and Keeping

Finding larvæ is easy, and breeding them up should be no harder in the Rio district than elsewhere for one living in a suburban house within easy reach of the forest; but most people live in flats, which do not favour breeding. The life histories of the great majority of the Lepidoptera are still unknown. Parasitisation seems more intense than in other places known to me.

Catching dayfliers is not difficult in the case of the Hesperiidæe and the weaker-fliers; but the larger butterflies are on the whole more difficult to catch; many of them like high trees; the steeper gradients around Rio make these probably easier to catch there than in flatter tropical areas. Flowering bushes sometimes attract numerous butterflies and render the task easier. Many kinds do not need sunshine to persuade them to fly, and may be caught in dull weather to some extent at least.

The introduction of mercury vapour lamps as a means of taking moths at night has made it easier to obtain a good series of a single species; hitherto the tropics were notorious for the multiplicity of species of which one succeeded in catching singletons only. So great is the number that comes to the new type of lamp at the best season that the problem is how to cope with the multitude. A small trap is quite impracticable, and less damage is done to specimens if one can tempt them into a large room which acts as a trap. To deal with all families it would be best to have two or three persons working in a team at a single light source. A team of several skilled persons, and much equipment would also be required to set and label the catch that would then result.

It is necessary to kill the larger species at once by injection to prevent them damaging themselves and the smaller moths that accompany them to light; this is equally true of the day-flying Morphinæ and Brassolids, though some collectors make do with squeezing the thorax of these.

The collectors in Rio are able to preserve their catches in good condition without undue trouble; the climate is tropical and humid but not badly so, though it would be advisable to avoid the most humid parts, such as Copacabana and Leblon. Drying certainly takes a long time unless one accelerates it with heat. On holidays of a week or ten days I have usually tried to set the catch as soon as possible after capture and have reduced the period of setting to as little as three days by the careful application of solar or electrical heat to the boards, or exposing them before a fire or pressure-lamp. Mites are particularly abundant and it is best to coat store-boxes with melted naphthaline and paraffin-wax.

The Agency, P. O. Box 114, BAHRAIN, PERSIAN GULF

BUTTERFLY COLLECTING IN TEXAS AND NEW MEXICO

by H. A. Freeman

The area covered by this paper is so vast that it is almost impossible to cover more than the most interesting localities. I will point out some of the best places to collect based on personal collecting and the notes obtained from other collectors. In Texas we have five distinct zones, the pine woods area of east Texas, the central Texas area in which Dallas is located, the lower Rio Grande valley area, the southwestern area in which Alpine and the Big Bend National park are located, and the panhandle area in which is the very interesting Palo Duro Canyon. Each of these areas will be taken up with some comments as to the best exact localities to visit and the period of the year when collecting is at its height.

For East Texas I will deal with one in particular. Situated a few miles north of Tyler is Tyler State Park, in which a person can get a fair example of most of the species of butterflies that occur over the entire area. This park is in a wooded section with a fair sized lake in about the center. The soil is mostly sandy and the prevailing types of vegetation are pines, oaks, cedars, several flowers such as *Verbena canadensis* and the interesting Button-bush *(Cephalanthus occidentalis)* and *Yucca louisianensis*. During March you can collect *Incisalia hadros* C. & W., *Incisalia henrici turneri* Clench several species of *Papilio, Hesperia metea licinius* Edw., *Erynnis martialis* (Scud.), which is a rarity in Texas, and *Megathymus yuccæ* (Bdv. & Lec.). The last named can best be collected by gathering the pupæ from the caudex of *Yucca louisianensis* the first week of March. During September it is possible to get an occasional specimen of *Amblyscirtes alternata* (Grote & Robinson) in and around Tyler. This is the only place that I have ever found this species in Texas. It might be noted here that the weather plays a very important part in just how successful you are in collecting during March in Tyler State Park as I have found during the past six years that *I. hadros* has been very hard to locate because of the bad climatic conditions. About the only species that seems to be easy to locate is *Megathymus yuccæ*.

The central part of Texas in which Dallas is located is characterized by having two distinct types of soil. The prevailing type is black sticky humus and the other is where you find limestone outcroppings. It is in the latter places that you will find your best localities to collect. There is one such place in Dallas on Buckner Blvd. one-half mile west of the drive-in theater. On *Yucca arkansana* in this area I have now collected around two hundred specimens of *Megathymus yuccæ stallingsi* Freeman from those plants during the past six years. During March the *Prunus* are in bloom and *Incisalia henrici turneri* fairly swarms at times around those blossoms. Another interesting species that will show up from year to year around that time of the season is *Euchloe olympia rosa* Edw. Beginning around the last of May and continuing until fall, other species that you can collect in this area are *Cogia* *outis* Skinner, *Amblyscirtes nysa* Edw., *Amblyscirtes belli* Freeman, *Polites vibex brettoides* (Edw.), *Mitoura gryneus castalis* (Edw.), and many more, of more or less importance. In this particular area you get strays from all the other four areas of the state. Even though the type locality of *Amblyscirtes eos* (Edw.) is Dallas this is distinctly a stray into this area. It is found commonly in the Palo Duro Canyon and around Alpine. It enters the central area more commonly around Palo Pinto and Mineral Wells. There are a number of others like that but one other in particular is worth some comment. I collected a number of *Mitoura xami* (Reakirt) in and around Pharr in the lower Rio Grande valley; however, one specimen was collected at Lancaster, ten miles south of Dallas, on *Ceanothus ovatus* Desf. This specimen was collected April 15, 1949, which was considerably off the time that I collected my south Texas specimens (October-December).

The Pharr area, which is in about the center of the lower Rio Grande Valley section, is one of the most interesting places to collect as you do not know what you are going to collect from day to day and from one year to the next. This part of Texas is definitely sub-tropical and many of the species that occur as native species are the same as you will find two hundred miles south in Mexico. The number of strays and new records for the United States that turn up in and around Pharr is remarkable. Because of the condition of the land and other factors the best collecting is to be done around the irrigation ditches and canals and along the Rio Grande river. One of the best places to collect was found to be on the La Reforma ranch which is situated north of Hidalgo just off the McAllen road. Any person desiring to find this locality can get there by driving from Hidalgo along beside the railroad and turn left on a dirt road that has the high power line running parallel with it. This turn-off is just about two miles from Hidalgo and you can go forward on this dirt road for about three-fourths of a mile and you will drive into the wooded area. Here is the place where I turned up a number of new United States records and saw my only *Morpho* in the United States. Butterflies fairly swarm during all the months of the year and only a few of the most interesting will be mentioned. Here along the sides of the road *Astraptes fulgerator* (Walsh), *Pellicia bromias* (G. & S.) and *costimacula* (H.-S.), *Spathilepia clonius* (Cramer), *Timochares ruptifasciata* (Ploetz), *Achlyodes thraso* (Hbn.), *Gorgythion begga pyralina* (Möschler), *Aguna asander* (Hew.), *Proteides mercurius* (Fab.), *Lerodea tyrtæus* Ploetz, *Lerodea edata* (Ploetz), *Amblyscirtes celia* Skinner, *Anteos mærula* (Fabr.), *Adelpha fessonia* Hew., *Chlorippe pavon* Latr., *Apodemia walkeri* G., *Lasaia sessilis* Schaus, *Thecla bazochii* G., *Thecla facuna* Hew., *Thecla cestri* (Reak.), and many others may be found. Another excellent place to collect is six miles north of McAllen on the road to Edinburg. It is up and down the irrigation canal that crosses under the highway. Just west of Mission two species of Megathymidæ may be collected, *Megathymus yuccæ wilsonorum* Stallings & Turner and *Stallingsia maculosus* (Freeman). To collect in that part of the state, just locate a nice irrigation ditch that has been there for several years and has had a lot of vegetation around it.

Every year that I go back to the southwestern part of Texas I learn a little more about collecting out there. When I first started going there in 1940 I found little to collect and I have heard a number of other collectors say the same. You must know the right places to visit or else your whole trip will have been without results. The best place to find good tourists courts and such is in Alpine. From there you can go in a number of directions. My favorite places are to go to Fort Davis and then on up to the summit of Mt. Locke. Eleven miles from Alpine there is a bridge that crosses a small stream of water which is usually flowing. In this particular area I have found a lot of very interesting butterflies, namely *Amblyscirtes oslari* (Skinner), *nysa, nereus* (Edw.), *eos, ænus* Edw., *texanæ* Bell, and *simius* Edw., *Adopæoides simplex* (Felder), *Celotes nessus* (Edw.), *Antigonus evansi* Bell and *pulverulenta* (Felder), *Cogia hippalus* (Edw.), *Thorybes drusius* (Edw.) and *pylades albosuffusa* Freeman, *Phyciodes picta* Edw., *Adelpha eulalia* D. & H., *Papilio multicaudatus* Kirby and many others. These species have been collected from late May until August. At the summit of Mt. Locke, around the McDonald Observatory, during the first of June, I have seen *Strymon polingi* (B. & B.) fairly common as they flew around *Quercus emoryi* and *Quercus grisea,* and *Amblyscirtes phylace* (Edw.) could be found flying around the blooms on *Linum rigidum* and *Houstonia nigricans* and *Oarisma edwardsii* (Barnes) sitting on the ground to dart about for a few seconds and then again alight. During July and August *Minois meadi* Edw. is common at high elevations throughout that area and many other very desirable butterflies. There are several species of *Agave* and *Yucca* found in the southwestern part of the state and so far only five species of *Agathymus* have been collected in that particular part of the state, *mariæ* (Barnes & Benjamin), *macalpinei* (Freeman), *florenceæ* (Stallings & Turner), *judithæ* (Stallings & Turner), and *chisosensis* (Freeman). I am sure that there are others just waiting to be collected. For best collecting results in the southwestern part of Texas locate some wooded canyon or else go up into the mountain areas where there is plenty of vegetation. The flats around Alpine are practically devoid of desirable species of butterflies, as is the case over most of that section.

I have found several nice places to collect in the panhandle of Texas. Perhaps the best is in the Palo Duro Canyon. The most productive part of the canyon is below Claude instead of the part near the town of Canyon. About fifteen miles due south of Claude there is a small hill just before you progress down into the canyon proper and it was on this hill that I first collected *Megathymus texanus* B & McD. and its form "albocincta. There are many other interesting butterflies found on that particular little hill: *Papilio multicaudatus, Mitoura gryneus castalis, Erynnis burgessi* (Skinner) and *meridianus* Bell, *Hesperia viridis* Edw., *uncas* Edw., *Amblyscirtes oslari, simius,* and *nysa.* Down in the bottom of the canyon there are a number of smaller canyons that lead into the main one and it is in these that you have the best results. In one spot I found *Pholisora alpheus* (Edw.) fairly common. It was interesting to me to note that in one small canyon I would find *Amblyscirtes erna* Freeman commonly while just a little way off another small canyon would yield not a single *erna* but plenty of *ænus* and both *texanæ* and *eos*. The only two specimens of *Megathymus yuccæ* Bdv. & Lec. (I believe this subspecies to be *coloradensis* Riley), that I collected in three years in the Panhandle were found flying around in one of these small canyons near the main canyon. Another good place to collect is on the Gray's ranch north of Skellytown. Here *Yucca glauca* grows very abundantly and during May and the first of June you can catch many fine specimens of *Megathymus texanus* and its form "albocincta". The best collecting season in the Panhandle is during the spring as there are only a few interesting species to be collected during the fall months. *Hesperia uncas* and *Amblyscirtes eos* are two of the species that are about as common during September as they are during May.

If I were to make a suggestion to collectors wishing to collect in Texas I would say that it would be best to select one particular area and concentrate on that place for the entire length of their visit. Most of the state has been collected over in more or less spasmodic trips by a lot of collectors; however, only a very few places have been thoroughly collected. Of those places I would say that the area around Dallas is perhaps the best known in the state and the areas in the west the least known. I have collected around Alpine almost every year since 1940 but actually it is almost virgin territory as far as being well known. In the section around Pharr it is doubtful whether a person would ever get all of the species that occur around that locality, as each year new things make their appearance and ones that were there the year before fail to appear. If a collector is wanting to get into some more or less virgin territory I would suggest the Guadalupe Mountains west and south of Pine Springs, Texas, during May and June. This section of the state has only been collected over in a very poor manner. There are a number of plants that grow in these mountains that also occur in the Chisos Mountains, in the Big Bend National Park. Because of the fact that the Chisos Mountains are in a National Park there has been little collecting done there so it is hard to say whether the same butterflies are associated with the plants that grow there and also in the Guadalupe Mountains. If a collector should desire to collect this area I would suggest that they go prepared to camp out, as there are no tourist courts nor places to sleep within miles of the mountains.

Actually the state of New Mexico affords a golden opportunity for any collector, as that state has been collected over less than most of the others in our union. Several collectors have collected around Raton, Folsom, Santa Fe, Jemez Springs, Ft. Wingate, Alamogordo, and Silver City; however, the northwestern, west, and southwestern parts of the state have been practically untouched. I have made only brief collecting trips to New Mexico and each time with very good results. On the Canadian river north of Tucumcari many interesting species were collected and observed during May. Around Raton may be found several *Hesperia* and *Speyeria* as well as *Pholisora mejicanus* (Reak.), *Strymon falacer godarti* Field, *Strymon titus immaculosus* Comst., especially during the month of August. While driving from Rodeo to Lordsburg I noticed a species of *Agave* growing in the mountains, most likely *pal-*

meri, so there should be some *Agathymus* in the *baueri* group in those mountains. I have specimens of *Agathymus mariæ* and *Megathymus violæ* Stallings & Turner from near Carlsbad, *Megathymus streckeri* Skinner from around Santa Fe and Albuquerque and *Megathymus texanus* from around Folsom. The type locality of *Megathymus yuccæ navajo* Skinner is near Ft. Wingate, and I have seen specimens of that subspecies from Zuni Mountains collected during May and June.

The geography of New Mexico is such that you can find almost any type of country in which to collect. The southeastern section from Carlsbad and Clovis where the elevation is slightly above three thousand feet affords one type of collecting; the mountains that run through the central part northward range up to over twelve thousand feet and are rich in butterflies, especially during the spring and early summer; the mountains northeast of Gallup should show an entirely different fauna, as should the ones northwest of Silver City and would be well worth a collector's time to investigate.

To sum up collecting in New Mexico I would simply say that so little is actually known about the best places to find butterflies in that state almost any mountainous area would be worthwhile. If I were going to do some extensive collecting there I would go to Silver City or Santa Rita during the last of May and work the mountains of that area on through June. Another place that might be worth selecting would be Gallup and visit thoroughly the mountains north of that city. When more work has been done, we can get a much better idea of just where to go to collect in New Mexico.

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THE SAGA OF AN ORPHAN *SPEYERIA DIANA* LARVA

by William H. Evans

All collectors know how important it is to label their specimens accurately. Of course, the small size of labels limits the data to essential information which does not reveal any of the events involved in the capture of the specimens. Even in the case of a preserved larva, the story behind the label is often interesting. An example of this can be shown in the eventful life of a *Speyeria diana* Cramer larva now in the preserved collection at Yale University. Perhaps an account written from the viewpoint of this larva will reveal all the important facts.

In September 1957, a badly worn female *S. diana* was captured in the Smoky Mountains of Tennessee and taken to Yale University where, under the guidance of Dr. C. L. REMINGTON, she laid four eggs. Apparently the academic life was too strenuous for a lady of her age, for she died a few hours after arrival.

The four eggs were entrusted to me for rearing of anything that might emerge. Soon after arrival, three eggs shriveled; but the fourth changed to a darker color. Twenty-eight days after the oviposition, the hero of this epic first saw the full light of day after chewing its way out of the only good egg. Regardless of the number of times it crawled across the paper on the floor of its one-inch-plastic-cube living quarters, it was unable to detach the egg shell from its last two or three segments. Soon he or she (we never learned which) crawled onto the lower surface of the paper and settled down for what should have been a very long nap. Suddenly it was swept off its feet by a small camel-hair brush and dumped into a puddle of water — really only one drop of rain water which had been dripped from a medicine dropper onto a small fragment of paper towel. When the drop spread out and soaked into the paper, the larva was able to escape from the damp surface.

A quick trip around the interior of its new home revealed it to be identical with its previous habitation, only the furnishings were different. On the floor were two bits of paper towel, one wet and one dry, and in one corner was a small pile of wet sand just large enough to hold the stem of a tender *Viola cornuta* leaf. By stretching a bit, the larva managed to reach the leaf and climb aboard without getting its feet wet. After exploring the upper surface, it found a hiding place in the curled edge of the leaf and went to sleep not expecting to be awakened for at least six months; however, he (she?) was not allowed to do what comes naturally, and was soon aroused by the prod of a broom straw. It was bad enough to suffer the discomfort of a clinging egg shell, but to be subjected to the bullying of the brute on the other end of that straw — that was too much! She (he?) coiled into a ball and rolled off the leaf landing in a drop of water on the floor of the box. While struggling out of the water onto a dry bit of paper towel, it dislodged the empty egg shell which had clung to its rear segments forty-eight hours.

By the time the larva found its way back to the leaf, it was hungry enough to eat a small notch out of the tender edge. After a few hours rest, it returned to the leaf edge for a full meal. From this time on, it ate and slept alternately without further prodding. Occasionally his (her?) privacy was invaded by a lepidopterist's prying eye peering through a magnifying glass. After devouring most of the first leaf and part of a fresh one, it molted after 14 days in the first instar.

In the first instar, the larva had been a whitish shade; but, after the first molt, it changed to jet black with no markings on the body or spines. During her (his?) 8 days in the second instar it ate several leaves, and grew rapidly, requiring no attention other than the furnishing of new leaves and an occasional cleaning of the rearing container. In the third instar, which lasted 10 days, some of the spines had a narrow orange ring around the base of the shaft. When it molted again, after 7 days in the fourth instar, it had outgrown the plastic box and had to be transferred to a cottage cheese cup with a wire-mesh top. The stems of fresh *Viola* leaves were pushed through holes in the bottom into water in a shallow jar beneath. It thrived on this diet and doubled its size during 10 days spent in the fifth instar.

In the last instar, it was quite a handsome creature with spotless glistening black body adorned with bright red jewels. The red coloring was not actually on the body, but on the lower one-third of each spine shaft. On the first segment, two very long black-shafted spines pointed forward and over and beyond the black head which was colored dark orange along its upper part. Up to this time, the larva had eaten all the leaves supplied in the cheese cup, which was kept in a warm place in its guardian's living room; however, for some unknown reason, it suddenly became fastidious in his eating habits. It would take only a few bites from each leaf, and then crawl around rapidly five or ten minutes before pausing for a few more bites. When it was taken outside and placed on a *Viola* plant growing in a flower bed, it quickly devoured a number of tender leaves, then crawled off the plant and back into the rearing container where it rested several hours before getting hungry again. Twice each day for almost three weeks, it was put out to graze in the flower bed while its caretaker guarded it from a lizard that often eyed the larva hungrily. No doubt these brief periods of freedom in the warm December sunshine were the best moments of its life. A few days were chilly and rainy, but the weather was not bad enough to interfere with the daily outings.

The larva had been treated as such a pampered pet that one would think it was devotion that caused its lepidopterist caretaker to look at it so often. Actually, a sinister plot was under way, and unfortunately the larva's I.Q. was not high enough for it to comprehend what was going to happen to it when it climbed aboard the twig which had always been used to transfer it to its *Viola* pasture. Its life came to a sudden tragic end when the twig was dropped into a pan of boiling water.

Epilogue

I must confess that I am the perpetrator of this evil deed, but hope it will not be considered murder since the larva sacrificed its life for the sake of science. It was unfortunate in showing structural features which differed so much from other species in the genus that it was imperative to kill it mercifully and in ideal condition in hot water and then preserve it permanently in a vial of alcohol. I hope this obituary will serve as a tribute to this heroic larva who made the supreme sacrifice.

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A RAPID METHOD FOR MAKING TEMPORARY INSECT LABELS IN THE FIELD[1]

by George W. Byers

One of the things that makes curators of entomological collections most unhappy is the receipt of specimens with inadequate or otherwise poor field data. At the time and place of collection, specimens must be somehow preserved and stored for transportation to the laboratory, and it is imperative that, whatever the method of such temporary storage, the minimum essential information regarding collection be inseparably attached to the specimens.

Many specimens may be placed together in a vial or jar of alcohol into which is also put an indelible label giving the usual locality, date and collector information and perhaps comments on ecology, etc., of the insects. Another widely used method of grouping specimens is spreading them between layers of cellucotton which are kept within a paper wrapper on which are recorded the field data. But for many kinds of insects, notably the Lepidoptera, these storage methods are not usually acceptable, as they result in too much damage to the individual specimen. This means that lepidopterists and certain others must package their specimens singly or only a few per container; and that in turn means the field data must be applied again and again, once to each packet, envelope or folded paper triangle.

This time consuming activity has been avoided by various entomologists in various ways. One resorts to rapid, longhand scribbling of the data, which is bad enough, but another scribbles only abbreviations, which often defy subsequent deciphering even by their author. A third entomologist, thinking himself extremely neat and methodical, enters a clearly penned code number on the triangle or envelope. Museums are filled up with packaged specimens bearing only such cryptic numbers because the curator has no means by which to "break" the code.

If minimum collection data are to be placed rapidly on every insect container, in the field, some mechanical device to facilitate the work is clearly indicated. Printing with set type is one obvious solution to the problem. If one knows where and about when he will be doing his collecting, he may have labels printed on his containers in advance, perhaps leaving certain blanks to be filled in with variable details of information. This system has the disadvantages of being expensive and requiring considerable advance planning. Hand set rubber type has been used by a few entomologists. In this case, one has the problem of providing enough pieces of type to allow spelling of all required place names and other data; hand setting in the field also consumes

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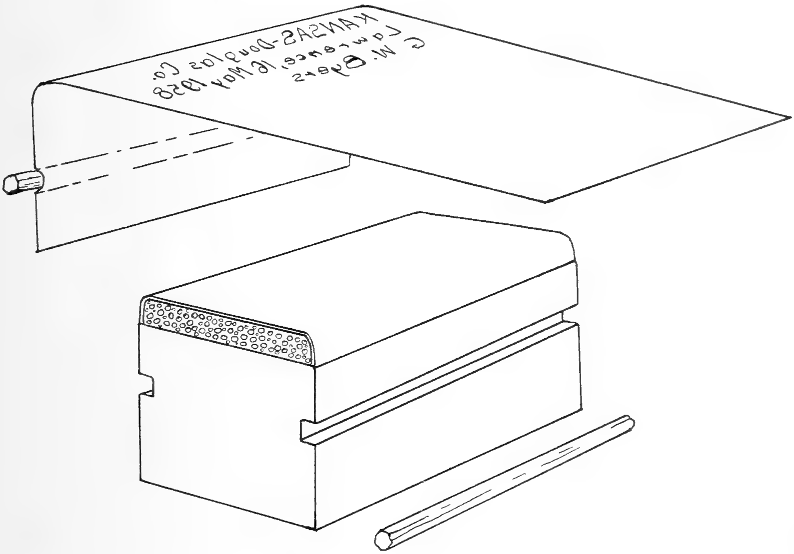
[1]Contribution No. 1045 from the Department of Entomology, University of Kansas, Lawrence, Kansas.



An inexpensive device for rapid printing of temporary insect labels in the field.

a lot of time. There are probably many other ways to meet this problem, but the following is one I have found easy, rapid, inexpensive and quite satisfactory in all ways.

This might be called a pocket sized mimeograph, as it operates in essentially the same way as a standard mimeograph machine. The device consists of a wooden block for convenience in handling, a piece of soft flannel cloth to hold the ink, a layer of rubber or synthetic plastic sponge interposed between the block and the cloth to give an even impression, and a stencil held in place over the inked cloth (see figure). The wooden block may be cut to whatever dimensions are required but should be about an inch thick so that it may be securely grasped. It is slotted or grooved by a saw cut about one-eighth of an inch wide and of equal depth along two sides, to allow the stencil to be crimped into a fixed position. About a one-eighth inch thickness of sponge is adequate. This should be attached to both the block and the cloth with ordinary glue, as plastic cements will dissolve the sponge. Canton flannel, such as is used for infants' gowns, is a good kind of cloth to use and is quite thick enough to hold the necessary ink for a hundred or more impressions.

The stencils are cut to the appropriate size from ordinary mimeograph stencil sheets. They should be slightly wider than the inked surface to prevent seepage of ink around the stencil .When cutting stencils, I cut also the stiff paper backing, which is then kept interleaved between stencil sheets, preventing them from becoming crumpled when carried in the field kit. While a usable inscription can be cut with a fine tipped stylus using only the stiff paper as a backing, I have obtained better results when the stencil is backed by a small square of plastic sheet having a very slightly rough, rather fabric-like surface. It hardly need be mentioned that the inscription should be so spaced on the stencil that it will not exceed the inked surface and that there will be free ends remaining for fixing the stencil in position on the block.

To use the labelling device, one first applies a small amount of mimeograph ink (experience will soon show just how much) to the flannel and spreads it evenly with a match stick or piece of an applicator stick. Next, the stencil with the inscription cut into it is inverted and laid on the inked surface in such a way that all cut portions of the stencil will be printed. The ends of the stencil sheet are crimped into the groves on the sides of the block by match sticks or other sticks sandpapered to suitable size. A few initial impressions on newspaper or other absorbent surface will even the distribution of ink and absorb any excess ink that might seep through certain parts of the inscription on the stencil. The inscription is then ready to be applied to envelopes or paper triangles.

Preparation of the stencil, inking the block and attaching the stencil require perhaps two or three minutes, after one gains a little experience, and impressions can be made about thirty per minute. Thus, in six minutes or so the experienced user can fully label a hundred triangles or envelopes.

My field mimeograph kit contains the following items:

a. the mimeograph block and sticks for crimping the stencil
b. a small cardboard box in which the block, with the last used stencil left in place, is stored between operations
c. a fine tipped (but not sharp pointed) stylus
d. a plastic backing sheet, four inches square, for cutting stencils
e. a supply of stencils cut to proper size and interleaved with stiff paper
f. a small tube of mimeograph ink
g. applicator sticks for spreading the ink
h. a few paper cleansing tissues (accidents will happen!)

All this equipment, together with a few hundred paper envelopes (2 x 3½ inch, No.2 drug type), can be stored in a cigar box or equivalent space. The total cost of the materials listed is perhaps $1.50, and only a little work is involved in making the block. But the cost of maintenance is extremely slight, the stencils costing somewhat more than a cent apiece and a small tube of ink lasting many years.

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A "HIT AND RUN" TRIP TO TEXAS AND NEW MEXICO

by Don B. Stallings, J. R. Turner, and Paul R. Ehrlich

In the spring of 1959 a series of circumstances led us to plan a four day expedition to various areas of Texas and New Mexico. The Stallings-Turner clan was interested in working on the biology of several species of *Megathymus* and *Agathymus* and Ehrlich was badly in need of southern snakes infected with a blood parasite (*Hæmogregarina serpentium*) to use in studies of disease transmission by mites. Our main objective, however, was to explore the Sandia Mountains of New Mexico in search of a new species (representing a new genus or subgenus) of Hairstreak. This search had been triggered by Ehrlich's discovery of a very unusual, tail-less, *Mitoura*-like thecline from this locality, in the collection of Noel McFarland, a student at the University of Kansas.

Because of pressing business, we were limited to a short foray (May 16-19 inclusive). The members of our party were Viola and Jack Stallings, Mrs. R. C. Turner, and the authors.

Leaving Caldwell, Kansas, early on the 16th, we headed south under cloudy skies. The weather was clear, however, when we made our first collecting stop just after noon near Pampa, Texas. There early, dwarfed *Megathymus texanus* Barnes & McDunnough were taken on the wing.

Later we stopped at Elida, New Mexico, where larvæ of *Megathymus yuccæ coloradensis* Riley were examined in *Yucca intermedia* var. *ramosa,* and some pictures were taken of a trio of Pronghorn Antelopes.

At dusk a stop near Elkins, New Mexico produced some 200 oak feeding larvæ of an unidentified *Hemileuca* species, which yielded some 150 pupæ.

Driving late, we reached White City at the entrance of Carlsbad Caverns National Park, where we spent what was left of the night.

Early the next morning, after securing the necessary permits, we began to collect the mesa area, carefully dodging the needle sharp spines of the ubiquitous *Agave lechuguilla,* which, in spite of our precautions, often penetrated our boots. The larvæ of *Agathymus mariæ* Barnes & Benjamin were abundant in this plant, while only eight larvæ of *Megathymus violæ* Stallings & Turner were found in scattered plants of *Yucca torreyi.* The high temperature kept most snakes under cover, but a number of butterfly species other than "megs" were taken, including: *Papilio polyxenes* Fabricius, *Nathalis iole* Boisduval, *Eurema nicippe* Cramer, *Pieris protodice* Boisduval & Leconte, *Euptoieta claudia* Cramer, *Melitæa definita* Aaron, *Strymon melinus* Hübner, *Mitoura siva* Edwards, *Plebejus acmon* Westwood & Hewitson, *Leptotes marina* Reakirt, *Hemiargus isola* Reakirt, *Everes comyntas* Godart, *Thorybes pylades* Scudder, *Pyrgus communis* Grote, *Celotes nessus* Edwards, *Atrytonopsis vierecki* Skinner, and *Amblyscirtes eos* Edwards.

Late in the afternoon we drove to the vicinity of Nickle, Texas, where the larvæ of *Agathymus carlsbadensis* Stallings & Turner were collected from

Agave parryi. More excitement was provided, however, by "Herman", a four and one-half foot *Crotalus atrox* (Western Diamond-backed Rattlesnake), which was retrieved from under a huge boulder after an hour's hard digging. Herman proved to be infected with hæmogregarines, as demonstrated by the somewhat "sporty" procedure of taking a blood-smear from a vein in the roof of his mouth.

That night we traveled north to Albuquerque.

The morning of the 18th found us madly chasing *Megathymus streckeri* Skinner on the lower western slopes of the Sandia Mountains, just north of Albuquerque. These were soon ignored, however, with the capture of our first specimen of the new Hairstreak. Diligent collecting in the lower reaches of La Cueva Canyon produced another dozen. General collecting later that day was rather good, especially along the road south of Placitas (east slope of the Sandias). The day's catch included: *Papilio rutulus* Lucas, *Papilio multicaudatus* Kirby, *Nathalis iole* Boisduval, *Pieris protodice* Boisduval & Leconte, *Pieris napi* Linné, *Euptoieta claudia* Cramer, *Limenitis bredowii* Geyer, *Apodemia mormo* Felder & Felder, *Atlides halesus* Cramer, *Strymon melinus* Hübner, *Mitoura spinetorum* Hewitson, *Mitoura siva* Edwards, *Leptotes marina* Reakirt, *Hemiargus isola* Reakirt, *Everes comyntas* Godart, *Glaucopsyche lygdamus* Doubleday, *Epargyreus clarus* Cramer, *Pyrgus communis* Grote, *Erynnis martialis* Scudder, *Erynnis propertius* Scudder & Burgess, *Hesperia viridis* Edwards, *Hesperia pahaska* Leussler, *Atrytonopsis vierecki* Skinner, and *Amblyscirtes ænus* Edwards.

We were back at the new species locality at dawn on the 19th. While waiting for the sun's warmth to start the bugs flying we discussed the fact that this *Mitoura*-like insect seemed to associate itself with bear-grass (*Nolina microcarpa*) rather than the locally abundant juniper. The belief in this association was strengthened by the discovery (JS) of a specimen of the insect still at rest deep in the foliage of the plant. The association was confirmed minutes later by the discovery (PRE) of a number of *Mitoura*-like larvæ feeding on the bloom of a bear-grass plant. Nearly 150 larvæ were discovered in a one-hour search, and eggs and egg-shells were later found on the plant. A number of the larvæ were brought back to Kansas where they commenced to pupate within the next three days. On June 6 adults began to emerge.

In addition to the living and preserved larvæ, some 25 adults of the species were taken in the two days. The present authors will describe the life history and habits in a subsequent paper, while the insect itself will be named shortly by EHRLICH and H. K. CLENCH.

At 11:30 A.M. we were forced to head for home. We arrived at Caldwell just before midnight, having traveled some 2000 miles in four days.

In total we worked with 38 butterfly species, of which 22 were placed in fixative for use in studies of internal morphology. Of three snakes captured, two were infected with hæmogregarines. Every objective of the field trip was achieved.

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COLLECTING *INCISALIA MOSSII* (LYCÆNIDÆ) ON VANCOUVER ISLAND

by Richard Guppy

Incisalia mossii H. Edwards is one of those butterflies whose local distribution and restricted habitat produce an illusion of rarity. Possibly the above remarks apply to all scarce insects, though I suspect there are some species which do actually remain at a very low population density.

Jones (*Annotated Check list of the Macrolepidoptera of British Columbia*) gives the distribution in B. C. as southern Vancouver Island, with a few scattered records for inland points near the southern boundary. In the *Lepidopterists' News* (vol.11: p. 58; 1957) there is a reference by H. K. Clench to *Incisalia mossii* from Vancouver. I suspect that this should correctly read "from Vancouver Island". The idea that Vancouver and Vancouver Island are the same thing is quite widespread, and will eventually cause some unfortunate mistakes. There is also a Vancouver in the State of Washington. The mixing up of the fauna of an island with that of the adjacent mainland is much more regrettable, from a scientific point of view, than would be the case if there were no water barrier.

On Vancouver Island *Incisalia mossii* is confined to dry rocky areas where *Sedum spathulifolium* Hook. or *S. oreganum* Nutt. grows. In ten years of hunting the thing, I never thought to connect its presence with *Sedum,* until it was pointed out to me. Actually the butterflies seldom stray more than a few yards from their breeding sites, and as I eventually learned, you can live nearly on top of a colony and never see one at all. I must point out, in my own defense, that a good part of my trouble stemmed from the extremely early, and extremely brief, flight season of this butterfly. Actually I collected some specimens from Mt. Benson, only 3300 ft., as late as June 10th. Ordinarily, the season at that elevation is no more than two weeks later than at sea level. The preceding winter had been one of unusually heavy snowfall, and it may be that this, always much deeper on the mountains, had by the slowness of its melting, held things up that spring. But, nevertheless, the incident did nothing to increase my ambition to get after them early.

Before that time, I had seen a few specimens along the road a mile or so from my home, while engaged in business remote from butterfly collecting. I made some guesses as to where these had originated, guesses that were all wrong. I could have just about heaved a stone onto the point of origin of these butterflies, but I gave it little thought, because I had collected there several times and had seen no *mossii.* The main object of my forays in this particular spot had always been the big skipper, *Erynnis propertius* (Scudder & Burgess). This butterfly is just a bit later in first appearance than *mossii,* and it continues on the wing very much later. I supposed, however, that I was in time to get at least some stragglers of even the earliest species.

Most of the foregoing looks like a lot of lame excuses for having taken a long time to get on to a good thing. But at least it does emphasize the extraordinarily circumscribed flight activity of *Incisalia mossii.* I have found in fact, that nearly all the Lycænidæ show in great measure this stay-at-home tendency. That the particular species under discussion seems more so than the others, may be due to the very short period when the adults are on the wing.

In 1957, while spending an afternoon with the *Erynnis,* as usual about the end of May, I netted a worn female *I. mossii.* I can say honestly that I decided right there on the plan of visiting the place earlier in the following year. But a few months later the *Report of the Provincial Museum for 1956* came to hand. In this, among a number of host records for V. I. Lepidoptera, G. HARDY briefly mentions *Sedum spathulifolium* as the food of *I. mossii.* I went back then for another look at my little patch, and noted that there was indeed a great deal of *Sedum* growing there. About that time I became fairly confident that I was not going very far for my *I. mossii* specimens the following spring.

This area presents a phenomenon fairly common on southeastern Vancouver Island, a patch of hillside on which the usual coniferous forest is replaced by scattered Garry Oaks and Arbutus. The soil in such places is either non-existent, or thin and sour, very wet in spring, and bone-dry later on. At the time of year when butterfly collecting commences, the aspect is far from barren. The greensward which stretches between the trees proves on close inspection to consist only in small part of grass, more of Camass, Buttercups and mosses. As many other wild flowers are present, the scene is one to delight the eye, and distract attention from the serious business of collecting.

It may well be asked why, if this place is so attractive, I did not visit it more regularly. The reason is that another very similar area lies even closer to home, in fact one might almost say in my back yard. This is my home ground, the place for a quick look around whenever I have not the time for a trip further afield. It looks almost exactly like the other spot but no *Sedum,* therefore no *I. mossii.* Why *Sedum* does not grow there I cannot say; it may be that it just never happened to get a foothold.

In 1958, of course, I was resolved really to watch the *Sedum* patch for *mossii.* The first butterflies were unusually early that year. I saw some *Incisalia iroides* Bdv. and Blues around on April 10th, but then a spell of bad weather kept me waiting until the 20th before I could get out again. Most probably the *mossii* had been around as soon, or sooner, than the others. My best day was in fact the first day on the spot, when I got ten specimens. After that their numbers dwindled rapidly until May 10th, after which no more were to be found. I will compare this with the flight season of some other very early butterflies. *Celastrina pseudargiolus* Bdv. & Lec., *Incisalia iroides,* and *Anthocaris sara* Bdv. are usually around until the first of June. *Erynnis propertius* and *Glaucopsyche lygdamus* Dbldy. are perhaps a week later starting, but I have taken both species as late as mid-July, still in fairly good condition.

In addition to Mt. Benson summit, which I mentioned earlier, the only other locality for *I. mossii* I have found is Thetis Lake Park near Victoria. In all three places *I. mossii* flies along with *I. iroides,* the proportion being about ten to one in favor of the latter species. These two are difficult to distinguish at a little distance, but I learned to pass up the commoner species almost entirely, by only netting those insects which settled on low herbage. In all the collecting spots I have mentioned, *Arctostaphylos uva-ursi* Speng. grows in dense mats, and the theory I had formed, which died hard, was that *I. mossii* fed on this plant, while *I. iroides* preferred the taller growing Ericaceous plants, such as Arbutus or *Gaultheria shallon* Pursh. As far as *iroides* is concerned I was right, and as for *mossii,* I had just guessed the wrong plant. This method of picking the species would be more nearly perfect if they were not both so fond of sipping from *Arctostaphylos* flowers.

I hate to remember now all the attempts I made to get *I. mossii* to oviposit. It is one of those insects which will just carry its eggs until it dies, rather than place them on the wrong plant. As soon as I tried *Sedum,* there was no trouble at all. As I am still too short of good specimens to waste any, I have not used many to obtain ova, but enough to provide a rough idea of the larva in its different stages. I was much interested to note that this caterpillar has been a *Sedum*-eater long enough to have evolved a complicated system of protective colouration. The very young larvæ feed on the flowers of *Sedum,* and are yellow to match. When the flowers wither, the caterpillars transfer to the pink-tinged leaves, and later instars are pale pink in colour. *I. iroides* uses the same system adapted to its particular host plants. Feeding at first on white or pale pink flowers, the larva is white. Becoming green later on, it then feeds on the unripe berries of *Gaultheria* or Arbutus.

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FOR COLLECTORS SPECIALIZING IN *EREBIA*

The Alps of Europe have been so well explored for so many years that it is remarkable that new discoveries are still reported in such a popular group as butterflies. The latest addition to the European fauna is *Erebia carpathicola* described in the current number of the *Entomologist* by A. Popescu-Gorj and A. Alexinschi. This is a species of moderate size of which 4 males were taken at an altitude of 1,660m- 1,700m on a mountain in the eastern Carpathians. On the upper surface there is a double eye-spot in a small fulvous field on the fore-wing but otherwise the wings are unmarked. The facies looks quite distinctive in the figure, and the male genitalia show an asociation with the *pronoe* group.

Those of your readers who are interested in this genus may have overlooked another new form described in 1953 by Descimon and de Lesse as *E. serotina (Rev. franç. Lépid.)*.

In this case only two examples were taken, but in the neighbourhood of Cauterets in the French Pyrenees. The butterflies are rather below middle size, the usual submarginal spots on yellow macules are present on the upper surface, and the male genitalia show the characters of the *epiphron* group. The butterflies were taken at 800m-900m in September, a very late month for these insects when most collectors have gone home, and perhaps this will explain why the form has been overlooked for so long.

Another paper of great interest in this connection is that of Lorkovic (*Biol. Inst. Zagreb* 2:159; 1952) in which he points out the distinctive features between the two butterflies *E. stirius* Godt. and *E. styx* Frr. which have been confused for over 100 years. Whereas *stirius* has a wide distribution in the Eastern Alps, and has been recorded as far west as the Jura Mts., *styx* appears to be restricted to the Julian Alps, especially in the Trenta valley where both species fly together. These additions bring the known *Erebia* species of Europe including the Carpathians, but excluding the boreal species and the rather dubious forms of the *tyndarus* - *cassioides* complex, to a total of 37.

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RECENT LITERATURE ON LEPIDOPTERA

(Under the supervision of PETER F. BELLINGER)

Under this heading are included abstracts of papers and books of interest to lepidopterists. The world's literature is searched systematically, and it is intended that every work on Lepidoptera published after 1946 will be noticed here; omissions of papers more than 3 or 4 years old should be called to DR. BELLINGER's attention. New genera and higher categories are shown in CAPITALS, with types in parentheses; new species and subspecies are noted, with type localities if given in print. Larval foodplants are usually listed. Critical comments by abstractors may be made. Papers of only local interest and papers from *The Lepidopterists' News* are listed without abstract. Readers, particularly outside of North America, interested in assisting with this very large task, are invited to write Dr. BELLINGER (San Fernando Valley State College, Northridge, Calif., U.S.A.). Abstractors' initials are as follows: [P.B.] — P. F. BELLINGER; [I.C.] — I. F. B. COMMON; [W.C.] — W. C. COOK; [A.D.] — A. DIAKONOFF; [W.H.] — W. HACKMAN; [T.I.] — TARO IWASE; [J.M.] — J. MOUCHA; [E.M.] — E. G. MUNROE; [N.O.] — N. S. OBRAZTSOV; [C.R.] — C. L. REMINGTON; [J.T.] — J. W. TILDEN; [P.V.] — P. E. L. VIETTE.

B. SYSTEMATICS AND NOMENCLATURE

Svensson, Ingvar, "Eine neue Art der Gattung *Tinea* Zeller (Lepidoptera)" [in German]. *Opusc. ent.*, vol. 18: pp. 225-227, 1 pl. 1953. Describes as new *T. bothniella* (Vasterbotten, Hällfors, Sweden); figures adults & genitalia of n. sp. & *T. columbariella*. [P. B.]

Swezey, O. H., "A new species of leaf miner in *Straussia* (Lepidoptera: Gelechiidæ)." *Proc. Hawaiian ent. Soc.*, vol. 15: p. 23. 1953. Describes as new *Aristotelia straussiella* (Mt. Tantalus, Oahu); excessively brief description without figures or comparison. [P. B.]

Tams, W. H. T., "Three new high mountain moths from East Africa (Lepidoptera: Heterocera)." *Ann. & Mag. nat. Hist.*, ser. 12, vol. 5: pp. 869-874, 17 figs. 1952. Describes as new: (Hepialidæ) *Gorgopis salti* (Shira Plateau, 12,450 ft., Kilimanjaro, Tanganyika); (Noctuidæ) *SALTIA*, and type *S. acrophylax* (14,500 ft., Kilimanjaro, Tanganyika), *S. edwardsi* (11,000 ft., Mt. Elgon, Kenya). [P. B.]

Tams, W. H. T., "A pest of coconut palms in Portuguese East Africa." *Bull. Brit. Mus. (nat. Hist.), Ent.*, vol. 3: pp. 69-73, 14 figs. 1953. Describes as new *TROGOCRADA* (monobasic; Limacodidæ), *T. deleter* (Micaure); figures larva & cocoon. [P. B.]

Tams, W. H. T., "Two new representatives of the genus *Hypotrabala* (Lepidoptera: Lasiocampidæ) from the Belgian Congo." *Bull. Brit. Mus. (nat. Hist.), Ent.*, vol. 3: pp. 74-75, 2 pls., 8 figs. 1953. Describes as new *H. regalis* (Belgian Congo, Lulua, Kapanga), *H. guttata fontainei* (Belgian Congo, Lusambo). Figures also ♂ 8th sternum of 6 spp. of genus. Transfers *Pseudometa schultzei* to *Mallocampa*. [P. B.]

Thomann, H., "Die Gattung *Endrosa* in Graubünden (Lep. Arctiidæ)" [in German]. *Mitt. schweiz. ent. Ges.*, vol. 24: pp. 413-437, 1 pl., 8 figs. 1951. Describes as new *E. kuhlweini subalpina* (Münster), *E. aurita modesta* (Filisur), *E. a. tecticola* (Soglio). Describes the 4 Swiss spp. & their races & "forms" (many of the latter new here). Plate illustrates 44 specimens in color. [P. B.]

Tindale, Norman B., "On a new genus of hepialid moths from Rarotonga in the Pacific islands." *Ann. & Mag. nat. Hist.*, ser. 12, vol. 7: pp. 13-15, 1 pl., 5 figs. 1954. Describes as new *TŒNGA* (monobasic), *T. oceanica*. [P. B.]

Tindale, N. B., "Note on the eucosmid (olethreutid) moth *Cryptophlebia ombrodelta* (Lower)." *Trans. Roy. Soc. South Australia*, vol. 78: pp. 97-98, 1 fig. 1955. Selects & figures a lectotype labelled "Australia, Lower Coll.". [I. C.]

Tindale, N. B., "Revision of the Ghost Moths (Lepidoptera: Homoneura, Family Hepialidæ) Part VI." *Rec. South Australian Mus.*, vol. 11: pp. 307-344, 25 figs., 3 pls. 1955. Describes as new: *Oxycanus rileyi* (Nomnagihé, 25 miles S. of Wangaar, 2000 ft., New Guinea), *O. tamsi* (Mt. Goliath, 5000-7000 ft., New Guinea), *O. xois*

(Dohunschik, Arfak Mts., 1400 m., New Guinea), *O. dives* (Mt. Kunupi, Menoo Valley, Weyland Mts., 6000 ft., New Guinea), *O. hecabe* (Hunsteinspitze, 1340 m., New Guinea), *O. serratus* (Wondiwei, Wandammen Mts., 1400 m., New Guinea), *O. thasus* (Fak Fak, 1700 ft., New Guinea), *O. thoe* (Wassior, Wandammen coast, New Guinea), *O. atrox* (Buntibasa district, Kratke Mts., 4000-5000 ft., New Guinea), *O. eos* (Cyclops Mts., New Guinea), *O. perplexus* (Ninay Valley, central Arfak Mts., 3500 ft., New Guinea), *O. mayri* (Mt. Siwi, Arfak Mts., 800 m., New Guinea), *O. discipennis* (Mt. Siwi, Arfak Mts., 800 m., New Guinea), *O. hebe* (Fak Fak, 1700 ft., New Guinea), *O. glauerti* (Western Australia), *O. kochi* (Australia), *O. armatus* (Western Australia). Figures types & ♂ genitalia; provides key to New Guinea spp. of *Oxycanus.* [I. C.]

Tite, G. E., "On the typical subspecies of *Lycæna phlæas* L., and the Scandinavian distribution of the species (Lepidoptera, Lycænidæ)." *Entomologist,* vol. 90: pp. 37-38, 1 map. 1957. Considers *L. p. phlæas, L. p. polaris,* & *L. p. eleus* distinct. Map shows Scandinavian records. [P. B.]

Toll, Sergiusz, "Additions to the butterfly-fauna of Poland" [in Polish; English summary]. *Documenta physiogr. poloniæ,* no. 6: pp. 1-37, 7 pls. 1947. This study has 3 parts as follows: Some new Nepticulidæ of Poland. In Poland are recorded 102 spp. of this family; the biology of 14 spp. is described (pp. 1-10, 12 figs.). *Lycia hanoviensis* Heym. and *Lycia hirtaria* Cl. a different species. The imagos and genitalia are figured. Describes as new *L. h. borealis* (Krółowiec) (pp. 11-15, 27 figs.). On some Microlepidoptera new or rare of Poland. A number of spp. are described with their biology, without new taxa. (pp. 16-37, 26 figs.). [J. M.]

Toll, Sergiusz, "Additions to the butterfly-fauna of Poland (Part II)" [in Polish; English summary]. *Documenta physiogr. poloniæ,* no. 9: pp. 1-26, 3 pls. 1948. 2 parts: *Nepticula geimontani* Klim. in Poland. Records the finds of the sp. in High Tatra Mts. (Valley of Kondratowa, 1800-2100 m.) and gives some remarks on biology (pp. 1-5, 1 fig.). Studies of some species of the group of *Argyroploce oblongana* Hw. and *A. cespitana* Hb. more difficult to ascertain and description of two new species. As new are described and figured (imagos & genitalia): *A. lewandowskii* (Ludwikow, near Poznań) & *A. (Celypa) kirinana* (Hsiaoling, Manchuria) (pp. 6-26, 39 figs.). [J. M.]

Toll, Sergiusz, "Family Eupistidæ (Lepidoptera) of Poland" [in Polish; English & Russian summaries]. *Documenta physiogr. poloniæ,* no. 32: pp. 1-293, 38 pls. 1952. Very important monograph of this family. All spp. are described (imagos & larval cases), with remarks on biology. As new are recorded: *E. lewandowskii* n.sp. (Promno, district Poznań), *E. klemensiewiczi* Toll (see *Bull. Soc. ent. Mulhouse* 1950: p. 83), & *E. vlachi* n.sp. (Litomeřice, northern Bohemia). [J. M.]

Toll, S., "Studien über die Genitalien einiger Coleophoriden. IX" [in German]. *Zeitschr. wiener ent. Ges.,* vol. 37: pp. 99-101, 1 pl. 1952. Describes as new *Coleophora parenthella* (Losowaja, E. Ukraine), *C. gaviæpenella* (Albarricin, Aragon, & Granada, Spain); compares these spp. with *C. laripenella* in adult structure & genitalia. [P. B.]

Toll, Sergiusz, "*Lozopera adelaidæ* sp. n. aus Polen (Lepidoptera, Tortricidæ)" [in German; Polish & Russian summaries]. *Ann. zool.,* Warsaw, vol. 16: pp. 61-64, 8 figs. 1955. Type locality Baligród, Kreis Lesko, Poland. [P. B.]

Toll, Sergiusz, "Versuch einer natürlichen Gruppierung der europäischen Œcophoridæ auf Grund des Baues der Genitalapparate, samt Beschreibung von zwei neuen Arten (Lepidoptera)" [in German; Polish & Russian summaries]. *Ann. zool.,* Warsaw, vol. 16: pp. 171-193, 8 pls. 1956. Proposes new subfamilies HERRICHIINÆ (including only *Herrichia excelsella),* DEUTEROGONIINÆ (including only *Deuterogonia pudorina),* & PLEUROTINÆ (including *Aplota, Pleurota, Macrochila, Topeutis,* & *Holoscolia);* gives key to subfamilies (including Amphisbatiinæ, Chimabacchinæ, Œcophorinæ, & Depressariinæ). Reviews spp. of *Borkhausenia,* which is divided into 10 subgenera: *Fabiola, Schiffermuelleria, Tichonia, Borkhausenia, TELECHRYSIS* (type *Recurvaria tripuncta), Decantha, METALAMPRA* (type *Œcophora cinnamomea), Batia, Lampros, BISIGNA* (type *Tinea procerella);* gives key to subgenera. Maintains distinctness of genera *Endrosis, Hofmannophila, Tubuliferola,* & *Holoscolia.* Describes as new *Topeutis adamczewskii* (Ukrainian S. S. R., Podolien, Zvenihorod); *Tubuliferola (TUBULIFERODES),* & type *T. josephinæ* (Poland, Kreis Cieszyn, Ustroń, Mt. Rownika, 750 m.). [P. B.]

de Toulgoët, H., "Description de deux Arctiidæ nouveaux de Madagascar" [in French]. *Bull. Soc. ent. France,* vol. 61: pp. 231-234, 4 figs. "1956" [1957]. Description of *Spilarctia griveaudi* & *S. vieui,* 2 new spp. of Arctiidæ from East Madagascar. [P. V.]

de Toulgoët, H., "Descriptions d'arctiides nouvelles de Madagascar (6e note) (Lep.)" [in French]. *Ann. Soc. ent. France,* vol. 125: pp. 57-73, 1 pl., 13 figs. "1956" [1957]. Descriptions of new spp. of arctiids from Madagascar: *Eilema crassicosta, E. marioni, E. pseudofasciata, E. distinguenda, E. melanothorax, E. pseudosoror, E. margarita, E. comma, E. nonagrioides, E. chinchilla, E. homochroma, E. aspersoides, E. hybrida, E. oberthüri; Isorropus splendidus, I. lateritea; Fodinoidea staudingeri læta.* [P. V.]

de Toulgoët, H., "Note pour servir à la révision systématique des Arctiidæ malgaches (Lep.)" [in French]. *Bull. Soc. ent. France,* vol. 61: pp. 178-183. "1956" [1957]. Note on the species of Arctiidæ from Madagascar described by the old authors. Established synonymies are rejected and other new ones made, after examination of the types. [P. V.]

Toxopeus, L. J., "Over de Javaanse subspecies van *Delias crithoë* Boisd." [in Dutch]. *Tijdschr. Ent.,* vol. 91: pp. cxvi-cxxiv, 1 map. 1949. Describes as new *D. c. cherima* (Tjerimai, S. of Cheribon), *D. c. centralis* (central Java, several localities), *D. c. radiata* (Lawoe). Describes distribution & variation of this montane sp. in Java. Describes pupa; foodplant *Loranthus.* [P. B.]

C. MORPHOLOGY

Bungenberg de Jong, C. M., "Polyploidy in animals." *Bibl. Genetica,* vol 27: pp. 111-228, 11 figs. 1957. Includes discussion of Seiler's work on the diploid & polyploid races of *Solenobia triquetrella,* & of experimental induction of polyploidy in *Bombyx.* [P.B.]

Callahan, Philip S., "Serial morphology as a technique for determination of reproductive patterns in Lepidoptera." *Bull. ent. Soc. Amer.,* vol.2, no.3: p.14. 1956. Abstract.

Colombo, Giuseppe, "Sulla struttura e funzione della cromatina delle cellule nutrici e degli oociti nella oogenesi del baco da seta (*Bombyx mori* L., Lepidoptera)" [in Italian]. *Rend. Accad. nac. Lincei,* ser.8, vol.22: pp.64-71, 1 fig. 1957. Describes & contrasts changes of chromatin & nuclear structure in oocyte & in nutritive cells. [P.B.]

Denucé, J. M., & G. Vandermeerssche, "Etude au microscope électronique des trachées des glandes séricigènes de *Galleria mellonella*" [in French]. *Ann. Soc. Roy. zool. Belg.,* vol.83: pp.183-188, 3 figs. 1952. Terminal branches of tracheal system intracellular; spiral thickenings of tracheal walls extend to end of branches. [P.B.]

Denucé, J. M., & G. Vandermeerssche, "Etude au microscope électronique des trachées des glandes séricigènes de *Galleria mellonella*" [in Flemish; French summary]. *Natuurwet. Tijdschr.,* vol.34: pp.187-190, 2 pls. 1953.

Diakonoff, A., "Problemen der terminologie van de genitalia bij de Lepidoptera" [in Dutch; English summary]. *Ent. Berichten,* vol.15: pp.294-295. 1955.

Dupuis, Claude, "Sur les principes d'une codification de la terminologie anatomique et morphologique relative aux insectes et quelques questions annexes de nomenclature" [in French; German & Russian summaries]. *Beitr. Ent.,* vol.7: pp.1-16. 1957. Proposes a code for morphological terms in entomology, comparable to the *International Rules of Zoological Nomenclature.* The author's principal recommendations are sensible, but their rigid application seems undesirable and their enforcement quite impossible. [P.B.]

Fischer, Ch., "Peroneura" [in French]. *Bull. Soc. ent. Mulhouse,* 1948: p.17, 1 fig. 1948. Figures specimen of *Aporia cratægi* with abnormal venation. [P.B.]

Frings, Hubert & Mable, "The loci of contact chemoreceptors involved in feeding reactions in certain Lepidoptera." *Biol. Bull.,* vol.110: pp.291-299, 4 figs. 1956. Receptors which respond to glucose solutions located on proboscis & on functional tarsi in insects studied (Satyridæ, Nymphalidæ, Amatidæ). [P.B.]

Frizzi, Guido, "L'eteropicnosi come indice di riconoscimento dei sessi in *Bombyx mori* L." [in Italian]. *Ricerca scient.,* vol.18: pp.119-123, 5 figs. 1948. Describes a cytological method of determining sex of larvæ. [P.B.]

Gentil, Karl, "Glitterfarben und Dunnblattfarben bei Schillerfaltern" [in German]. *Natur und Volk,* vol.87: pp.138-141, 5 figs. 1957. Explains structure of iridescent scales of Lepidoptera. [P.B.]

Haines, L. C., "An extraordinary bilateral gynandromorph butterfly." *Austral. Zool.,* vol.12: p.262, 1 pl. 1956. Figures a bilateral gynandromorph of *Heteronympha merope* (Satyridæ) from New South Wales. [I.C.]

Hannemann, H. J., "Die männlichen Terminalia von *Micropteryx calthella* L. (Lep. Micropterygidæ)" [in German]. *Deutsche ent. Zeitschr.,* N.F., vol.4: pp.209-222, 9 figs. 1957. Describes morphology of ♂ genitalia & associated structures, especially musculature. The genitalia are not retracted into the 8th abdominal segment as in other Lepidoptera, & most of the muscles are distinctive. [P.B.]

Hanser, Gisela, "Über die Histogenese der Augenpigmentgranula bei verschiedenen Rassen von *Ephestia kühniella* Z. und *Ptychopoda seriata* Schrk." [in German]. *Zeitschr. indukt. Abstammungslehre,* vol.82: pp.74-97, 23 figs. 1948. Describes development & pigment content of pigment granules in eyes of normal moths & mutants with reduced eye color. [P.B.]

Hosai, Sadao, "Wing-area of butterflies" [in Japanese]. *Shin Konchu,* vol.5, no.4: pp.32-34, 2 figs., 2 tables. 1952. Quotients (K) are calculated for 22 spp. by dividing wing-area (A) by the square of wing-length (L.). [T.I.]

Ikeuchi, Shingo, "A study on the proboscis and its sensory organ of Rhopalocera from phylogenical point of view" [in Japanese]. *New Entomologist,* vol.1, nos.3/4: pp.5-11, 20 figs. 1952. Results conform well with those of Dr. Yagi's study on the pseudopupil. [T.I.]

Kettlewell, H. B. D., "A fertile gynandrous *Biston betularia* L." *Entomologist,* vol.88: p.68. 1955. Moth with ♂ antenna on right side only. [P.B.]

Kettlewell, H. B. D., "A fertile somatic mosaic in *Biston betularia.*" *Entomologist,* vol. 88: p.83. 1955. Melanic ♀ with patch of typical pigment on wing. [P.B.]

Kiriakoff, S .,"De gehoororganen en de systematiek der Lepidopteren" [in Dutch]. *Ent. Berichten,* vol.14: pp.246-250, 2 figs. 1953. General discussion of tympanic organs & their importance in classification of Lepidoptera. Figures organs of "notodontoid" & "phalænoid" types. [P.B.]

Koyama, Nagao, & Shigemitsu Tanaka, "Morphological observation on the development of the compound eye in the Silkworm *(Bombyx mori* L.) (2)." *Journ. Fac. Textiles Sericult. Shinsu Univ., Ser.A, Biol.,* no.6: 14 pp., 4 pls. 1956. Gives detailed description of histology of eye development during pupal stage. [P.B.]

Kroon, D. B., Th. A. Veerkamp, & W. A. Loeven, "X-ray analysis of the process of extension of the wing of the butterfly." *Proc. nederl. Akad. Wetensch., ser. C,* vol.55: pp.209-214, 3 pls. 1952. Study of histological & molecular changes in expanding wing of *Aglais urticæ.* [P.B.]

Kruminš, Rolfs, "Die Borstenentwicklung bei der Wachsmotte *Galleria mellonella* L." [in German]. *Biol. Zentralbl.,* vol.71: pp.183-210, 13 figs. 1952. Describes apparatus (of 3 cells) which forms each larval seta; same cells persist through larval life and (some) into adult stage, producing setæ of different types; no new seta-forming cells appear between hatching & development of imaginal epidermis. [P.B.]

Kühnelt, Wilhelm, "Der Kopulationsapparat der Schmetterlinge und seine Bedeutung für die Systematik" [in German]. *Ent. Nachrichtenbl. österr. und schweizer Ent.,* vol.2: pp.46-48, 69-72, 4 figs. 1950. Brief description of basic plan of genitalia of Lepidoptera, with definitions of morphological terms. Description of method of preparation. [P.B.]

Lane, Charles (greatly assisted by Miriam Rothschild), "Notes on the brush organs and cervical glands of the Ruby Tiger *(Phragmatobia fuliginosa* L.)." *Entomologist,* vol.90: pp.148-151, 3 figs. 1957. Describes & figures abdominal scent organ & discusses scent produced from cervical glands. [P.B.]

de Lesse, Hubert, "Recherches cytologiques et biogéographiques sur quelques lépidoptères rhopalocères" [in French]. *Bull. Soc. zool. France,* vol.78: pp.287-291. April 1953. Survey of chromosome numbers in some Lycænidæ & *Erebia* (especially *E. tyndarus* group) ; notes on distribution of latter. [P.B.]

de Lesse, H., "Etude cytologique des *Lysandra* fixés par M. Beuret" [in French]. *Mitt. ent. Ges. Basel,* N.F., vol.6: pp.77-80. 1956. Study of the chromosomes of the lycænids *L. coridon* & *L. hispana,* collected, bred, & crossed by M. Beuret. [P.V.]

Loibl, Hans, "(Lep. Bomb.) Ein Zwitter von *Aglia tau* L." [in German]. *Bombus,* no.80/81: p.337. 1954. Describes bilateral gynandromorph. [P.B.]

Loritz, Jean, "Über Wirkung der Hornamputation bei Raupen von *Celerio euphorbiæ* L. (Sphingidæ)" [in German]. *Roux' Archiv Entwicklungsmech.,* vol.149: pp.333-

338, 5 figs. 1957. Amputation of larval abdominal horn did not affect metamorphosis, but many adults had reduced vitality, & abnormalities in genitalia & other structures were found. In F_1 generation some larvæ had horn reduced or absent. [P.B.]

Lower, Harry F., "The development of the integument during the life cycle of *Persectania ewingi* (Wwd.) (Lepidoptera: Agrotidæ)." *Zool. Jahrb., Abt. Anat.,* vol.76: pp.165-198, 7 pls, 31 figs. 1957. Describes structure of epidermis, basement membrane & all cuticular layers of larva, prepupa, pupa, & adult, & changes occurring between stages. [P.B.]

Maeki, Kodo, "A cytological study on 16 species of the Japanese Papilionidæ (Lepidoptera - Rhopalocera)" [in Japanese; English summary]. *Kromosomo,* vol.32: pp. 1115-1122, 29 figs. 1957. Gives haploid chromosome number & testis color of spp. of *Parnassius, Lüdorfia, Graphium, Byasa,* & *Papilio.* All haploid numbers are 30-31, except *G. sarpedon* (n=20) & *Parnassius eversmanni* (n=62). [P.B.]

Mukerji, D., & S. N. Banerjee, "The early embryonic stages of the Silkworm, *Bombyx mori,* nistid yellow variety." *Proc. zool. Soc. Bengal,* vol.5: pp.19-26, 1 pl. 1952. Describes development through 30th hour. [P.B.]

Narbel-Hofstetter, Marguerite, "La pseudogamie chez *Luffia lapidella* Goeze (Lépid. Psychide)" [in French]. *Revue suisse Zool.,* vol.62: pp.224-229, 1 fig. 1955. Preliminary account of hereditary form of parthenogenetic development in this sp. [P.B.]

Nüesch, H., "Ueber den Einfluss der Nerven auf die Muskelentwicklung bei *Telea polyphemus* (Lepid.)" [in German]. *Revue suisse Zool.,* vol.59: pp.294-301, 2 figs. 1952. Innervation is necessary for development of adult muscles, which are absent if nerves supplying them are cut in pupal stage. [P.B.]

Nüesch, H., "Das thorakale Nervenmuskelsystem der Puppe von *Telea polyphemus* (Lep.)" [in German]. *Revue suisse Zool.,* vol.62: pp.211-218, 4 figs. 1955. Detailed description of muscle rudiments & nerves in head & thorax of diapausing pupa. [P.B.]

Okano, Masao, "Morphology on the pupæ of Japanese Lepidoptera (1)." *Ann. Rep. Gakugei Faculty, Iwate Univ.,* vol.3: pp.52-56, 18 figs. "1951" [1952]. *Oberthüria falcigera* (Bombycidæ); *Agathia carissima, Hipparchus dieckmanni, Ophthalmodes albosignaria, Angerona nigrisparsa* (Geometridæ); *Phytometra mandarina, Cucullia fraterna* (Noctuidæ). [T.I.]

Pagden, H. T., "The presence of coremata in *Creatonotus gangis* (L.) (Lepidoptera: Arctiidæ)." *Proc. R. ent. Soc. London (A),* vol.32: pp.90-94, 1 pl. 1957. Photos of living adult ♂ with paired forked vesicles, longer than body, everted from end of abdomen; function unknown. Review of previous observations on similar structures. [P.B.]

Palm, Nils-Bertil, "Sexual differences in size and structure of the corpora allata in some insects." *K. Svenska Vetenskapsakad. Handl.,* ser.4, vol.1, no.6: 24 pp., 17 figs. 1949. Describes & figures glands in *Pieris napi* & *Ephestia kühniella.* Notes on glands of some saturniids. [P.B.]

Palm, Nils-Bertil, "The rectal papillæ in insects." *Lunds Univ. Årrskr.,* N.F., Avd.2, vol.45, no.8: 36 pp., 8 figs. 1949. Survey of structures in 22 orders of insects; function uncertain, perhaps reabsorbtion of water. [P.B.]

Panov, A. A., "Bau des Insektengehirn[s] während der postembryonalen Entwicklung" [in Russian; German summary]. *Rev. Ent. URSS,* vol.36: pp.269-284, 3 figs., 2 pls. 1957. Comparative studies & bibliography on brain of new-born insect larvæ; development of the brain during the postembryonal period in various insect groups, including some Lepidoptera. [N.O.]

Piepho, Hans, "Über die polare Orientierung der Bälge und Schuppen auf dem Schmetterlingsrumpf" [in German]. *Biol. Zentralbl.,* vol.74: pp.467-474, 5 figs. 1955. Study of polarity in epidermis of *Galleria mellonella,* carried out by transplanting pieces of abdominal epidermis in last larval stage & noting resulting distortions of scale orientation on adult abdomen. [P.B.]

Piepho, Hans, & Wolfgang Marcus, "Wirkungen richtender Faktoren bei der Bildung der Schuppen und Bälge des Schmetterlingsrunpfes" [in German]. *Biol. Zentralbl.,* vol.76: pp.23-27, 4 figs. 1957. Scale orientation on abdomen of *G. mellonella* determined by orientation of dividing cells during metamorphosis. [P.B.]

Puchta, O. & J. Seiler, "Die Entwicklung des Genitalapparates bei triploiden Intersexen von *Solenobia triquetrella* (Lepid. Psychidæ)" [in German]. *Revue suisse Zool.,* vol.62: pp.334-337. 1955. Summary of development of reproductive system in intersexes, presented as supporting evidence for Seiler's theory of the mechanism of intersex formation. [P.B.]

Puri, V. D., "Studies on the anatomy of sugarcane moth borers. I. Comparative anatomy of the antennæ." *Proc. Indian Acad. Sci. B.*, vol.45: pp.32-42, 4 pls. 1957. Describes antennal anatomy in *Sesamia inferens* & 7 Pyralidæ. Sexual dimorphism is pronounced in *Emmelocera depressella, Bissetia steniellus,* & *S. inferens.* [P.B.]

Puri, V. D., "Studies on the anatomy of the sugarcane moth borers. III. Comparative study of the head and its appendages." *Proc. Indian Acad. Sci. B,* vol.46: pp.96-108, 5 pls. 1957. Comparative study of exoskeleton, tentorium, & mouthparts of adults. [P.B.]

de Puysegur, K., "Un cas de gynandromorphisme chez *Heodes virgaureæ* L" [in French]. *Rev. franç. Lépid.,* vol.14: p.122, 1 fig. "1953" [1954]. Figures bilateral gynandromorph. [P.B.]

Ratzendorfer, Carla, "Volumetric indices for the parts of the insect brain. A comparative study in cerebralization of insects." *Journ. N. Y. ent. Soc.,* vol.60: pp.129-152, 1 fig., 2 tables. 1952. Includes *Ephestia kühniella* adults & 7 other unrelated insects. [P.B.]

Ris, Hans, & Ruth Kleinfeld, "Cytochemical studies on the chromatin elimination in *Solenobia* (Lepidoptera)." *Chromosoma,* vol.5: pp.363-371, 9 figs. 1952. Material shed by chromosomes in 1st maturation division of eggs is ribonucleoprotein. [P.B.]

Schneider, Dietrich, & Karl-Ernst Kaissling, "Der Bau der Antenne des Seidenspinners *Bombyx mori* L. II. Sensillen, cuticulare Bildungen und innerer Bau" [in German]. *Zool. Jahrb., Abt. Anat.,* vol.76: pp 223-250, 26 figs. 1957. Very detailed description of internal anatomy & sense organs of antennæ; sense organs number about 20 000 per antenna & include all known types of insect sensillæ except photoreceptors. [P.B.]

Schwanwitsch, B. N., "O risunke kryla Palearkticheskikh Hesperiidæ i nekotorykh *Argynnis* (Lepidoptera)" [in Russian; On the wing pattern in the Palearctic Hesperiidæ and some *Argynnis*]. *Ent. Obozrenie,* vol.32: pp.137-147, 36 figs. 1952. Analyzes wing pattern of Hesperiidæ, ascertains regularities, & establishes a prototype pattern for this family. Compares the hind wing pattern with that in *Argynnis.* [N.O.]

Shirozu, Takashi, & Hideho Yamamoto, "Morphology of the male genital organ of *Argyronome laodice japonica* Ménétriès (Nymphalidæ)." *Sieboldia,* vol.2: pp.161-168, 4 pls. 1953. The skeletal and membranous parts and muscles are described and illustrated minutely. [T.I.]

Stumm-Zollinger, Elisabeth, "Histological study of regenerative processes after transsection of the *nervi corporis cardiaci* in transplanted brains of the Cecropia Silkworm (*Platysamia cecropia* L.)." *Journ. exper. Zool.,* vol.134: pp.315-326, 4 figs. 1957. Medial & lateral groups of neurosecretory cells in brain normally connect with each other through the nerves to the corpora cardiaca; if these nerves are cut, the 2 groups of cells become connected by a secondary nerve network. This connection is essential for the production of the brain hormone. It is suggested that the corpora cardiaca function as a site for combination of substances produced by the 2 groups of neurosecretory cells to form this hormone. [P.B.]

Takahashi, Yasuo, "Studies on the cuticle of the Silkworm, *Bombyx mori* L. VIII. Sublayers of epicuticle." *Annot. zool. japon.,* vol.29: pp.186-195. 1956.

Taylor, J. Sneyd, "Note on the proboscis in the Saturniidæ." *Ent Rec. & Journ. Var.,* vol.69: pp.151-153. 1957. Describes functional proboscis in spp. of *Epiphora* (seen drinking at puddles) & similar organ in *Samia cynthia.* [P.B.]

Treat, Asher E., "The ctenoid form of the noctuid epaulette." *Amer. Mus. Novit.,* no. 1766: 10 pp., 14 figs. 1956. Describes form of ridge overlapping tympanic membrane in various noctuids; when this ridge is provided with branched, spiny teeth it may serve to protect the membrane against parasitic mites. [P.B.]

G. PHYSIOLOGY

Fukuda, T., "Conversion of pyruvic acid to alanine in the Silkworm larva." *Nature,* vol.180: p.245, 1 fig. 1957. *Bombyx mori.*

Garcia, Isabelle, Marie Tixier, & Jean Roche, "Dégradation L-aminoacidexeoxydasique de la L-arginine chez les insectes aux divers stades de leurs métamorphoses" [in French]. *C. R. Soc. Biol.,* vol.150: pp.468-470, 2 figs. 1956. Study of enzyme mediating arginine degradation in *Bombyx mori* etc. [P.B.]

Garcia, Isabelle, Marie Tixier, & Jean Roche, "Sur les dérivés guanidiques présents chez les insectes aux différents stades de leur développement" [in French]. *C. R. Soc. Biol.,* vol.150: pp.321-324. 1956. Study of arginine degradation products in *Bombyx mori* and other insects. [P.B.]

Gilbert, Lawrence I., & Howard A. Schneiderman, "The quantitative assay of the juvenile hormone of insects." *Anat Rec.,* vol.128: p.555. 1957. Abstract; *Galleria* and Saturniidæ.

Glick, P. A., J. P. Hollingsworth, & W. J. Eitel, "Further studies on the attraction of Pink Bollworm moths to ultraviolet and visible radiation." *Journ. econ. Ent.,* vol. 49: pp.158-161. 1956.

Grison, P., & R. Silvestre de Sacy, "Déplacement orienté de la femelle de Cheimatobie *Operophtera brumata* L. (Lep. Geometridæ)" [in French]. *Bull. Soc. ent. France,* vol.59: pp.151-154. "1954" [1955]. Wingless ♀♀, active at dusk, move toward vertical dark objects subtending a horizontal angle of at least 3°; normal reaction is to tree trunks, but vertical painted stripes serve as stimuli under proper conditions. [P.B.]

Grossbach, Ulrich, "Zur papierchromatographischen Untersuchung von Lepidopteren-Augen" [in German]. *Zeitschr. Naturforsch.,* vol.12b: pp.462-465, 3 figs. 1957. Study of fluorescent substances in eyes of 30 spp. (8 families) of Lepidoptera; types of substances present show some correlation with systematic position. [P.B.]

Hanec, William, & Stanley D. Beck, "Diapause in the European Corn Borer." *Bull. ent. Soc. Amer.,* vol.3: p.24. 1957. Abstract; *Pyrausta nubilalis.*

Hanser, Gisela, "Das erste Insekten-Hormon in kristallisierter Form" [in German]. *Umschau,* vol.56: pp.167-170, 7 figs. 1956. Report of purification of ecdyson & review of hormonal control of metamorphosis in Lepidoptera etc. [P.B.]

Hanser, Gisela, "Wirkung eines Metamorphose-Hormons bei *Ephestia kühniella* (Epidermisveränderungen bei der induzierten Puppenhäutung)" [in German]. *Zool. Anz.,* Suppl. no.20 *(Verhandl. deutschen Zool. in Hamburg):* pp.209-215, 2 figs. 1957. Injection of ecdyson produces metamorphic changes in isolated abdomen of *Ephestia* or *Galleria* larva. [P.B.]

Hasegawa, Kinsaku, "Studies on the voltinism in the Silkworm, *Bombyx mori* L., with special reference to the organs concerning determination of voltinism (a preliminary note)." *Proc. Japan Acad.,* vol.27: pp.667-671. 1951. Evidence from transplantation experiments that hormone produced by subesophageal ganglion stimulates eggs to enter diapause in *B. mori* & other moths. [P.B.]

Heimpel, A. M., "Further observations on the pH in the gut and the blood of Canadian forest insects." *Canad. Journ. Zool.,* vol.34: pp.210-212. 1957. Data for a variety of Lepidoptera (Tortricidæ, Notodontidæ, Arctiidæ, Saturniidæ, Nymphalidæ). [P.B.]

Heller, J., & T. Chojnacki, "Pyrophosphates in the hawkmoth, *Cellerio* [sic!] *euphorbiæ.* III. Tracer studies with P^{32}" *Bull. Acad. polon. Sci., Ser. Sci. biol.,* vol.5: pp.277-279. 1957.

Heller, J., & L. Szarkowska, "Does the hæmolymph of insects contain uric acid?" *Bull. Acad. polon. Sci., Ser. Sci. biol.,* vol.5: pp.111-113, 3 figs. 1957. Affirms presence of uric acid in pupal sphingids. [P.B.]

Heslop, I. R. P., "Times of flight of *Apatura iris* (L.) (Lep: Nymphalidæ)." *Ent. Gazette,* vol.8: pp.226-231. 1957. Notes on flight habits as affected by time of day, weather, etc. [P.B.]

Hidaka, Toshitaka, "Recherches sur le déterminisme hormonal de la coloration pupale chez lépidoptères I. Les effets de la ligature, de l'ablation des ganglions et de l'incision des nerfs chez prépupes et larves âgées de quelques papilionides" [in French]. *Annot. zool. japon.,* vol.24: pp.69-74. 1956. Hormone produced in central nervous system controls pupal coloration in *Papilio xuthus* & *P. protenor.* [P.B.]

Hinton, H. E., "Some aspects of diapause." *Science Progr.,* vol.45: pp.307-320. 1957. Calls attention to distinctions, frequently neglected, between factors determining & those initiating diapause; and between factors terminating diapause & those permitting resumption of development. Reviews evidence for hormone-controlled synchrony of development in host & parasite. Describes effect of "diapause hormone" on permeability of ovaries and resulting penetration of tryptophane derivatives into egg. [P.B.]

Hodgson, Edward S., "A comparative electrophysiological analysis of chemoreceptors in arthropods." *Anat. Rec.,* vol.128: pp.565-566. 1957. Abstract; including *Epargyreus* & *Limenitis.*

Huard, G., & R. P. Corbe, "Recherches photométriques sur *Parnassius apollo* L. (lépidoptères)" [in French]. *Bull. Soc. zool. France,* vol.76: pp.18-21. 1951. Records light-absorbing power of different pattern elements on wings. [P.B.]

Ito, Toshio, "Blood phenoloxidase in *Bombyx mori* II. Change of activity during development and a certain characteristic of the enzyme." *Jap. Journ. Zool.,* vol.11: pp. 253-260, 6 figs. 1954.

Jacobson, L. A., & P. E. Bakeley, "Effects of moisture during starvation of larvæ of the Pale Western Cutworm, *Agrotis orthogonia* Morr. (Lepidoptera: Phalænidæ)." *Canad. Ent.,* vol.89: pp.465-469, 1 fig. 1957. Mortality lowest at medium (53%) relative humidity. [P.B.]

Jarvis, F. V. L., "Further observations on hibernation." *Proc. Trans. south London ent. nat. Hist. Soc.,* 1950-51: pp.96-106. 1951. Distinguishes spp. which may be induced to emerge from hibernation by application of heat, and those ("true hibernators") which cannot. Discusses the nature of diapause in the latter, with examples from some Lepidoptera; speculates on causes of diapause. [P.B.]

Karlson, Peter, "Über die Häutungshormone der Arthropoden" [in German]. *Zool. Anz.,* Suppl. no.20 *(Verhandl. deutschen Zool. in Hamburg):* pp.203-208, 1 fig. 1957. Review of properties and activity in various arthropods of hormone ecdyson, extracted from *Bombyx mori.* [P.B.]

Kato, Akira, "Some examples of flying formation among paired butterflies" [in Japanese]. *Shin Konchu,* vol.5, no.3: pp.22-23. 1952. 11 instances. [T.I.]

Kettlewell, H. B. D., "Unusual behavior of a sound sensitive larva." *Entomologist,* vol.88: pp.97-98. 1955. Larvæ of *Mesocelis montana* react to ♂ (but not ♀) human voice by shaking violently; sensitive to low-frequency sounds only. [P.B.]

Kikkawa, Hideo, Zenichi Ogita, & Shozo Fujito, "Studies on the pigments derived from tryptophan in insects." *Proc. Japan Acad.,* vol.30: pp.30-35, 2 figs. 1954. Demonstrates metals in pigments from eggs of certain *Bombyx mori* mutants. [P.B.]

Kleinhout, J., "Spinvermogen, stamoriëntatie en gezichtsvermogen bij de rupsen van de dennespanner, *Bupalus piniarius* L." [in Dutch; English summary]. *Ent. Berichten,* vol.17: pp.101-113, 1 fig. 1957. Describes tendency of *B. piniarius* & *Semiothisa liturata* to move toward tall vertical objects after being blown out of trees; shows that orientation is visual. [P.B.]

van der Kloot, William G., & Carroll M. Williams, "Cocoon construction by the Cecropia Silkworm. I. The role of the external environment" [in English; German summary]. *Behaviour,* vol.5: pp.141-156, 1 pl., 7 figs. 1953. Describes cocoon and analyzes pattern of movement of larva in spinning it. Prevention of certain movements by crowding, unsuitable locations, etc., results in formation of abnormal cocoons. [P.B.]

van der Kloot, William G., & Carroll M. Williams, "Cocoon formation by the Cecropia Silkworm. II. The role of the internal environment" [in English; German summary]. *Behaviour,* vol.5: pp.157-174, 3 pls., 7 figs. 1953. Amount of silk present in silk glands determines spinning behaviour in part, as well as part of cocoon (inner or outer envelope) which is being spun. [P. B.]

van der Kloot, William G., & Carroll M. Williams, "Cocoon construction by the Cecropia Silkworm. III. The alteration of spinning behaviour by chemical and surgical techniques" [in English; German summary]. *Behaviour,* vol.6: pp.233-255, 5 figs. 1954. Spinning behaviour is controlled by brain centers in or near corpora pedunculata. Spinning behaviour may be deranged by CO_2 (permanently), CO (temporar--ily), low O_2 tensions, or injection of atropine or malononitrile; these agents presumably affect the above centers specifically, since behaviour other than spinning was not affected. [P.B.]

Kozhantshikov, I. V. "K voprosu o zhiznennom termicheskom optimume. IX. Amplituda temperatury kak faktor v razvitii neparnogo i dubovogo shelkopryadov" [in Russian; To the problem of vital thermic optimum. IX. Temperature amplitude as a factor in development of *Ocneria dispar* L. and *Antheræa pernyi* Guer.]. *Ent. Obozrenie,* vol.32: pp.27-42. 1952. A comparative analysis of adaptation to temperature changes. [N.O.]

Kubo, Moritada, "Peculiar actions of butterflies before egg laying" [in Japanese]. *New Entomologist,* vol.1, nos.3/4: p.32. 1952. Tappings by forelegs on foodplants prior to oviposition are observed in *Polygonia c-aureum, Araschnia burejana, Argynnis anadyomene* (Nymphalidæ), and *Papilio machaon hippocrates.* [T. I.]

Kuchlein, J. H., "Insecten in hun overwinteringskwartieren" [in Dutch; English summary]. *Ent. Berichten,* vol.17: pp.141-142. 1957. Note on hibernation of *Acrolepia* & *Agonopteryx* spp. in caves in Limburg. [P.B.]

Kuzuya, Takeshi, "Oviposition of *Leptidea amurensis* (Pieridæ)" [in Japanese]. *Shin Konchu,* vol.5, no.2: pp.10-11, 1 fig. 1952. Chemical sense of foretarsi is suggested. [T.I.]

Legay, J.-M., "Chimiotactisme et apprentissage chez le ver à soie" [in French]. *Bull. Soc. Hist. nat. Toulouse,* vol.86: pp.172-175, 1 fig. 1951. *Bombyx mori* larvæ show learning ability in search for food over fixed path. Changes in behaviour in course of development are noted. [P.B.]

Levy, Robert I., & Howard A. Schneiderman, "The direct measurement and significance of changes in intratracheal gas composition during the respiratory cycle of the Cecropia moth." *Anat. Rec.,* vol.128: p.583. 1957. Abstract.

H. MIGRATION

Abbott, Charles H., "A quantitative study of the migration of the Painted Lady Butterfly, *Vanessa cardui.*" *Bull. ecol. Soc. Amer.,* vol. 30: p. 27. 1949. Abstract.

Amanshauser, Hermann, "Was ist ein Wanderfalter?" [in German]. *Zeitschr. wiener ent. Ges.,* vol. 40: pp. 273-276. 1955. Distinguishes between "true" migration, which is followed by return flight or by breeding in new territory; "catastrophic migration", ending in death of migrants; and other natural movements (airstream transport, permanent range extension, etc.). [P. B.]

Baynes, E. S. A., "Range on migrant insects in Ireland for 1950." *Irish Nat. Journ.,* vol. 10: pp. 134-135. 1951. Records of 9 Lepidoptera. [P. B.]

Baynes, E. S. A., "Report on migrant insects in Ireland for 1951." *Irish Nat. Journ.,* vol. 10: pp. 247-248. 1952. 9 spp.

Baynes, E. S. A., "Report on migrant insects in Ireland for 1952." *Irish Nat. Journ.,* vol. 11: pp. 45-46. 1953. 12 spp.

Baynes, E. S. A., "Report on migrant insects in Ireland for 1953." *Irish Nat. Journ.,* vol. 11: 195-197. 1954. 10 spp.

Baynes, E. S. A., "Report on migrant insects in Ireland for 1954." *Irish Nat. Journ.,* vol. 11: pp. 286-287. 1955. 10 spp.

Baynes, E. S. A., "Report on migrant insects in Ireland for 1955." *Irish Nat. Journ.,* vol. 12: pp. 25-28. 1956. Including 4 butterflies, 4 sphingids, 1 noctuids, 3 pyralids. [P. B.]

Baynes, E. S. A., "Report on migrant insects in Ireland for 1956." *Irish Nat. Journ.,* vol. 12: pp. 145-146. 1957. Records of 11 Lepidoptera; comparative numbers, 1950-56, recorded for 16 spp. [P. B.]

Biezanko, C. M., "Migrações de lepidopteros no Rio Grande do Sul e Uruguai" [in Portuguese]. *Chacaras e Quintaes,* vol. 92: pp. 485-486, 1 fig. 1955. Migration of *Metamorpha stelenes.* Foodplants *Calliandra, Pithecolobium.* [P. B.]

Broekhuysen, G. L., "Butterfly migration at Ottenby Bird Observatory." *Opusc. ent.,* vol. 18: p. 244. 1953. *Pieris brassicæ* & *P. napi;* S. Sweden. [P. B.]

Broquet, M., "Observations sur la migration de la *Vanessa cardui* L." [in French]. *Bull. Soc. Sci. nat. Ouest France,* ser. 6, vol. 1: pp. 33-34. 1952. Observations on northward migration in W. France. [P. B.]

Burmann, Karl, "Wanderfalter auf Gletschern" [in German]. *Zeitschr. wiener ent. Ges.,* vol. 37: pp. 101-103. 1952. Numerous Lepidoptera found freshly dead on snow in E. Alps, evidently killed while flying over mountains; some migrants, and lowland spp. apparently carried up in air currents. [P. B.]

Burmann, Karl, "*Pyrameis cardui* L. in Nordtirol" [in German]. *Zeitschr. wiener ent. Ges.,* vol. 39: pp. 3-5. 1954. Migration records, 1951 & 1952. [P. B.]

Burmann, Karl, "Einige Wanderfalterbeobachtungen aus Nordtirol 1953" [in German]. *Zeitschr. wiener ent. Ges.,* vol. 39: pp. 267-269. 1954. Notes on 21 migrant spp. [P. B.]

Burmann, Karl, "Nordtiroler Wanderfalterbeobachtungen 1954" [in German]. *Zeitschr. wiener ent. Ges.,* vol. 40: pp. 241-244. 1955. Notes on 20 migrants. [P. B.]

Burton, J. F., & D. F. Owen, "Insect migration in S. W. France." *Ent. mo. Mag.,* vol. 90: pp. 66-69. 1954. Southward movement of various insects in October, including 7 Lepidoptera. [P. B.]

Callahan, Philip S., "A possible correlation between the fat content and the reproductive patterns of *Pseudaletia unipuncta* and migration." *Bull. ent. Soc. Amer.,* vol. 3: p. 32. 1957. Abstract.

Chnéour A., "Migrations des papillons dans le zone méditerranéene, principalement en ce qui concerne la Tunisie" [in French]. *Bull. Soc. Sci. nat. Tunisie,* vol. 6: pp. 67-70, 3 pls. 1953. Notes on migration and migrant spp. in North Africa; figures of 20 spp. [P. B.]

Cretschmar, Max, "Funde von *Laphygma exigua* Hb. (Noctuidæ) im Jahre 1952" [in German]. *Zeitschr Lepid.,* vol. 3: pp. 161-162. 1955. European records of this southern migrant. [P. B.]

Crozes, J., "Observations et notes de chasse" [in French]. *Rev. franç. Lépid.,* vol. 14: p. 146. 1954. Reports migration of *Vanessa cardui* at Monte Carlo; records of *Papilio festhameli* (Aude) & *Charaxes jasius* (Ariège). [P. B.]

Daniel, Franz, "Oekologische und physiologische Probleme bei wandernden Sphingiden" [in German]. *Zeitschr. Lepid.,* vol. 3: pp. 91-100. 1955. Distinguishes between "true migrants", which invade Europe each year and have a wide range without local variants, and "roamers", whose migrations are less regular and apparently more subject to weather, and which have distinct local races. Various aspects of biology related to migration are considered. [P. B.]

Eliot, N., "*Nymphalis antiopa* on the Cote d'Azur." *Entomologist,* vol. 88: pp. 84-88. 1955. Suggests that species migrates from coastal strip to higher country shortly after emergence and hibernates there, returning in spring. [P. B.]

Fassnacht, Joseph, "A propos de *Pyrameis atalanta* L. et des migrations" [in French]. *Bull. Soc. ent. Mulhouse,* 1948: pp. 37-38. 1948. Report of annual southward movement; comments by Loeliger. [P. B.]

French, R. A., "Migration records, 1954." *Entomologist,* vol. 88: pp. 125-130. 1955. Notes on 35 British immigrants, and records of Lepidoptera seen at lighthouses & lightships. [P. B.]

French, R. A., "Migration records, 1956." *Entomologist,* vol. 90: pp. 227-238. 1957. Records of 48 British immigrant spp. [P. B.]

French, R. A., "The Death's Head Hawk Moth in Great Britain in 1956." *Bull. southeastern Union sci. Soc.,* no. 112: 3 pp. 1957. Report on record invasion of the migrant *Acherontia atropos.* [P. B.]

Harbottle, A. H. H., "The occurrence of *Pontia daplidice* Linn. in North Cornwall in 1945." *Ent. Gaz.,* vol. 1: pp. 49-50. 1950. This migrant was common and bred locally. Notes on larvæ, reared on *Raphanus maritimus.* [P. B.]

Hayward, Kenneth J., "Migration of butterflies in Argentina, 1953-54." *Proc. Roy. ent. Soc. London (A),* vol. 30: pp. 59-62. 1955. *Ascia monusta, Libytheana carinenta.*

Iwase, Taro, "Migration of *Parnara guttata* (Hesperiidæ)" [in Japanese]. *Trans. Minamiuwa ent. Soc.,* vol. 2: pp. 7-8. 1953. Migration in Shikoku suggested. [T. I.]

Jarvis, F. V. L., "The meteorological approach to entomology." *Ent. Gaz.,* vol. 1: pp. 201-216, 7 figs. 1950. Simple meteorology with special reference to Great Britain; the influence of weather on migration and other phenomena is discussed. [P. B.]

Kawashima, Kenjiro, "Large mass of *Parnara guttata* Bremer et Gray (Hesperiidæ) passed through Tokyo" [in Japanese]. *Shin Konchu,* vol. 6, no. 11: p. 14. 1953. South or southwest flight was observed on Sept 12 ("13" in error) 1953 (cloudy, windless), in a belt of about 2 km. in width. [T. I.]

Kummerer, H., "Migrations" [in French]. *Bull. Soc. ent. Mulhouse,* 1948: pp. 69-71. 1948. Reports migrations of *Vanessa cardui* in Alsace; notes by Loeliger. [P. B.]

Kurosawa, Yoshihiko, "*Parnara guttata* Bremer et Grey (Hesperiidæ) migrate over Ueno Park (Tokyo)" [in Japanese]. *Shin Konchu,* vol. 6, no. 13: p. 14. Sept. 13 (Sunday) 1953; mass flight in southward direction following light wind. [T. I.]

Lempke, B. J., "Trekvlinders in 1951 (twaalfde jaarverslag)" [in Dutch; English summary]. *Ent. Berichten,* vol. 14: pp. 150-157, 2 figs. 1952. Report on 23 spp. of migrants in Holland. [P. B.]

Lempke, B. J., "Trekvlinders in 1952 (dertiende jaarverslag)" [in Dutch; English summary]. *Ent. Berichten,* vol. 14: pp. 316-321, 339-345, 4 figs. 1953. 29 spp. [P. B.]

Lempke, B. J., "Trekvlinders in 1953 (veertiende jaarverslag)" [in Dutch; English summary]. *Ent. Berichten,* vol. 15: pp. 201-206, 213-220, 2 figs. 1954. 26 spp. [P. B.]

Lempke, B. J., "Trekvlinders in 1954 (vijftiende jaarverslag)" [in Dutch; English summary]. *Ent. Berichten,* vol. 15: pp. 460-467, 2 figs. 1955. 25 spp. [P. B.]

Lempke, B. J., "Vlindertrek" [in Dutch; English summary]. *Ent. Berichten,* vol. 16: pp. 71-72. 1956. Request for information on migrants; suggests that *Agrotis ypsilon* is an immigrant in Holland. [P. B.]

Lempke, B. J., "Trekvlinders in 1956" [in Dutch; English summary]. *Ent. Berichten,* vol. 17: pp. 189-196, 217-224, 4 figs. 1957. Report on 26 spp. of migrant Lepidoptera in Holland. [P. B.]

Lipscomb, C. G., "Continental migrant butterflies in 1957." *Ent. Rec. & Journ. Var.,* vol. 69: pp. 232-233. 1957. Notes from Germany. [P. B.]

Lœliger, R., "Les premières expériences de notre centre d'observation de Zurich (Suisse) au sujet des migrations de papillons en 1946" [in French]. *Bull. Soc. ent. Mulhouse,* 1948: pp. 27-29, 44-46. Notes on migrations of *Plusia gamma, Vanessa* spp., pierids, & sphingids. [P. B.]

Losada S., Belisario, "Nuevas especies para Colombia localizadas por primera vez por la Seccion de Entomologia" [in Spanish]. *Rev. Facult. nac. Agron.,* Medellín, vol. 7: pp. 325-332, 3 figs. 1947. Includes record of *Historis acheronta* migrating. [P. B.]

Mazzucco, Karl, "Österreichische Forschungszentrale für Schmetterlings-wanderungen. Rundschreiben Nr. 5" [in German]. *Zeitschr. wiener ent. Ges.,* vol. 39: pp. 93-96. 1954. Notes on migrations of *Heliothis scutosa,* sphingids, *Pieris daplidice,* & *Vanessa* spp. in Austria in 1953. [P. B.]

Mazzucco, Karl, "Österreichische Forschungszentrale für Schmetterlings-wanderungen. Rundschreiben Nr. 6" [in German]. *Zeitschr. wiener ent. Ges.,* vol. 40: pp. 140-143. 1955. List of migrants recorded in Salzburg; notes on migrants observed in 1954. [P. B.]

Mazzucco, Karl, "Österreichische Forschungszentrale für Schmetterlings-wanderungen. Rundschreiben Nr. 7" [in German]. *Zeitschr. wiener ent. Ges.,* vol. 21: pp. 89-95. 1956. Gives numerous records of mass movements of *Pieris* spp. in 1955 in Austria & Bavaria; notes on *Vanessa* spp.; comments on Amanshauser's definition of "migrant." [P. B.]

Mazzucco, Karl, "Österreichische Forschungszentrale für Schmetterlings-wanderungen. Haus der Natur, Salzburg. Rundschreiben Nr. 8" [in German]. *Zeitschr. wiener ent. Ges.,* vol. 42: pp. 43-45. 1957. Notes on some migrants, especially *Acherontia atropos,* in Austria. [P. B.]

Miles, Philip M., "Immigrant Lepidoptera observed in Wales during 1953." *Ent. mo. Mag.,* vol. 90: pp. 248-250. 1954. Notes on 9 immigrants, *Phlogophora meticulosa* included, and on phenology of 2 hibernating nymphalids. [P. B.]

Miles, Philip M., "Immigrant Lepidoptera observed in Wales during 1954 and 1955." *Ent. mo. Mag.,* vol. 93: pp. 184-187. 1957. Includes records of 10 spp. (butterflies, sphingids, noctuids, pyralids). [P. B.]

Muspratt, Vera M., "Migrations de *Pyrameis atalanta* L." [in French]. *Bull. Soc. ent. Mulhouse,* 1949: pp. 34-40, 44, 61-62. 1949.

Newman, L. Hugh, "*Nymphalis antiopa*: migrant or stowaway?" *Entomologist,* vol. 88: pp. 25-27. 1955. Indirect evidence for importation of this butterfly into Britain on timber ships from Scandinavia. [P. B.]

Nordman, A., "The geographical distribution in Europe of the migrations of the Large White, *Pieris brassicæ,* and some remarks on their climatological causes." *Notul. ent.,* vol. 34: pp. 99-106, 4 maps. 1954. Introduces some new points of view on the migrations of *P. brassicæ* in central Europe and shows in which areas of the Palearctic region extreme climate conditions exclude the occurrence of the species or at least prevent a higher frequency. [W. H.]

Nordström, Frithiof, "Fjärilvandring" [in Swedish]. *Ent. Tidskr.,* vol. 74: pp. 102-103. 1953. *Gonepteryx rhamni; Celerio lineata livornica.*

Owen, D. F., "Additional records of insect migration in S. W. France." *Ent. mo. Mag.,* vol. 90: pp. 112. 1954. *Pieris* & *Colias* seen flying south in September. [P. B.]

Parsons, R. E., "Migration of the butterfly *Appias albina danada.*" *Journ. Bombay nat. Hist. Soc.,* vol. 47: pp. 394-396. 1947.

Penn, George Henry, "Mass flight of *ocola* skippers." *Lepid. News,* vol 9: p. 79. 1955.

Rauch, Richard H., "Pennsylvania's super-flyway." *Penn. Forests & Waters,* vol. 3: pp. 116-177, 6 figs. 1957. Includes note on *Danaus plexippus* migrating. [P. B.]

Rothschild, Miriam, "Notes on insect migration on the north coast of France." *Ent. mo. Mag.,* vol. 93: pp. 375-276. 1956. Reports of minor movements of nymphalids & pierids. [P. B.]

Rudebeck, Gustav, "Some observations concerning migratory movements in *Pyrameis atalanta* L. together with some general considerations" [in Swedish; English summary]. *Opusc. ent.*, vol. 16: pp. 49-54, 1 map. 1951. Report on northward migration over SW extremity of Sweden. Notes on significance of insect migration. [P. B.]

Rzedowski, J., "Nota sobre un vuelo migratorio de la mariposa *Danaus plexippus* L. observado en la region de Ciudad del Maiz, S. L. P." [in Spanish; English summary]. *Acta zool. mexicana,* vol. 2, no. 2: pp. 1-4, 1 map. 1957. Notes on 2 southward flights in San Luis Potosi, in October & December. [P. B.]

Sevastopulo, D. G., "Field notes from East Africa — VIII." *Entomologist,* vol. 88: pp. 37-40. 1955. Notes on migrations of *Glycesthia creona infida, Achæa thermopera, Libythea labdaca, Achæa catocaloides, Catopsilia florella.* Larvae of *Alenophalera variegata* attacked by termites. List of butterflies at light. Brown form of *Acherontia atropos* larva, unlike other forms, does not feed or egest during daytime. [P. B.]

Stafford, C. W., "A small migration in Virginia." *Lepid. News,* vol. 10: p. 44. 1956.

Tanner, Vasco M., "Tortoise-shell butterfly in migration." *Great Basin Nat.,* vol. 13: p. 8. 1953. *Nymphalis californica,* in Utah. [P. B.]

Teale, Edwin Way, "An apparent migration of the Mourning Cloak." *Lepid. News,* vol. 9: p. 143. 1955.

Warnecke, Georg, "Wanderfalter in Europa" [in German]. *Zeitschr. wiener ent. Ges.,* vol. 35: pp. 100-106. 1950. General discussion of butterfly migration and of migrant spp. in Europe; notes on information needed. [P. B.]

Warnecke, Georg, "Besonderheiten der Wanderfalter-Einflüge 1952" [in German]. *In* Titschack, E., ed., *Deutscher Entomologentag in Hamburg,* 1953: pp: 200-203. Jena: Fischer. 1954. Report on notable flight of *Vanessa cardui* in Germany. [P. B.]

Warnecke, Georg, "Wanderfalter 1948 in Deutschland" [in German]. *Zeitschr. Lepid.,* vol. 3: pp. 65-71. 1955. Notes on 17 spp. of migrants in Germany. [P. B.]

Wittstadt, H., "Bericht über den Wanderzug von Weisslingen (Pieriden) in den bayerischen Gebieten im Sommer 1955" [in German]. *Nachrichtenbl. bayer. Ent.,* vol. 5: pp. 12-15, 28-31. 1956. Describes migration of *Pieris brassicæ* & *P. rapæ* in Donau region, and resulting plague of larvæ in southern Germany. [P. B.]

Yagi, Nobumasa, "On the emigration of butterflies" [in Japanese]. *New Entomologist,* vol. 1, nos. 3/4: pp. 3-4. 1952.

I. TECHNIQUES

Harvey, J. K., Improved technique for inflating and mounting insect larvæ." *Canad. Ent.,* vol.89: pp.280-283, 5 figs. 1957. Recommends drying inflated larva over infrared lamp. Describes procedure in removing gut, etc., inflating, and mounting; describes apparatus for making elbow pins on which to mount larvæ. [P.B.]

Hawkins, John, & J. J. Devitt, "Forecasting hatching levels of the European Corn Borer." *Journ. econ. Ent.,* vol.45: pp.203-209, 2 figs. 1952. Three methods observed, using regression lines, which will forecast the peak of larval hatching with considerable accuracy. [W.C.]

Hayano, Ikuo, "Reports on the Richard technique" [in Japanese]. *Shin Konchu,* vol. 5, no.4: pp.5-7, 2 figs. 1952. Reaction of female's foretarsi to the stimuli of foodplants is discussed, among others. [T.I.]

Henson, W. R., "A temperature gradient apparatus for small insects." *Canad. Ent.,* vol.90: pp. 54-59, 3 figs. 1958.

Hohl, F., "Sujet à traiter: Préparation des chenilles. Croquis de l'appareil à souffler" [in French]. *Bull. Soc. ent. Mulhouse,* 1950: pp. 3-5, 1 fig. Describes technique for inflating larvæ. [P.B.]

Houyez, P., "Technique: flacons à cyanure" [in French]. *Lambillionea,* vol.55: p.36. 1955. Describes method of making cyanide bottle, using plaster bandage. [P.B.]

Houyez, P., "Techniques d'élevages" [in French]. *Lambillionea,* vol.55: pp.77-79. 1955. Recommends pierced, used X-ray sheets for walls of rearing cages; nutrient solution for foodplants. Notes on special provisions for pupation, eclosion, etc. [P.B.]

Iwase, Taro, "Shephard technique for mating butterflies in captivity" [in Japanese]. *Shin Konchu,* vol.5, no.4: pp. 2-4. 1952. Japanese version of Dr. Ford's explanation in his *Butterflies* (1945), with Swynnerton's simpler method. [T.I.]

Janmoulle, E., "Technique: Utilization de pièges lumineux" [in French]. *Lambillionea,* vol.57: pp.28-30. 1957. Note on some light-traps: Rothamsted, Wageningen, & Robinson models. [P.V.]

Janse, A. J. T., "On the scientific value of type material and its care." *Journ. ent. Soc. southern Africa,* vol.10: pp.175-178. 1948. Recommendations on labelling, deposition, and storage, to keep types both safe and available. [P.B.]

Kaelin, A., & C. Auer, "Statistische Methoden zur Untersuchung von Insektenpopulationen dargestellt am Beispiel des Grauen Lärchenwicklers (*Eucosma griseana* Hb = *Semasia diniana* Gn.)" [in German]. *Zeitschr. angew. Ent.,* vol.36; pp.241-283, 423-461, 4 figs. 1954. A study of a population of *E. griseana* used to illustrate sampling methods and analysis of data by modern statistical techniques. [P.B.]

Koch, Manfred, "Die Tötungsspritze" [in German]. *Ent. Zeitschr.,* vol.59: pp.5-9. 1949. Describes method of killing insects with ammonia-filled syringe. [P.B.]

Kondo, Shigeki, "Reports on Richard technique" [in Japanese]. *Shin Konchu,* vol.5, no.4: pp.8-10. 1952. Papilionidæ 1, Pieridæ 2, Nymphalidæ 9, Satyridæ 2, Lycænidæ 4, Hesperiidæ 1 succeeded. Nymphalidæ 3, Satyridæ 1, Pieridæ 2 failed. [T.I.]

de Lesse, H., "Pour des méthodes de récoltes entomologiques pratiques et modernes" [in French]. *Entomologiste* 11: pp.120-123. "1955" [1956]. Indications for practical and modern methods to collect Rhopalocera. [P.V.]

Leston, Dennis, "The stethoscopic cage: a device for hearing the sounds produced by small arthropods." *Entomologist,* vol.88: pp.188-189, 1 fig. 1955. Describes cage made of celluloid between 2 funnels, connected by rubber tubing to ear pieces. [P.B.]

Lughofer, Franz, "Köderfang der *Brephos*-Arten" [in German]. *Zeitschr. wiener ent. Ges.,* vol.39: p.181. 1954. Reports taking 2 spp. in daylight at liquid manure. [P.B.]

Miles, Philip M., "A trap designed to collect insects attracted by 'sugar'." *Ent. mo. Mag.,* vol.90: pp. 86-87, 1 fig. 1954. Trap consists of section of tree trunk surmounted by a plastic canopy and resting in a plastic cone, beneath which is a killing bottle. [P.B.]

Miller, C. A., "A technique for assessing Spruce Budworn larval mortality caused by parasites." *Canad. Journ. Zool.,* vol.33: pp.5-17, 3 figs. 1955. Describes method: proportion of larvæ parasitized is estimated from samples, and mortality at time of parasite emergence is calculated (to eliminate mortality of parasitized larvæ caused by other factors). [P.B.]

Miller, L. W., & E. J. Martyn, "A sampling technique for undergound grass grubs." *Journ. Austral. Inst. agric. Sci.,* vol.18: pp.110-111, 2 figs. 1952. Technique described for estimating larval populations of the pasture pest, *Oncopera intricata* (Hepialidæ). [I.C.]

Morris, R. F., "A sequential sampling technique for Spruce Budworn egg surveys." *Canad. Journ. Zool.,* vol.32: pp.302-313, 4 figs. 1954. Describes sampling technique permitting prediction of level of infestation. [P.B.]

Morris, R. F., "The development of sampling techniques for forest insect defoliators, with particular reference to the Spruce Budworm." *Canad. Journ. Zool.,* vol.33: pp. 225-294, 16 figs. 1955. Deals with objectives, all aspects of planning, sampling, & data evaluation. The methods, designed to give as complete a picture as possible of *Choristoneura fumiferana* populations, deserve application to other insects. [P.B.]

Morris, R. F., & C. A. Miller, "The development of life tables for the Spruce Budworm." *Canad. Journ. Zool.,* vol.32: pp.283-301, 1 fig. 1954. Describes methods of sampling and analysis permitting development of tables which show mortality and survivorship in all stages, and factors responsible for mortality; methods developed for *Choristoneura fumiferana.* [P.B.]

Morris, R. F., F. E. Webb, & C. W. Bennett, "A method of phenological survey for use in forest insect studies." *Canad. Journ. Zool.,* vol.34: pp.533-540, 2 maps. "1956" [1957]. Measurement of shoot growth of host plant in different areas gives an indication of phenological differences between these areas, and permits more accurate timing of samples of insect populations. Technique developed in studies on *Choristoneura fumiferana.* [P.B.]

Ono, Sachio, "My experiments in Richard technique" [in Japanese]. *Shin Konchu,* vol.5, no.4: pp.11-12. 1952. 3 examples of success & equal number of failures. [T.I.]

Pitman, C. M. B., "Fruit as a bait for moths." *Ent. Rec. & Journ. Var.,* vol.69: pp.6-8. 1957. Notes on effectiveness of rotten pears, in comparison with "sugar". [P.B.]

Riley, N. D., "A fungicide of entomological interest." *Ent. Gaz.,* vol.5: p.62. 1954. Reports successful mailing of butterflies papered in envelopes dampened with merthiolate; immediate setting was possible after two months in shipment. [P.B.]

Robinson, H. S., "Prophylactic methods in the rearing of lepidopterous larvæ." *Ent. Gaz.,* vol.1: pp.139-141. 1950. Describes methods of sterile rearing; reports that one commercial disinfectant eliminates losses from disease introduced on foodplant. [P.B.]

Robinson, H. S., "A new larval detergent." *Ent. Rec. & Journ. Var.,* vol.63: pp.218-219. 1951. Reports successful treatment of diseased larvæ with "T.C.P." disinfectant. [P.B.]

Robinson, H. S., "The effects of light on night-flying insects." *Proc. Trans. south London ent. nat. Hist. Soc.,* 1950-51: pp.112-113, 1 pl., 6 figs. 1951. Disucsses properties of various light sources as they affect insects, especially different spectral ranges visible to humans and to insects; and behavior of night-flying insects under artificial illumination. Mercury vapor lamps are best light sources for attracting moths; a trap with such a lamp set over a funnel divided by vertical vanes is very efficient. [P.B.]

Robinson, H. S., "The optimum conditions for the occurrence and observation of rare insects." *Proc. Trans. south London ent. nat. Hist. Soc.,* 1951-52: pp 118-125, 2 figs. 1952. Introduces methods of calculating the probability of occurrence of an insect of known rarity in a sample of a given size. Capture of rarities is favored by proper selection of time and place and by technique permitting collection of maximum number of insects; for night-flying Lepidoptera, these conditions are met by use of light traps, especially on warm, moonless nights with high humidity. [P.B.]

Robinson, H. S., "Mercury-vapour lamp technicalities." *Ent. Gaz.,* vol.4: pp.280-281. 1953. On connecting these lamps, which cannot be used directly on ordinary electric circuits. [P.B.]

Robinson, H. S., "Mercury-vapour lamp technicalities. No.2—power factor correction condensers." *Ent. Gaz.,* vol.5: pp.111-112. 1954. Method of restoring power lost by necessary use of an impedance. [P.B.]

Robinson, H. S., & P. J. M. Robinson, "Some notes on the observed behaviour of Lepidoptera in flight in the vicinity of light-sources together with a description of a light-trap designed to take entomological samples." *Ent. Gaz.,* vol.1: pp.3-15, 12 figs. 1950. Considers the most effective light source to be that with the maximum surface brightness (therefore, the minimum surface). Describes a light trap, suitable for collecting living specimens, based on this principle. Noctuidæ and Sphingidæ taken in this trap in one summer's collecting are listed by abundance classes. [P.B.]

Rohlf, F. James, "A new technique in the preserving of soft-bodied insects and spiders." *Turtox News,* vol.35: pp. 226-228, 4 figs. 1957. Larvæ are dehydrated in alcohol or dioxane and left in anhydrous ether for a day or more; they are then heated near a lamp until all ether has evaporated. The vaporising ether expands the specimen. [P.B.]

Ross, Edward S., *Insects close up.* 81 pp. Berkeley: Univ. Calif. Press. 1953. See review in *Lepid. News,* vol.10: p.57.

Rozman, Robert, "Notes on techniques." *Lepid. News,* vol.11: p.53. 1958,

Salt, R. W., "Extent of ice formation in frozen tissues, and a new method for its measurement." *Canad. Journ. Zool.,* vol.33: pp.391-403, 6 figs. 1955. Technique applies to larvæ of *Loxostege sticticalis,* and other insects. [P.B.]

Schams, Ewald, "Über das Konservieren von Puppen" [in German]. *Zeitschr. wiener ent. Ges.,* vol.42: pp.72-74. 1957. Recommends packing pupal shell with cotton wool and gluing parts back in natural position; method said to be superior to preservation of whole pupæ, though more laborious. [P.B.]

Singh, M. P., "A note on cutworms and their rearing." *In* D. K. McE. Kevan, ed., *Soil Zoology:* pp.281-283. London: Butterworth. 1955. Rearing precautions and general biology of these noctuid larvæ. [P.B.]

Stahl, C. F., "Trapping hornworm moths." *Journ. econ. Ent.,* vol.47: pp.879-882, 4 figs. 1954. Large numbers of adults of the Tobacco Hornworm, *Protoparce sexta,* and of the Tomato Hornworm, *P. quinquemaculata,* were captured in both bait and light traps, but the use of such traps had little or no effect on the general hornworm population. [W.C.]

Straatman, Raymond, "Notes on methods of collecting Indo-Australian Lepidoptera." *Lepid. News,* vol.9: pp.74-76. 1955.

Surany, Paul, "Continuous mass rearing of the European Corn Borer in the laboratory." *Biol. Notes Ill. nat. Hist. Survey,* no.37: 11 pp., 7 figs. 1957. Describes various types of containers used, and techniques used for mass rearing of *Pyrausta nubilalis.* Larvæ fed on string beans. [P.B.]

Swain, H. D., "On stripping and papering insect cabinets." *Ent. Gaz.*, vol 2: pp.183-185, 2 figs. 1951. Useful information on procedure in reconditioning old drawers. [P.B.]

Symes, H., "Notes on the treatment of hibernating larvæ." *Ent. Rec. & Journ. Var.*, vol.69: pp.208-211. 1957.

Travassos Filho, Lauro, "Líquido para preservação das estruturas internas de lepidópteros e demais insetos que habitualmente se montam en alfinetes" [in Portuguese; English summary]. *Arq. Zool. Est. São Paulo*, vol.7: pp.439-444, 1 pl. 1950. Recommends killing Lepidoptera by injecting fluid which fixes and preserves internal organs. [P.B.]

Uhler, Lowell D., "How to make a cyanide killing jar." *Turtox News*, vol.31: p.30. 1953. Recommends putting plaster in dry and moistening with atomizer. [P.B.]

Vago, C., "Action du permanganate de potassium comme désinfectant des œufs d'insectes vis-à-vis des viroses" [in French]. *Bull. Soc. zool. France*, vol.79: pp.138-141. 1954. Treatment of eggs with 1% $KMnO_4$ virtually eliminates virus disease in larvæ. [P.B.]

Vanderzant, E. S., "Growth and reproduction of the Pink Bollworm on an amino acid medium." *Journ. econ. Ent.*, vol.50: pp.219-221. 1957. Describes artificial diet used. [W.C.]

Vanderzant, E. S., & R. Reiser, "Aseptic rearing of the Pink Bollworm on synthetic media." *Journ. econ. Ent.*, vol.49: pp.7-10. 1956. *Pectinophora gossypiella* reared for 3 generations. [W.C.]

Vanderzant, E. S. & R. Reiser, "Studies of the nutrition of the Pink Bollworm using purified casein media." *Journ. econ. Ent.*, vol.49: pp.454-458. 1956. Media with synthetic base successfully used to rear *Pectinophora gossypiella*. Data on requirements given. [P.B.]

Vestjens, W., "Breeding *Nymphalis io* L. and *Aglais urticæ* L. with artificial light" [in English; Dutch summary]. *Ent. Berichten*, vol.15: pp.505-509, 3 figs. 1955. Mating and oviposition took place readily in box lit by fluorescent tubes; 4 successive generations of *N. io* reared in 3 months. [P.B.]

Wagstaffe, Reginald, & J. Havelock Fiedler, eds., *The preservation of natural history specimens. Volume One. Invertebrates.* xiii + 205 pp. 139 figs. New York: Philosophical Library. 1955. Includes section on Lepidoptera: killing, setting adults, mounting genitalia, and preservation of other stages. [P.B.]

Waldbauer, Gilbert B., "Freezing: a method for the preservation of insects." *Turtox News*, vol.33: p.186. 1955. Recommended for specimens to be dissected. [P.B.]

Weaver, Nevin, & Russell C. Thomas, Jr., "A fixative for use in dissecting insects." *Stain Technol.*, vol.31: pp.25-26. 1956. 5 ml. 40% formaldehyde, 2½ ml. glacial acetic acid, 20 gm. chloral hydrate, diluted to 100 ml. with distilled water; said to harden soft parts, soften cuticular structures, and preserve tissue undistorted. [P.B.]

Williams, C. B., R. A. French, & M. M. Hosni, "A second experiment on testing the relative efficiency of insect traps." *Bull. ent. Res.*, vol.46: pp.193-204, 2 figs. 1955. Ultraviolet light more efficient than ordinary light, and Robinson light trap superior to Rothamsted model for Macrolepidoptera. [P.B.]

Wyatt, S. Silver, "Culture *in vitro* of tissue from the Silkworm, *Bombyx mori* L." *Journ. gen. Physiol.*, vol.39: pp.841-852, 3 pls. 1956.

Wykes, N. G., "The techniques of entomological drawing in water-colours." *Proc. Trans. south London ent. nat. Hist. Soc.*, 1953-54; pp.98-103. 1955. Describes method of painting Lepidoptera. [P.B.]

J. MISCELLANY

Munroe, Eugene, "Karl Jordan the lepidopterist." *Trans. Roy. ent. Soc. London*, vol. 107: pp. 69-75. 1955.

Paclt, J., "Obituary. Felix Bryk. 1882-1957." *Entomologist*, vol. 90: p. 192. 1957.

Patočka, Jan, "Za RNDr. Vladislavem Paškem" [in Czech]. *Acta Soc. zool. Bohemoslov.*, vol. 19: pp. 97-98, 1 fig. 1955. Obituary note with a review of published studies. [J. M.]

Pfeffer, Antonín, "†Clen korespondent CSAV Julius Miloš Komárek" [in Czech]. *Acta Soc. zool. Bohemoslov.*, vol. 19: pp. 297-305, 1 fig. 1955. Obituary note with a review of published studies. Prof. Dr. Komárek studied problems about harmful Lepidoptera, namely *Lymantria*. [J. M.]

Rautenberg, L. E., "Beiträge zur Kenntnis alter naturwissenschaftlicher Werke. Beitrag 6" [in German]. *Beitr. Ent.,* vol.5: pp.60-69, 5 figs. 1955. Describes work by Drümpelmann & Friebe, 1806-1814, on fauna of NE Russia; records animals described & figured (including Lepidoptera); reproduces 3 of the fine plates (2 show Lepidoptera). [P.B.]

Rautenberg, L. E., "Beiträge zur Kenntnis alter naturwissenschaftlicher Werke. Beitrag 9. Karl August Friedrich Harzer als Autor und Illustrator" [in German]. *Beitr. Ent.,* vol.6: pp.180-190, 5 figs. 1956. Information on the rare *Der Kleine Schmetterlingsjäger,* by Harzer (1829) and on the books which he illustrated. [P.B.]

Rautenberg, L. E., "Beiträge zur Kenntnis alter naturwissenschaftlicher Werke. Beitrag 11" [in German; English & Russian summaries]. *Beitr. Ent.,* vol.7: pp.429-444, 4 figs. 1957. Describes the very rare *Beschreibung und Abbildung schlesischer Insekten, Schmetterlinge,* shown here to be by Carl Richter; lists parts, & Lepidoptera treated & figured. [P.B.]

Rautenberg, L. E., "Beiträge zur Kenntnis alter naturwissenschaftlicher Werke. Beitrag 12" [in German; English & Russian summaries]. *Beitr. Ent.,* vol.7: pp.609-631, 4 figs. 1957. Describes the *Fauna insectorum Europæ* (1812-1847) published in 24 parts by Ahrens, Kaulfuss, & Germar, and gives an index to it. [P.B.]

Reiss, Hugo, "Direktor Dr. H. Thomann in Landquart (GB) 80 Jahre alt" [in German]. *Zeitschr. wiener ent. Ges.,* vol.40: pp.212-214, 1 fig. 1955. Biographical note on Austrian lepidopterist, with list of publications and of new species discovered by him. [P.B.]

Reisser, Hans, "Dipl.-Ing. Hans Kautz†. Ehrenmitglied der Wiener ent. Gesellschaft" [in German]. *Zeitschr. wiener ent. Ges.,* vol.41: pp.241-245, 1 pl. 1956. Obituary of Austrian lepidopterist who specialized in variation of *Pieris napi* & *P. bryoniæ.* [P.B.]

Reisser, [H.], "Dr. Hermann Ronniger†" [in German]. *Zeitschr. wiener ent. Ges.,* vol. 41: pp.210-212, 1 fig. 1956. Obituary & list of publications of Austrian lepidopterist. [P.B.]

Reisser, [H.], Leo Schwingenschuss†. Ehrenmitglied der Wiener ent. Gesellschaft" [in German]. *Zeitschr. wiener ent. Ges.,* vol.41: pp.270-272, 1 pl. 1956. Obituary of Austrian entomologist. [P.B.]

Reisser, [H.], "Ludwig Osthelder†. Korrespondierendes Mitglied der Wiener ent. Gesellschaft" [in German]. *Zeitsch. wiener ent. Ges.,* vol.41: pp.212-213. 1956. Obituary of German lepidopterist. [P.B.]

R[eisser, H.], "Robert Spitz†. Ehrenmitglied der Wiener ent. Gesellschaft" [in German]. *Zeitschr. wiener ent. Ges.,* vol.41: pp.245-246, 1 pl. 1956. Obituary of Austrian lepidopterist. [P.B.]

Reisser, [H.], "Dr. Egon Galvagni†, Ehrenmitglied der Wiener ent. Gesellschaft" [in German]. *Zeitschr. wiener ent. Ges.,* vol.42: pp.129-131, 1 pl. 1957. Obituary of Austrian lepidopterist. [P.B.]

Remington, C. L., "How many butterfly species in a day?" *Lepid. News,* vol.9: pp.77-78. 1955.

Robinson, H. S., "Some suggestions on the examination of an ethical and a practical problem." *Ent. Gaz.,* vol.3: pp.45-51. 1952. Considers ethics of killing insects. Denies that light-trap collecting seriously reduces moth population. [P.B.]

Roepke, W., "Enkele aantekeningen over het werk vaon Pieter Cramer en over zijn persoon" [in Dutch; English summary]. *Ent. Berichten,* vol.16: pp.22-25. 1956. Bibliographical notes. Gives dates of publication of parts of Cramer's *Papillons exotiques.* [P.B.]

Ronniger, H., "Ing. Anton Ortner†" [in German]. *Zeitsch. wiener ent. Ges.,* vol.39: pp.178-179, 1 fig. 1954. Obituary of Austrian microlepidopterist. [P.B.]

Rothschild, Miriam, "Karl Jordan: a biography." *Trans. Roy. ent. Soc. London,* vol. 107: pp.1-9. 1955.

Schaefer, L., M. Teyreaux, & M. Coquillet, "Henri Testout, entomologiste" [in French]. *Bull. mens. Soc. linn. Lyon,* vol.20: pp.73-78. 1951. Obituary of French lepidopterist; list of his publications and of new entities he described. [P.B.]

Seitz, Adalbert, & Elli Franz, *Als Naturforscher durch alle Erdteile.* 315 pp., 78 figs. Frankfurt am Main: Kramer. 1951. Collected accounts of Seitz's collecting trips; many Lepidoptera mentioned. [P.B.]

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JOURNAL OF
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Volume 13 1959 Number 3

SOME COMMENTS ON PROTECTIVE RESEMBLANCE AMONGST AFRICAN LEPIDOPTERA (RHOPALOCERA)*

by V. G. L. VAN SOMEREN and T. H. E. JACKSON

INTRODUCTION

The essence of life is the ability to survive, and the chances of survival of a species largely depend on the degree of plasticity or adaptability exhibited by that species in the struggle for existence. Natural Selection, working on small mutations, inherent in the genetics of all forms of life, is the means whereby adaptation is achieved. The struggle for existence has gone on since the dawn of Life and must therefore be of universal application. The object of this paper is to give certain evidence, so far as African Lepidoptera (Rhopalocera) are concerned, in support of this view on Evolution.

CHARLES DARWIN, in his *Origin of Species,* expounded the broad principles governing the formation of species, and the application of these principles to the special case of "Mimicry" and Müllerian Resemblance formed the classical writings of BATES, WALLACE, MÜLLER, TRIMEN, POULTON, and others.

In so far as Africa is concerned, attention was first focussed on the subject by TRIMEN, and later by POULTON and HALE CARPENTER. They were amply assisted in the field by such great naturalists as MARSHALL, SWYNNERTON and CARPENTER himself. It was shown that in Africa "Mimicry and Mullerian Resemblance" centered around two compact groups of distasteful butterflies, the Danaidæ and Acræidæ, the mimics being found chiefly amongst the Nymphalidæ, Papilionidæ and Lycænidæ.

The accumulated knowledge was crystalized and ably illustrated by ELTRINGHAM in his *African Mimetic Butterflies* (1910), and the work has been carried still further by POULTON, CARPENTER and others.

SIMPLE OR PRIMITIVE MIMICRY

To those who have had the opportunity of extensive collecting in Africa, the impression must have been conveyed at some time or other that numerous species appear deceptively alike. This may be noted in the field, or perhaps

* The cost of several of the colored plates with this paper has been financed by the generous support of MARGARET M. CARY, L. B. DOYLE, B. HEINEMAN, S. A. HESSEL, R.R. MCELVARE, and B. STRUCK; the remainder has been borne by the authors. — C. L. R.

not even until the end of the days' collecting when the captures are being examined. Obvious examples of Batesian mimicry and Müllerian Resemblance are noted, but there are others outside these two catagories which obtrude themselves, for example the numerous species of *Neptis* which were taken flying together in the same area, all black and white, all very similarly patterned, some large, some small, not distinguishable on the wing, yet obviously different when closely examined. Some turn out to be common, others rare. Then one may note amongst the captures certain examples which are not *Neptis* nor *Neptidopsis,* but female *Euptera* or even *Pseudothyma.*

Our own experience in the field supplies ample evidence that the theory of Batesian Mimicry and Müllerian Resemblance is sound. We feel however that many simpler and more primitive forms of "protective resemblance" have been overlooked, largely perhaps because it was always considered essential to find a distasteful model around which a group could be centered. We submit that this criterion is not always necessary, and further, that since "Batesian and Mullerian Resemblance" are very highly specialised products of evolution, the more primitive groups would be most unlikely to contain distasteful models. It is necessary therefore, to look for much simpler factors in the "models" which would nevertheless be sufficient to bring the forces of Natural Selection into play. The use of the term "primitive" is relative: here a contrast between groups which have evolved specialised glands and fluids to promote protection, thus highly specialised products, and groups which have not. A species may go on mutating and forming other species, which latter will be "younger" as species than their ancestors; and conversely, another may not mutate, or may not mutate so fast, and yet may be found today in its original form along with species 1a and 1b; thus No. 2 might be considered "more primitive" than 1a or 1b.

The Müllerian groups present the greatest evolutionary advance amongst Rhopalocera; they possess specialised glands whose secretions are relatively nauseating to would-be predators and thus enjoy a high degree of immunity to attack. Due to this, they have evolved certain pronounced and unusual habits such as slow sailing flight, they select exposed positions for resting, and are almost devoid of "fear" responses.

We suggest that "Protective Resemblance" exists among relatively *edible* Rhopalocera and can be divided into three natural groups each involving factors other than distastefulness, as follows:

A. *Large size, great strength, and toughness of integument* such as we find amongst the Charaxidinæ.

B. *Difficulty of capture, i.e.* quickness of flight together with great power of vision and wariness; a form of low flight which is obliterative, the colours of the upperside (browns, blues, and greens chiefly) being eminently suited to the environment and blending with high-lights and shadows; a flight close to the ground, in and out of the undergrowth so that the colours appear intermittently.

Examples: Nymphalinæ, especially *Euphædra, Euryphene, Euryphura,* and *Diestogyna.* (The late Prof. HALE CARPENTER suggested the term "dysleptic", *i.e.* difficult to capture, for this group.)

C. *Safety in numbers.* A species will gain by resemblance to another species, if attacked, by the simple law of average. There is no limit to the number of species that may be so associated. This is the principle involved in Müllerian Resemblance amongst associated distasteful species, and there appears no reason why it should not apply to relatively edible species as well. Among a group such as this, it would assure that no one edible species would be preyed upon to the exclusion of the others. Thus ELTRINGHAM (1910: p.19) quoting from MELDOLA'S translation of MÜLLER'S original paper, wrote: "If both species are equally common then both will derive the same benefit from their resemblance — each will save half the number of victims which it has to furnish to the inexperience of its foes. But if one species is commoner than the other, then the benefit is unequally divided, and the proportional advantage for each of the two species which arises from their resemblance is *as the square* of their relative numbers. . . . Let us suppose that in a given region . . . . 1200 butterflies of a distasteful species have to be destroyed . . . . and that in this region there exist 2,000 individuals of one (A) and 10,000 of another (B) distasteful species. If they are quite different, each species will lose 1,200 individuals; but if they are deceptively alike, then this loss will be divided among them in proportion to their numbers, the first (A) will lose 200, and the second (B) 1,000. The former (A) accordingly gains 1,000 (or 50 percent.) of the total loss, and the latter (B) only 200 (or 2 percent.) of this number. Thus while the relative number of the two species is in the ratio of 1 : 5, the advantage derived by those possessing the resemblance is 25 : 1." These remarks of course referred to two distasteful species, but they apply equally well to non-distasteful. There is thus an "arithmetic" basis to the degree of advantage accruing, and it is this *"arithmetic"* aspect, so well exemplified in what we term *Simple or Primitive Mimicry* among edible groups to which we wish to call attention, and emphasise. The principle involved in these groups is precisely that quoted by ELTRINGHAM. Although we have cited other attributes which may possibly assist in the protection of the species, this "arithmetic" aspect applies in all groups. We submit the following grouping and examples.

PROPOSED GROUPING IN MORE DETAIL

Group A. Nymphalidæ: Charaxidinæ.

The similarity of colouration and pattern amongst many *Charaxes* was drawn attention to by POULTON (1926). He cited various examples and these we repeat here with additions and corrections to the nomenclature. The models are common and always larger and are characterised by tough integument, considerable fighting power, strong flight and comparative wariness.

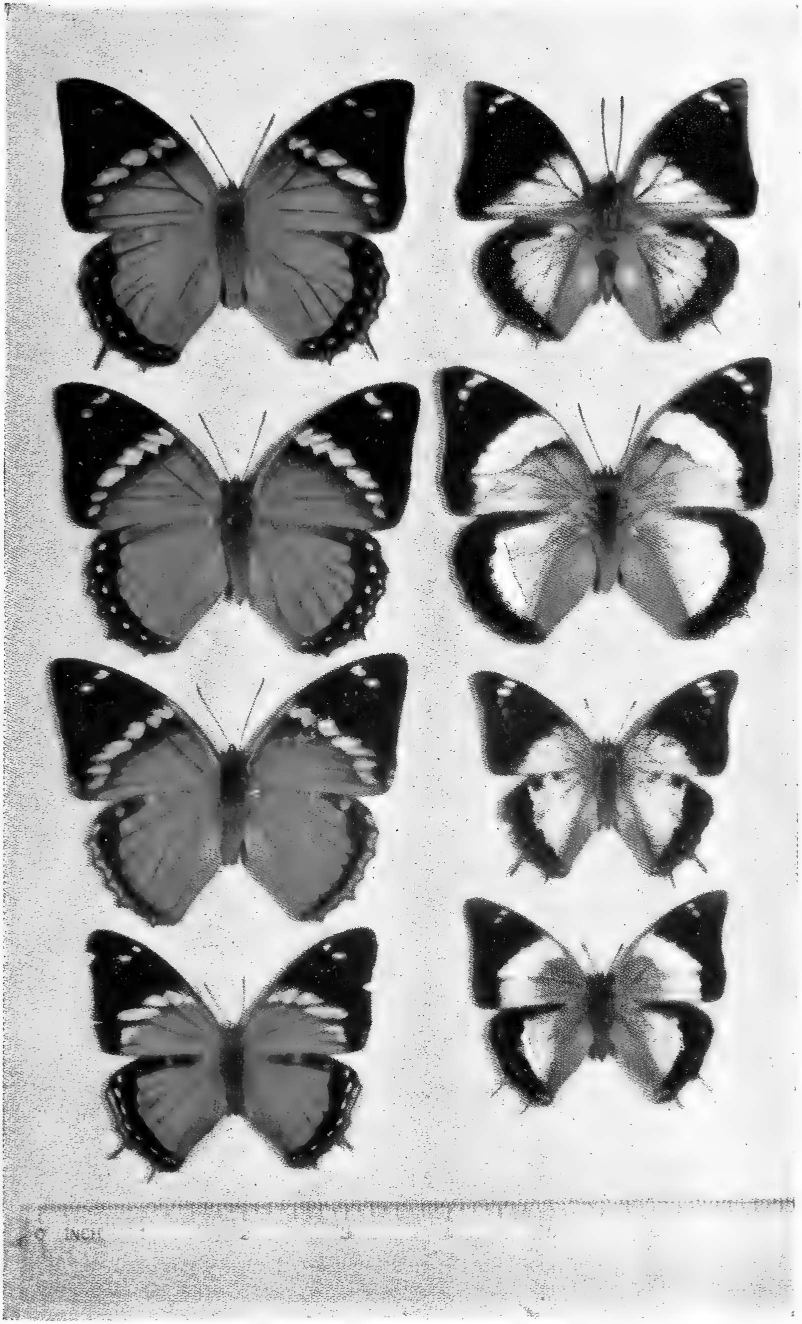
The mimics are always smaller and weaker, and often rare. This is, in fact, a form of Müllerian mimicry in that it involves a deterrant in the models, but of a kind differing from that implied in the usual concept of Müllerian resemblance based on *distastefulness.* The resemblance in Group A is one of colour and pattern alone; all are *edible.*

MODEL	MIMIC
Charaxes tiridates Cramer ♂	*C. numenes* Hew. ♂ *C. bipunctatus* Roths. ♂ *C. mixtus* Roths. ♂ & ♀ *C. etheocles* Cramer ♀ f. "alladinis"
C. tiridates ♀ (See Plate 1)	*C. numenes* ♀ *C. bipunctatus* ♀ *C. cedreatis* Hew. ♀
C. bohemanni Felder ♂ (See Plate 1)	*C. viola phæus* Hew. f. ♀ "phæus" *C. manica* Trimen, f. ♀ "pseudophæus"
C. bohemanni ♀ (See Plate 1)	*C. manica* Trimen, f. ♀ "manica" *C. fulgurata* Aur. f. ♀ "fulgens" *C. fulgurata* f. ♀ "lunigera"
C. brutus Cramer	*C. hildebrandtii* Dewitz ♂ & ♀ *C. baumanni* Rog. ♂ & ♀ *C. opinatus* Heron ♀ *C. aubyni* Poulton f. ♀ "aubyni"
C. ameliæ Doumet ♀	*C. etheocles* Cramer f. "etheocles" ♀ *C. etheocles* f. "catachrous" ♀ *C. etesipe* Godart f. ♀ "etesipe"
C. castor Cramer	*C. etesipe* Godart f. ♀ "castoroides"
C. protoclea Feisth. ♂	*C. anticlea* Drury ♂
C. pelias saturnus Butler	*C. achæmenes* Felder f. ♀ "achæmenes" *C. viola kirki* Butler f. ♀ "rogersi"
C. cithæron Felder	*C. violetta* Smith ♂ & ♀ *C. ethalion* Bois. f. ♀ "rosæ"
C. ansorgei Roths.	*C. etheocles evansi* van Som. ♀

Many other examples could be quoted, but the above are outstanding amongst this group.

Plate 1.* Group A. Left row (all from Uganda), top to bottom: *Charaxes tiridates* ♀ [C]; *C. numenes* ♀ [C]; *C. bipunctatus* ♀ [MR]; *C. cedreatis* ♀ [MR]. Right row (all from South Africa), top to bottom: *C. bohemanni* ♂ [C]; *C. bohemanni* ♀ [C]; *C. viola phæus* f. ♀ "phæus" [MR]; *C. manica* f. ♀ "manica" [MR].

* In all plate captions, C=common, M=moderately, R=rare.



Group B. Nymphalinæ.

The genera, *Euphædra, Euryphene, Euryphura,* and *Diestogyna* possess to a marked degree the characteristics already mentioned for this group. They are denizens of the great African forest regions, which, it is generally agreed, at one time covered most of the continent. They must therefore be a very ancient group and should show, to great perfection, "Protective Resemblance." There is evidence that the age of the Great Primary Forests in Africa is very far removed in time from the present; thus it is fair to assume that the forest faunua is more primitive than that of the savannah and secondary forests. It was in the latter that the high degree of specialisation first evolved (*i.e.* the development of glands secreting acrid and obnoxious substances, as in Acræinæ and Danainæ), in response to the more open and exacting environment. Nevertheless, one cannot assume that the more ancient forest fauna did not also evolve its own forms of protective resemblance, and it is, in part, the object of this paper to draw attention to this fact.

A study of the Nymphalinæ both in cabinet and in the field amply demonstrates that this is the case; the resemblances amongst the whole group are so bewilderingly alike, that a minute examination is often required for separation of the species, and in some cases, particularly *Euphædra,* classification is still far from satisfactory.

The group feeds in the adult stage exclusively on rotting fruits on the ground, with wings closed after a deliberate perceptable *full exposure* of the upper surface. The underside is cryptic. It is the upperside or exposed surface which has been, and still is being modified by Natural Selection. We are convinced that this is no chance resemblance, and the numbers of entirely different models and groups show that it cannot be due to a common environment, parallel development, or consanguinity; several genera may be involved. In some cases both sexes are affected, in others only one sex, and this applies to both models and mimics. The greater the uniformity of colour, the greater the chance of escape of the weaker less numerous species in the association which conform to this colour and pattern, for it must be remembered that the important predators hunt by sight, and colour is therefore all-important. A glance at the examples cited, where are often involved one sex only, species of different genera, and far removed in time, completely rules out any suggestion of consanguinity.

The underside patterns retain the ancient characters diagnostic of the species; within minor limits of variation these are extraordinarily constant. This point cannot be overstressed.

The models are sometimes larger and are always common and dominant species of a given area; the mimics are weaker and often rare.

From amongst several large groups which could be cited, we select to illustrate our point the following examples:

MODEL	MIMIC
Euphædra spatiosa Mab. ♂ & ♀	*Euphædra medon innotata* Holl. ♀
(See Plates 2 & 3)	*Euphædra herberti* Sharpe ♀
	Euryphene comus Ward ♂ & ♀
	Euryphene phranza moreelsi Aur. ♀
	Euryphene flaminia Stdg. ♂ & ♀
	Euryphene maximiana Stdg. ♂ & ♀
	Euryphene nivaria Ward ♂ & ♀
	Euryphene rubrocostata Aur.
	Euryphene wilwerthi Aur
	Harmilla hawkeri Joicey & Talbot ♂ & ♀
Euphædra zaddachi Hew.[1]	*Euphædra eusemoides imitans* Holl.
(See Plate 3)	
Euphædra sarita inanoides Sharpe ♂ & ♀	*Euphædra eberti* Aur. ♂ & ♀
	Euphædra preussi Stdg. ♂ & ♀
	Euphædra xypete cyanea Holl. ♂ & ♀
	Euphædra xypete cærulescens Smith ♂ & ♀
	Euphædra karschi Bartel ♂ & ♀
	Euryphene aurivilii Niep. ♂ & ♀
	Euryphene phantasia Hew. ♀ white bar
	Euryphene severini Aur. ♀
	Euryphene chlæropis B. Baker ♀
	Euryphene leptotypa B. Baker ♀
	Euryphene luteola B. Baker ♀
Euphædra ceres Fab.	*Euphædra gausape* Butler ♂ & ♀
(See Plate 4)	
Euphædra themis aureola Kirby	*Euphædra cyparissa aurata* Carp. ♂ & ♀
(See Plates 4, 5)[2]	*Euryphene sophus sophus* Fab.
	Euryphene congolensis Capron.
	Euryphene phranza phranza Hew.
	Euryphene lætitia Plötz
	Euryphene cutteri Hew.
	Euryphene sp. nov. ?

[1]The diurnal agaristid moth *Xanthospilopteryx longipennis* Wlk. is thought to be the primary model, but the moth is sporadic in appearance, and field experience shows that *E. zaddachi*, which is very common, is the model for *E. eusemoides imitans.*

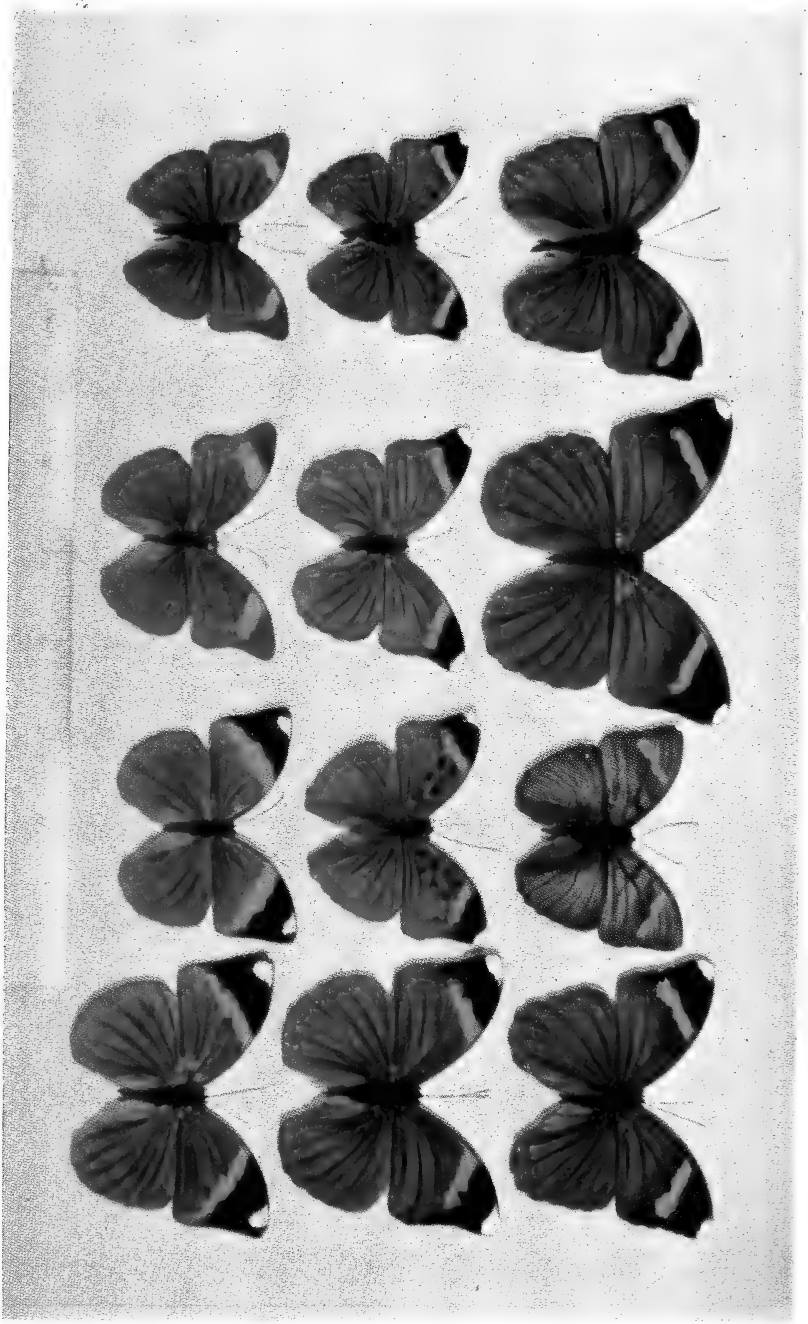
[2]Note that the uppersides are amazingly alike, but the undersides of all are very different and fully diagnostic of the species.

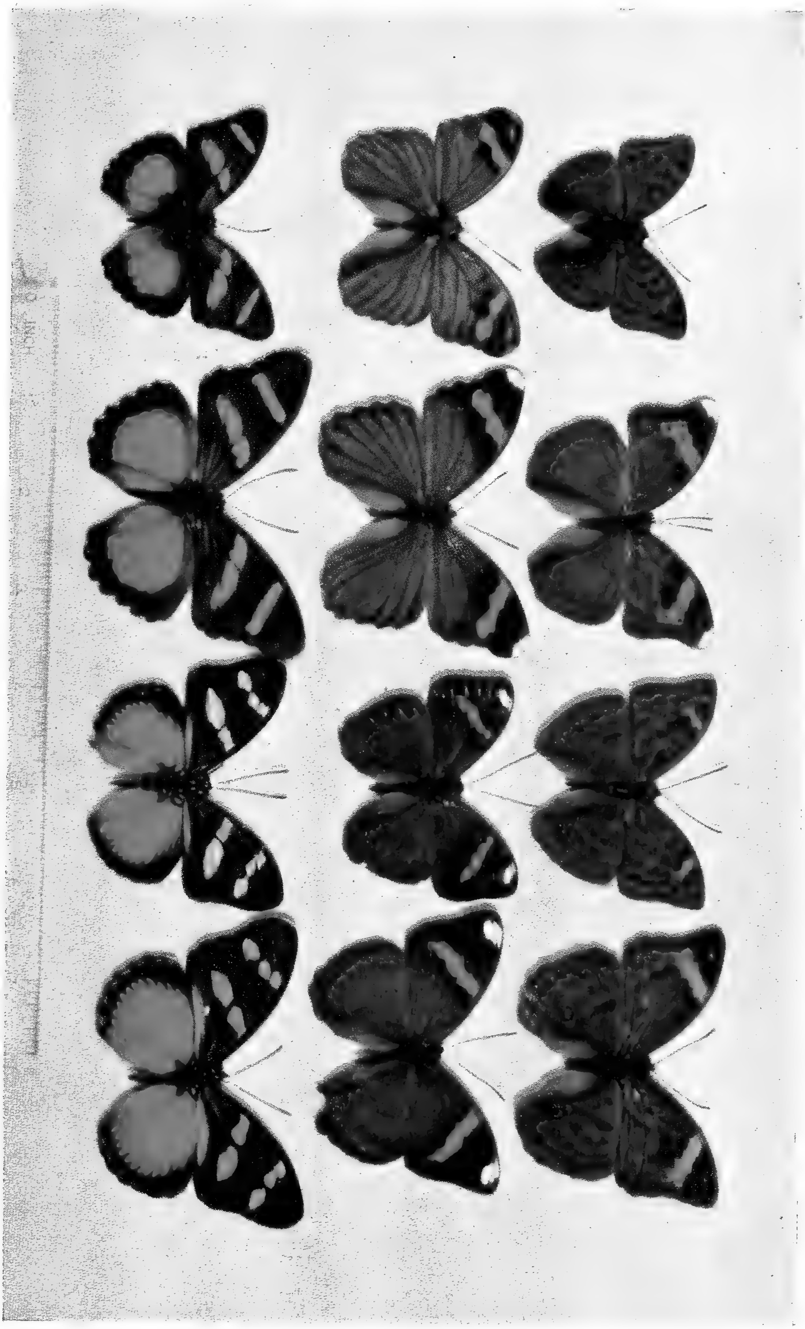
Plate 2. Group B. All from eastern Belgian Congo. Left two rows: top, *Euphædra spatiosa* [C]; middle, *E. flaminia* [MC]; bottom, *E. nivaria* [R]. Right two rows: top, *E. medon innotata* (♂ non-mimetic) [C]; middle, *E. maximiana* [MR]; bottom, *E. comus* [MR]. For each species on plates 2, 3, 5, ♂ is at left, ♀ at right.

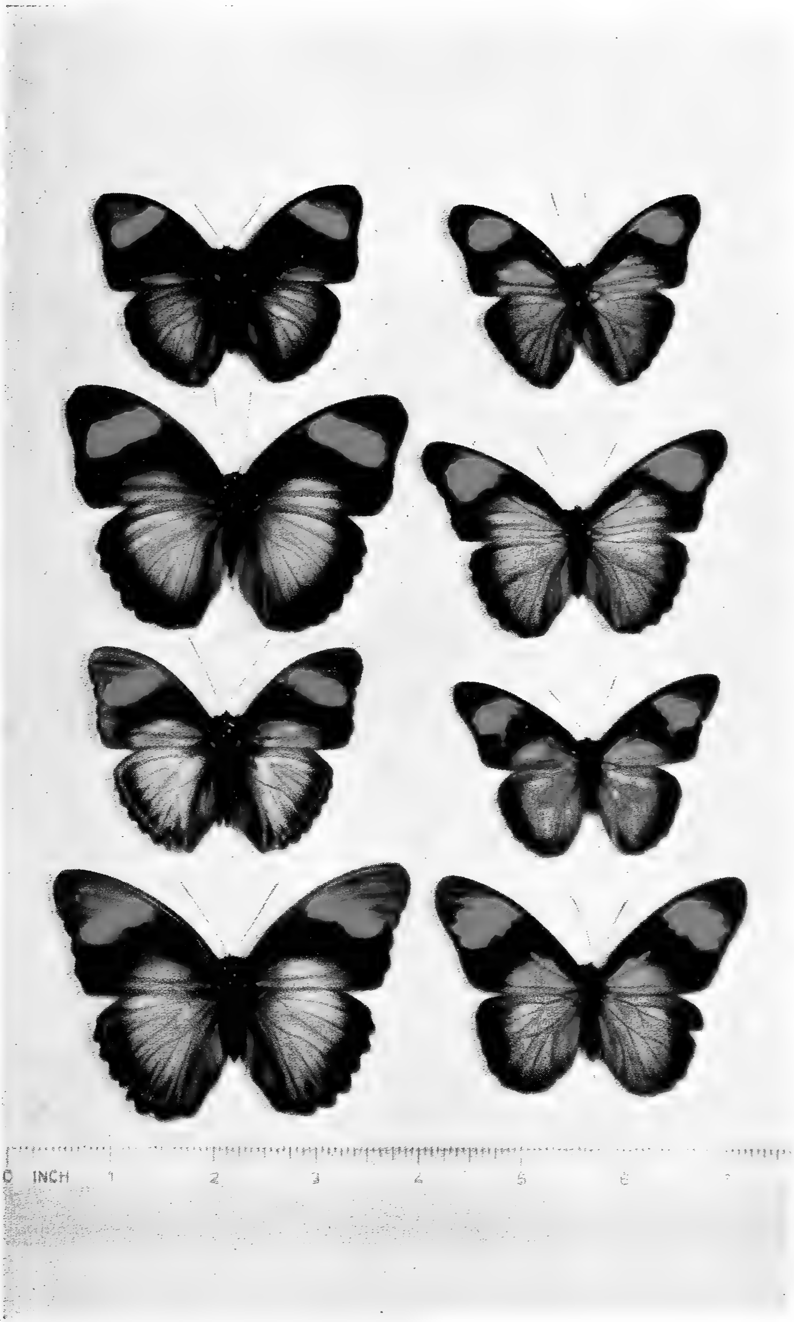
Plate 3. Group B. All from eastern Belgian Congo. Left two rows: top, *Euryphene phranza moreelsi* [R]; *E. rubrocostata* [R]; *Euphædra zaddachi* [C]. Right two rows: *Euryphene wilwerthi* [MR]; *Harmilla hawkeri* [R]; *Euphædra eusemoides imitans* [R].

Plate 4. Group B. All from Nigeria. Left row: top, *Euphædra ceres* ♂ [C]; 2nd, same, ♀; 3rd, *E. themis aureola* ♂ [C]; bottom, same, ♀. Right row: top, *E. gausape* ♂ [MR]; 2nd, same, ♀; 3rd, *E. cyparissa aurata* ♂ [MR]; bottom, same, ♀.

Plate 5. Group B. All from Nigeria. Left two rows: top, *Euryphene sophus sophus* (♂ non-mimetic)) [C]; middle, *E. lætitia* (♂ non-mimetic) [MR]; bottom, *E. cutteri* [MC]. Right two rows: top, *E. phranza phranza* (♂ non-mimetic) [MC]; middle, *E. congolensis* (♂ non-mimetic); bottom, *E. sp. nov.*? [R].



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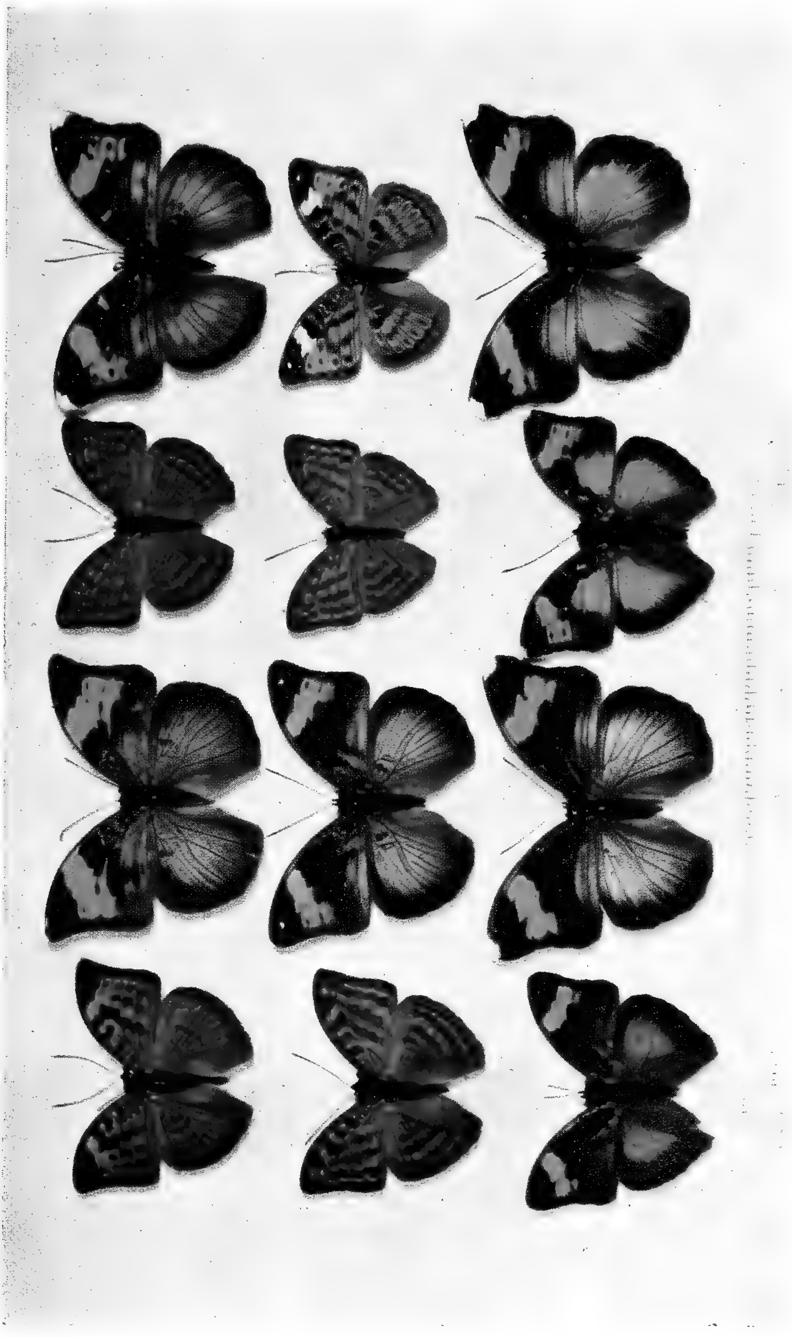


MODEL	MIMIC
Euryphene absolon Fab. ♀ (See Plates 7, 9, 10)	*Euryphene subtentyris* Strand ♀
	Euryphene abesa Hew. ♀
	Euryphene zonara Butler ♀
	Euryphene mandinga Felder ♀
	Euryphene cottoni B. Baker ♀
	Euryphene oxione squalida Talbot ♀
	Euryphene ikelemba Aur. ♀
	Diestogyna ribensis Ward ♀
	Diestogyna camarensis Ward ♀
	Diestogyna goniogramma Karsch ♀
	Diestogyna luteostriata B. Baker ♀
	Diestogyna saphirina Karsch ♀
	Diestogyna ituriensis Jackson & Haw. ♀
	Diestogyna intermixta Aur. ♀
	Diestogyna gambiæ Feist. ♀
	Cynandra opis Drury ♀

It is usually assumed that the primary models for this group are the species of *Catuna,* said to be distasteful, but we doubt if they can be considered "inedible" in the same way as Danainæ and Acræinæ. In the absence of evidence to the contrary, it is assumed that Nymphalidæ (excluding Danainæ and Acræinæ auct.) and all other families of Rhopalocera (excluding the pierid genus *Mylothris*) are edible in some degree, as is born out by our experience in the field. We are certain that there is much "secondary" mimicry centered round the very common female of *Euryphene absolon,* assisted by *Catuna.*

There is some evidence that there are several species amongst the *Euphædra eleus* group closely mimicking each other, but they require further investigation. Sufficient evidence, however, has been given in support of our contention that the Nymphalinæ have developed an amazing degree of perfection in "protective resemblance" built up on an "arithmetic" basis.

Group C. Pieridæ, Lycænidæ, Hesperiidæ.

Pieridæ: The common red-tipped group of *Colotis,* the black and white *Anaphæis* and *Belenois,* and the various species of *Eurema* are good examples of "Ochlosis", and it is unnecessary in a brief review such as this to give long lists of species which come within this catagory. The value of this form of resemblance was amply demonstrated during a visit to the Tana River near the Mbere country where the above groups were being preyed upon by numbers of Robber Flies (Asilidæ, Diptera). We noted that species of *Colotis* seemed to be equally common and no one species suffered to the exclusion of another. However, in one particular area which was very restricted, we found the uncommon species *Colotis pallene rogersi* Dixey. It was closely associated with its food plant, also a species of very restricted distribution; but in this same area there were three other very common *Colotis,* notably the widespread *C. evenina* Wall. which often has dimorphic females, but at this time all were of the dry-season form with red tips thus presenting a perfect model for the smaller and rarer *C. pallene rogersi*. We wanted this species, but for every one secured we netted a dozen *C. evenina*. Examples such as this, together with certain lycænids listed hereafter, are probably based on the numerical principle involved in Müllerian Resemblance, as quoted previously, and are *not* true "Ochlosis" since they consist of one very common model and a scarce mimic. We figure some of the *Colotis* involved, on Plate 6. These suffice to indicate the similarity: *Colotis daira thruppi* Butler, *C. antevippe* Bois., *C. evenina casta* Gerst., *C. pallene rogersi* Dixey.

Lycænidæ: There are numerous examples of this type of mimicry amongst the Lycænidæ, too numerous to list in detail in this brief paper, and it will suffice to mention just a few. The sexes are often dissimilar, and moreover one or other is sometimes non-mimetic.

Examples: Lipteninæ.

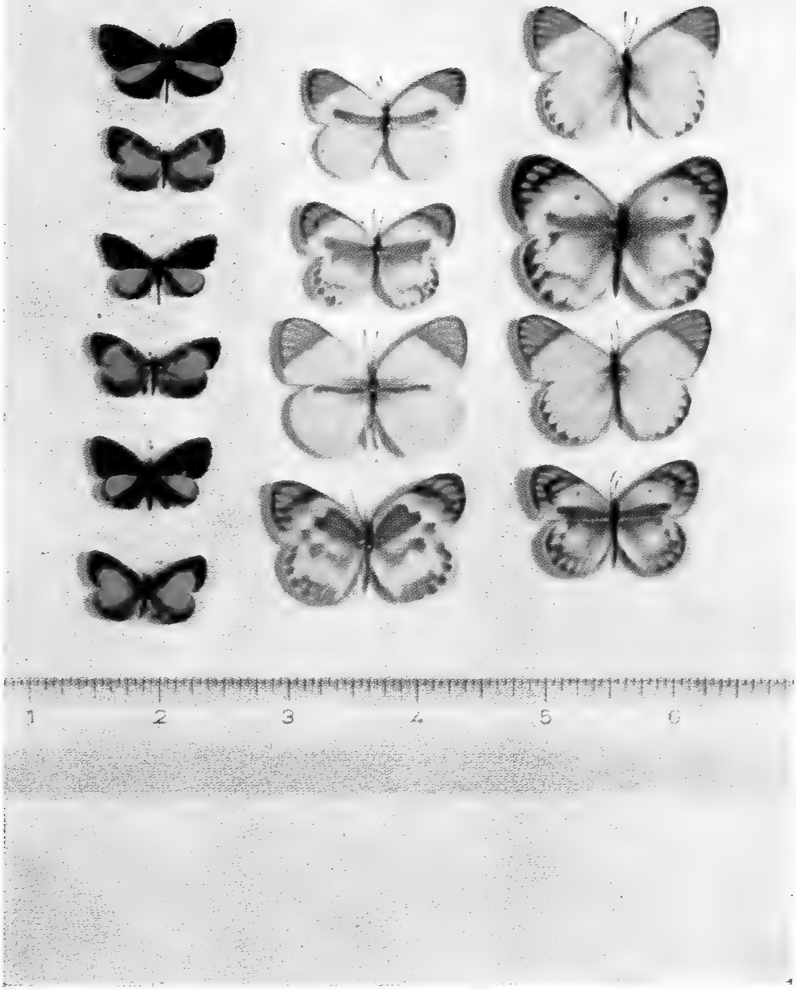
MODEL	MIMIC
Liptena ideoides Dewitz ♂ & ♀	*Eresina rougeouti* Stemp. ♂ & ♀
	Eresina conradti Stemp. ♂ & ♀
Liptena modesta Kirby ♀	*Liptena rubromaculata* Strand ♀
Teriomima minima Trimen	*Eresinopsis bichroma* Strand

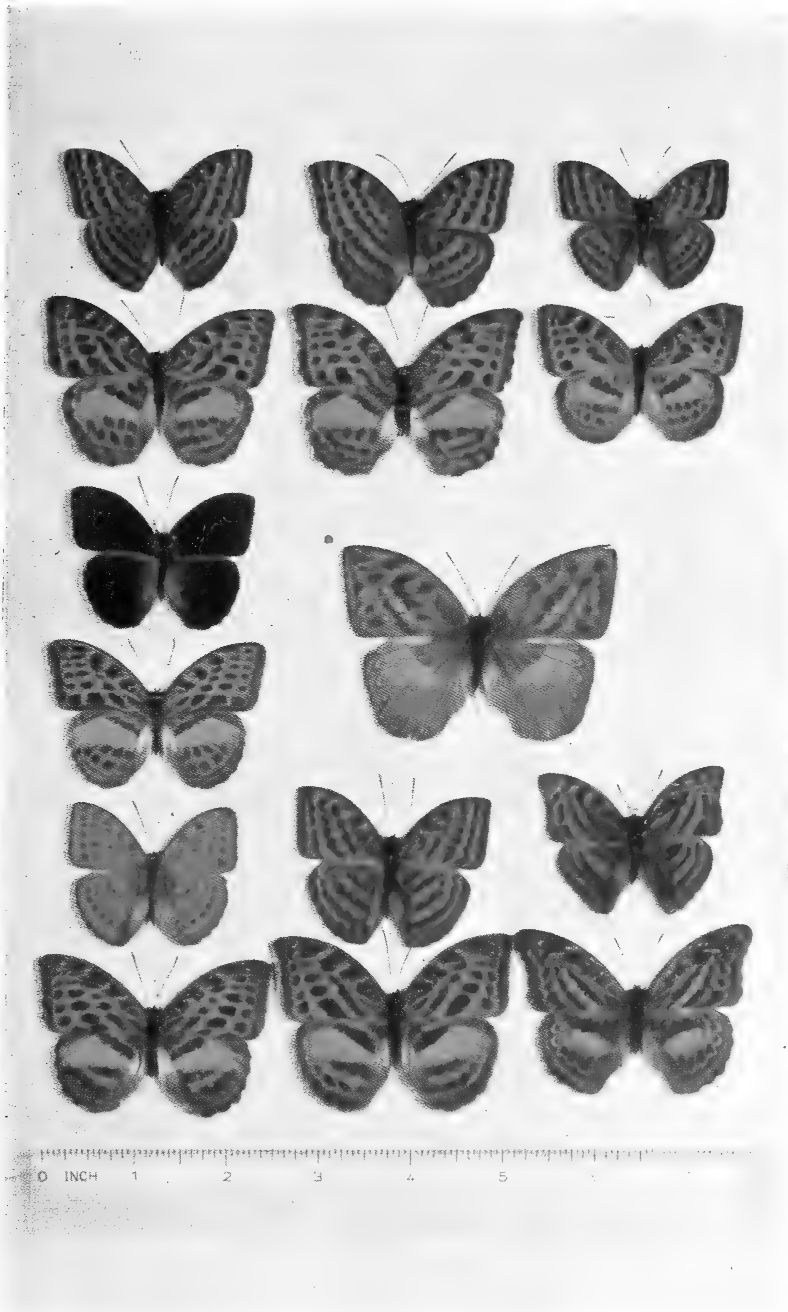
Other examples amongst the *Liptena* centered around *L. opaca* Kirby could be cited. Most of the *Ornipholidotos* form a mimetic group centered around the very common *O. kirbyi* Aur.

In the large genus *Epitola* in which the sexes are dimorphic, many fly together and very closely resemble each other.

Plate 6. Group C. All Lipteninæ (left) from Katera, Masaka, Uganda; all Pieridæ (middle, right) from Emberre, Tana River, Kenya. Left row: top, *Liptena ideoides* ♂ [C]; 2nd, same, ♀ ; 3rd, *Eresina rougeouti* ♂ [R]; 4th, same, ♀ ; 5th, *E. conradti* ♂ [R]; bottom, same, ♀. Middle row: top, *Colotis daira thruppi* ♂ [MR]; 2nd, same, ♀ ; 3rd, *C. evenina casta* ♂ [MC]; bottom, same, ♀. Right row: top, *C. antevippe* ♂ [C]; 2nd, same, ♀ ; 3rd, *C. pallene rogersi* ♂ [R]; bottom, same, ♀.

Plate 7. Group B. All from eastern Belgian Congo. Males non-mimetic. Top two rows (♂ above, ♀ below): left, *Euryphene absolon* [C]; center, *E. mandinga* [MC]; right, *E. subtentyris* [MC]. Middle: left above, *E. abesa* ♂ [MC]; left below, same, ♀ ; right (large), *E. ikelemba* ♀ [R]. Bottom two rows (♂ above, ♀ below): left, *E. zonara* [MC]; center, *E. oxione squalida* [MC]; *E. cottoni* [R].

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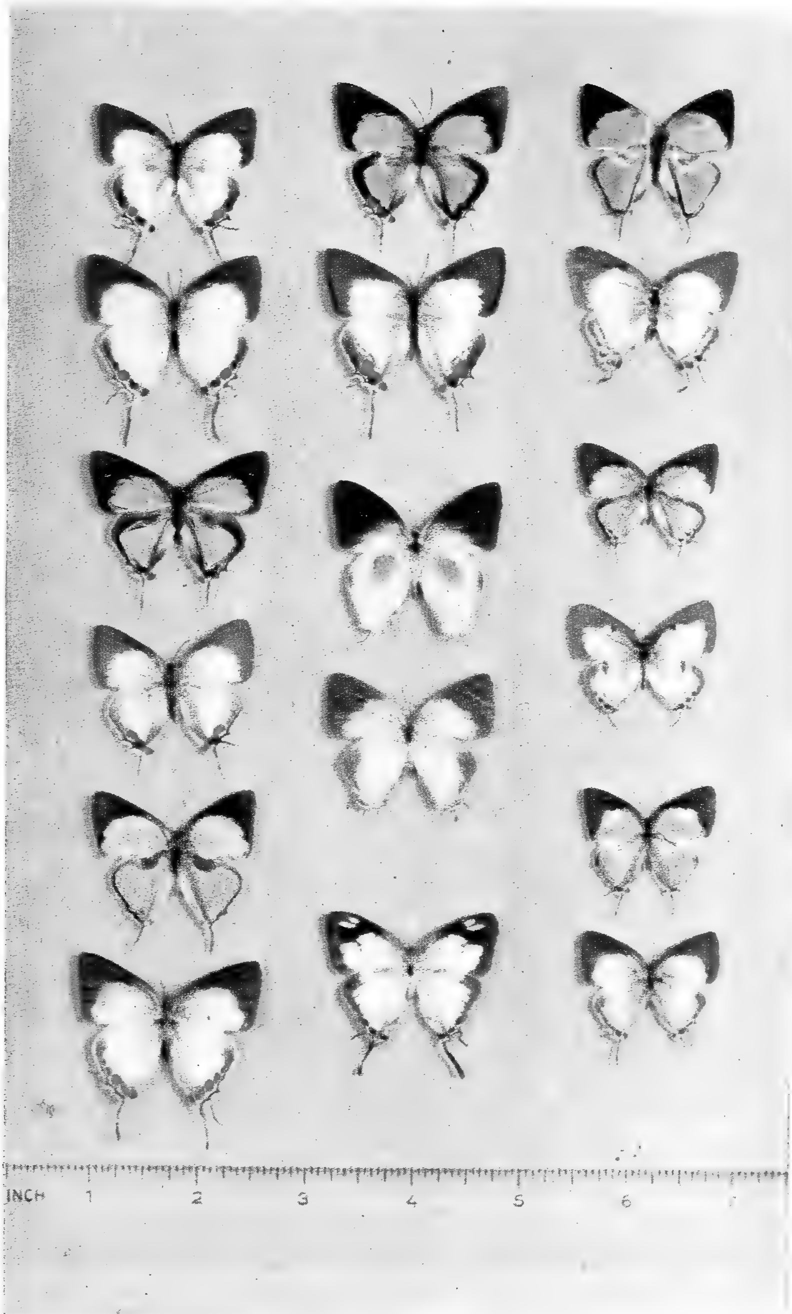
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Lycæninæ. There are several groups of associated Lycæninæ which are to be found flying around their food plants (here various species of *Loranthus*) which are remarkably alike. The majority are sexually dimorphic. We cite an outstanding example which we noted in the west Madi, West Nile district of Uganda.

MODEL	MIMIC
Argiolaus ismenias Klug ♂ & ♀ (See Plate 8)	*Argiolaus crawshayi niloticus* Stemp. & Bennett, ♂ non-mimetic
	Argiolaus menas Drury, ♂ non-mimetic
	Argiolaus vansomereni Stemp. & Bennett, ♂ non-mimetic
	Dapidodigma hymen Fab.
	Stugeta marmorea Butler
	Epamera scintillans Aur., ♂ non-mimetic
	Epamera aphnæoides nasissii Riley, ♂ non-mimetic
	Epamera iasis albomaculata Sharpe, ♂ non-mimetic

Among other groups we note:

Anthene opalinus Stemp. ♂ & ♀	*Anthene otacilia benadirensis* Stemp. ♂ & ♀
Anthene contrastata Ungemach	*Anthene talboti* Stemp.
Virachola livia Klug	*Virachola dohertyi* B. Baker *Virachola suk* Stemp. ♂
Anthene amarah Guérin ♀	*Virachola suk* ♀
Chloroselas pseudozeritis Trimen	*Desmolycæna rogersi* B. Baker

All the above are sexually dimorphic and each sex of the mimic closely resembles the corresponding sex of the model, above and below. Model and mimic fly together around *Acacia* trees.

Hesperiidæ. Examples of mimetic associations among the African Hesperiids are numerous but still require detailed study. An outstanding association is to be found among the genus *Spialia* where all the species are white-

PLATE 8. Group C. All from Metu, West Madi, Uganda. Left row: top, *Iolaus ismenias* ♂ [C]; 2nd, same, ♀; 3rd, *I. crawshayi niloticus* ♂ [C] (non-mimetic); 4th, same, ♀; 5th, *I. menas* ♂ [MC] (non-mimetic); bottom, same, ♀. Center row: top, *I. vansomereni* ♂ [R] (non-mimetic); 2nd, same, ♀; 3rd, *I. hymen* ♂ [R in this locality]; 4th, same, ♀; bottom, *I. marmorea* ♀ [MR]. Right row: top, *I. scintillans* ♂ [R] (non-mimetic); 2nd, same, ♀; 3rd, *I. aphnæoides nasissii* ♂ [MC] (non-mimetic); 4th, same, ♀; 5th, *I. iasis albomaculata* ♂ [MR] (non-mimetic); bottom, same, ♀.

spotted on a dark ground; many fly together, some very common, others very rare. Thus in one area in northern Uganda when we were hunting for *Spialia wrefordi* Evans, we netted six *S. colotes transvaaliæ* Trimen and about the same number of *diomus* Hopffer for every one *wrefordi*.

Apart from group associations there are instances where two species of different genera resemble each other closely and fly together:

MODEL	MIMIC
Cœliades libeon Druce	*Pteroteinon iricolor* Holl.
Cœliades forestan Cramer	*Mopala orma* Plötz
Cœnides dacela Hew.	*Pteroteinon pruna* Evans
Kedestes callicles Hew.	*Kedestes rogersi* Druce

The foregoing evidence is, we submit, sufficient to support the suggestion that there does exist a simple form of mimetic association which is "Protective Resemblance", and there is not the slightest doubt as to the value of this association to the weaker and less common species. The results achieved are in every way parallel to those accruing from Batesian Mimicry and Müllerian Resemblance. The groups we have drawn attention to differ only in regard to the fact that distastefulness is not a *sine qua non* either in the models or associated members. We submit that the evidence here given, amplifies, and does not run contra to the great Theory of Mimicry.

It has been suggested that Müllerian Resemblance is in a class by itself and that it does not imply deceit; we do not subscribe to this view. A predator would obviously be equally deceived between *Danaus chrysippus* L. and *Acræa encedon* L., or *Acræa pharsalus* Ward and *A. cepheus* L., as it would between *Acræa karschi* Aur. and *Mimacræa krausei* Dewitz.

All categories of Protective Resemblance result in the same thing, *i.e.* the increase in the chances of survival of the species concerned, and differ only in the factors by which they are governed to achieve this end. The Müllerian groups are merely the most highly advanced, but even here, as we have shown, the "arithmetic" aspect, so ably demonstrated by Müller himself, plays an important part.

The theory embodied in this paper is not a new one, since A. R. Wallace (1889: p. 245), referring to F. Müller's account of the female of *Leptalis melite* (L.) imitating one of the common Brazilian Pieridæ, wrote: "This is evidently not a case of true mimicry, since the species imitated is not protected; but it may be that the less abundant *Leptalis* is able to mingle with the female Pieridæ and thus obtain a partial immunity from attack." Thus the phenomenon to which we draw attention is widespread, and not limited to Africa!

Plate 9. Group B. All from Nigeria. Males non-mimetic. Left row: top, *Cynandra opis* ♂ [C]; 2nd, same, ♀; 3rd, *Diestogyna saphirina* ♂; 4th, same, ♀; 5th, *D. gambiæ* ♂ [C]; bottom, same, ♀. Center row: top, *D. ribensis* ♂ [C]; 2nd, same, ♀; 3rd, *D. goniogramma* ♂ [MR]; bottom, same, ♀. Right row: top, *D. intermixta* ♂ [R]; 2nd, same, ♀; 3rd, *D. camarensis* ♂ [R]; 4th, same, ♀; 5th, *D. ituriensis* ♂ [R]; bottom, same, ♀.

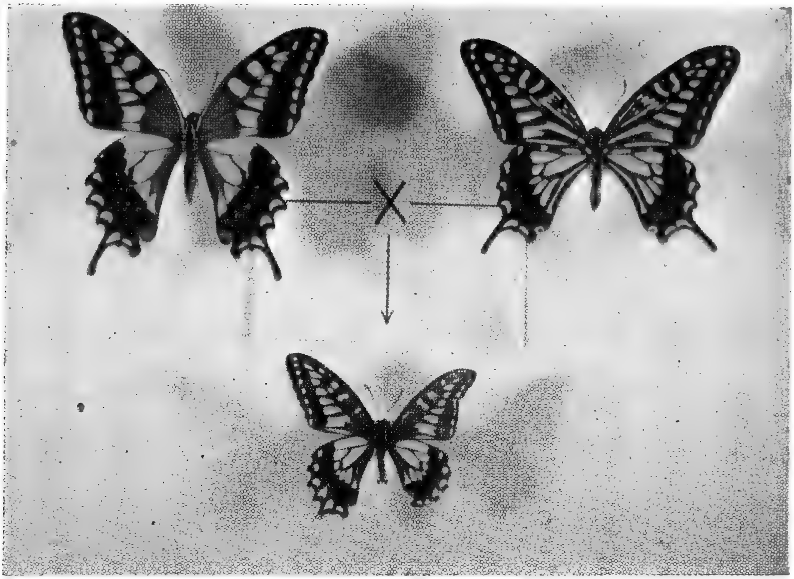

Fig. 1. *P. hippocrates* (left), *P. xuthus* (right), and F_1 hybrid (below).

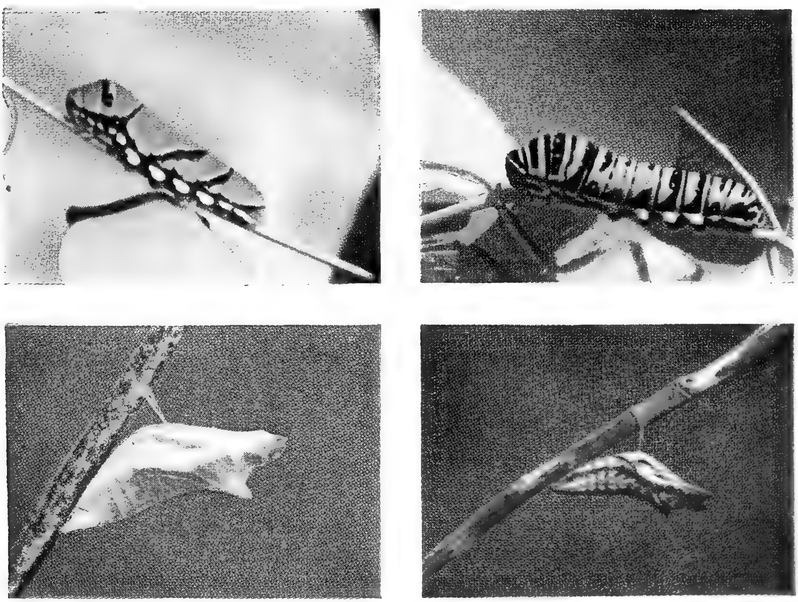

Fig. 2. Left, larva and pupa of *P. xuthus;* right, same of F_1 hybrid (*hippocrates* × *xuthus*).

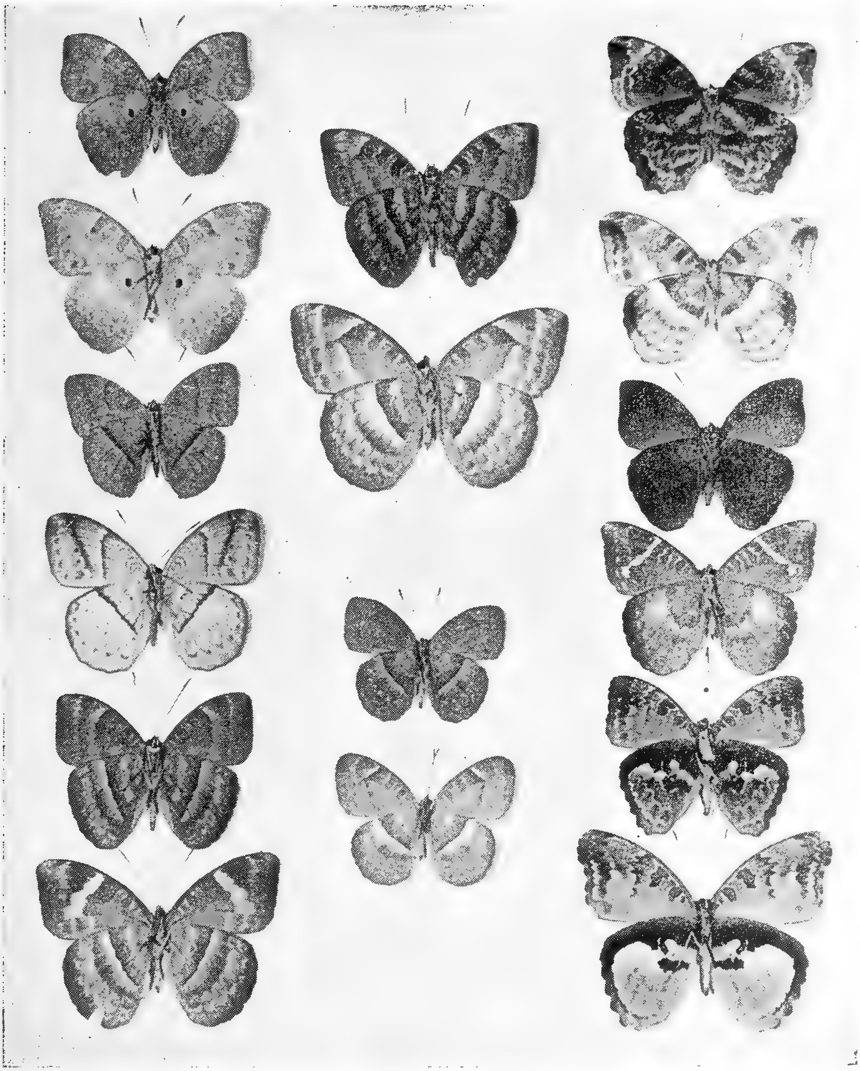

PLATE 10. Undersides of same specimens as in Plate 9.

TERMINOLOGY OF MIMICRY

We submit that there is a case for the overhaul of the terminology of Mimicry, from Crypsis to the highly specialised Müllerian groups, and that new terms are desirable for the categories we have cited in this paper.

We suggest the following broad classification of Mimicry:

1. SIMPLE or PRIMITIVE (Apatetic colouration). ARITHMETIC

a) No distasteful model; all edible. Where several species centre around abundant powerful species	CHARAXINÆ: as cited by POULTON and here amplified.
b) No distasteful model; all edible. Where several species centre around an abundant successful species whose characteristics are: elusiveness, quickness of flight low to the ground; obliterative colouration; acute vision and wariness. "Dysleptic", (difficult of capture) was suggested by CARPENTER.	NYMPHALINÆ: *Euphædra, Euryphene, Euryphura, and Diestogyna*, as cited in the text.
c) No distasteful model; all edible. Where several similarly coloured and patterned species fly together. Safety in numbers; the mortality rate is shared and in ratio to numbers. The term "OCHLOSIS" was suggested by CARPENTER. We propose ARITHMETIC as a better term applicable to all three groups.	PIERIDÆ: as cited. LYCÆNIDÆ: Lipteninæ & Lycæninæ as cited.

2. BATESIAN MIMICRY (Aposematic and Pseudaposematic).

A distasteful model present, around which edible species resembling it are associated; i.e., warning model and deceitful mimics.	ACRÆIDÆ: *Bematistes, Acræa.* DANAIDÆ: with which are associated Nymphalidæ, Papilionidæ & Lycænidæ.

3. MÜLLERIAN RESEMBLANCE (Aposematic colouration; i.e., warning colours).

Several distasteful species conforming to a common colouration and pattern; degree of deterrant character varying in participating members.	DANAIDÆ, ACRÆIDÆ (African) as so often cited in literature.

References

Eltringham, H., 1910. *African mimetic butterflies.* Oxford Press. 136 pp., 10 pls.

Poulton, E. B., 1926. Mimicry in African butterflies of the genus *Charaxes,* with a classification of the species. *Verh. III. int. Ent. Kongr.* 2: 518-575.

Wallace, A. R., 1889. *Darwinism.* Macmillan & Co., London. 494 pp., 37 figs.

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WIDE EXPERIMENTAL CROSSES BETWEEN *PAPILIO XUTHUS* AND OTHER SPECIES

by Charles L. Remington

Since 1953 I have been conducting a series of hybridization studies of the *polyxenes-machaon* complex of the genus *Papilio* (see preliminary reports — Remington 1956, 1958). A series of papers is now in preparation on specific groups of crosses and on some general questions such as hybrid sex-ratios and hybrid sterility. The purpose of the present paper is to present the results of the two widest crosses from which we have been able to rear offspring. These were *Papilio xuthus* ♀ × *hippocrates* ♂ and *P. polyxenes* ♀ × *xuthus* ♂.

Papilio xuthus Linné is an Asiatic species found from Japan to upper Burma, southward into Formosa, Luzon, and Guam. Its phylogenetic relationships have been in some doubt, and it has been associated with the *polyxenes-machaon* group, the *glaucus* group, and perhaps others. The larval color pattern is not similar to that of species of either group, and the pupal form is likewise very different. Comments on the systematic position of *P. xuthus* will be found in the Discussion, below. The usual larval foods are various Rutaceæ.

Papilio polyxenes Linné is common in the U. S. A. west to the Rocky Mts., north to southern Canada, and with various little-known relatives extending to northern South America. The usual larval foods are Umbelliferæ only.

Papilio hippocrates Felder is usually placed as a sub-species of *P. machaon* Linné, but there are grounds for considering it a separate species. The broods of F_1 hybrids with European *machaon* are strongly deficient in females (Clarke & Sheppard 1956 and my later data). There may be a difference in chromosome number; *P. machaon* in Europe has n=30 (commonly 32 in Finland — see Federley 1938) (Lorkovič 1941), whereas *P. hippocrates* has n=31 (Maeki 1958). The wings are longer and narrower than in true *machaon*. Unlike European *machaon, hippocrates* has in the females a summer form of very large size and extremely dark pigmentation. It is difficult to find from the literature the exact geographic ranges of *hippocrates* and of the Chinese and Siberian populations of the *machaon* forms. *P. hippocrates* (including minor sub-races such as *amurensis* and *sachalinensis*) is abundant all over Japan and is present in Korea, Manchuria, Amurland, and Sakhalin (see Eller 1939). This relatively moist and elevated region is bounded on the west by drier plains, and it is possible that there is a gap in which no *machaon*-like *Papilio* is present, separating *hippocrates* from the *aliaska*-like *machaon* to the northeast and from the Chinese and Mongolian forms to the south and west. The usual larval foods are Umbelliferæ and Rutaceæ.

Table 1. CROSSES OF *P. XUTHUS* WITH OTHER SPECIES

Brood	Parents	Eggs laid	Eggs fertile	Eggs hatched	Minutes *in copulo*	Results
324	♀ *pol.* × ♂ *xu.*	190	?	? (>8)	33+	2 ♂♂ from 8 pupæ
362	same	151	0	——	133	——
307	♀ *xu.* × ♂ *hip.*	97	?	?(9 of 72)	33	♂ from 1 pupa
309	same	24	?	4	23-29	see text
305	♀ *hip.* × ♂ *xu.*	50±	0	——	39-56	——
349	same	63	0	——	22-82	——
302	♀ *xu.* × ♂ *syriacus*	25+	0	——	51	——
304	♀ *glaucus* × ♂ *xu.*	9	0	——	48-52	——
315	same	13	13?	0	41-69	——
			CONTROLS			
306	♀ *xu.* × ♂ *xu.*	25±	0	——	31	——
335	same	26	26?	26?	39-135	——
378	same	1	0	——	15-42	——
308	♀ *hip.* × ♂ *hip.*	81	many	many	7-29	——
400	♀ *pol.* × ♂ sib	51	51?	35	38-56	——
405A	same	30	0	——	163-219	——
409	same	38	36	29	23-265	——

EXPERIMENTAL CROSSES

Eighteen attempts to hand-pair *P. xuthus* with other species resulted in successful initial copulation. Fifteen of these pairs remained *in copulo* for at least 20 minutes and therefore might have been at least partially fertile. However, no eggs were laid by females of the following 6 pairs: 4 (♀ *glaucus* × ♂ *xuthus*); 1 (♀ *polyxenes* × ♂ *xuthus*); and 1 (♀ *xuthus* × ♂ *hippocrates*). Table 1 shows the results of the remaining 9 *xuthus* pairings. A few explanatory comments are needed. In the column marked "Minutes *in copulo*", where there are two hyphenated numbers the actual separation was not observed; the first number is the minimum duration, the second number the maximum (*e.g.*, ♀ 309 remained *in copulo* at least 23 minutes but not more than 29). We had to farm out some of the lots of eggs to collaborators who were not prepared to record color changes which indicate that embryonic development has begun or to keep a tally of the number hatching. Most of the queries (?) in Table 1 are from these lots.

The control crosses show, as expected, that there is a much stronger tendency for intraspecific eggs to start development and to hatch than for the interspecific crosses having *P. xuthus* as one parent. However, they also show that a significant proportion of intraspecific eggs do not develop and a few more do not hatch. Note that the three control broods which produced no fertile eggs were from pairings which must have been of very short or very long duration. Long duration is usually caused by abnormal initial coupling, in which event insemination is not effected and disengagement is difficult. From Cross 315 (♀ *glaucus* × ♂ *xuthus*) we got 13 ova, most or all of which showed the distinct mottling associated with embryonic development in eggs of *P. glaucus* Linné. None hatched.

The photographs show the color patterns of the imagines of the three parental species and the F_1 hybrids from the two crosses from which adults were reared. The most distinctive differences are listed in Tables 2 and 3, along with the expression of each in the hybrids. Wing characters are those of the upperside only; no additional distinctive difference was found on the undersides. If a character in the hybrid is exactly like that of one parent and completely unlike that of the other species, the interspecific difference is probably controlled by a single Mendelian factor.

The summer generation of *P. xuthus* is strikingly different from the spring generation, having all black markings much more extensive, the blue band on the hindwing obsolescent, and so on. The *xuthus* characters in the Tables are those of the summer generation, because the F_1 hybrids represent this generation and the pure *xuthus* reared simultaneously show the typical summer phenotype.

The Cross ♀ P. polyxenes × ♂ P. xuthus

With Brood 324 (F_1 of ♀ *polyxenes* × ♂ *xuthus*) the mother was from stock from Connecticut, the father from a wild larva taken on tangerine at Osaka, Japan. 190 ova were laid from about 23 June to 9 July 1957. The precise numbers of ova which showed the fertility color-change and which hatched were not recorded, but several hatched of the first 145 ova laid. None of the next 32 ova hatched, and none of the final 13 ova even showed the fertility color-change. (It is usual for *Papilio* females to have decreasing fertility in the course of egg-laying, regardless of the father.) Eight larvæ were reared successfully on Umbelliferæ and pupated but only two adults emerged, both stunted, crippled males with even lower viability than with the male from Cross 307. There was no possibility of pairing them, and their abdomens apparently lacked normal testes. The two F_1 hybrids are shown in Plate 1, along with *P. polyxenes*. Consult Plate 2 for characters of *P. xuthus*.

The 2 F_1 hybrid ♂♂ from ♀ *polyxenes* × ♂ *xuthus* are almost identical to normal ♂ *polyxenes*. Note in Table 2 that of the 14 most conspicuous differences between *xuthus* and *polyxenes* males, the hybrids match *polyxenes* in 11, closely resemble *xuthus* in only 1, and are intermediate in 2. This great dominance of *polyxenes* characters is also seen in its hybrids with *brucei* Edwards (Remington 1958) and with various *machaon* forms (Clarke &

Knudsen 1953, etc.). Although male *polyxenes* and *xuthus* nearly always have a prominent median black spot in the pale wedge nearest the forewing apex in the postmedian row, this spot is totally absent in both hybrids. The only other characters of the F_1 hybrid not shared with ♂ *polyxenes* are: lighter color in the pale markings, elongation of the second and the last two spots of the postmedian row on the hindwings, and a conspicuous dorsal pale patch on the basal half of the antennal club.

Table 2. INTERSPECIFIC DIFFERENCES BETWEEN ♂ *PAPILIO XUTHUS* AND ♂ *P. POLYXENES* AND THEIR EXPRESSION IN THE HYBRID*

Character	*xuthus*	*polyxenes*	Hybrid
1. Pale markings:	creamy white	deep yellow	int
2. Basad ½ of FW:	4 pale streaks in cell, 2 caudad of cell	uniformly dark	*pol*
3. 2nd pale wedge from FW apex in p.m. row:	with black median spot	spotless	*pol*
4. FW discal cell:	heavily striped	single apical bar	*pol—*
5. P.m. row of pale spots on FW & HW:	most much broader than long	about as broad as long	*pol*
6. Submarginal lunules of FW:	most much longer than broad	about as long as broad	*pol*
7. Basal 1/3 of front cell of HW:	pale	dark	*pol*
8. HW p.m. pale spots:	all very long	most length = breadth	int
9. HW posterior cell:	median pale stripe to base	basal 2/3 dark	*pol*
10. Outer tail fringe:	pale	dark	*pol—*
11. Palpi & tegulæ:	whitish	black	*pol*
12. Pterothorax:	pale laterally	all black	*pol*
13. Abdomen:	whitish, with wide mid-dorsal and 4 thin subventral black bands	black with subdorsal & subventral row of yellow spots	*pol—*
14. Basal ½ antennal club:	big dorsal pale spot	no pale patch	*xu*

*Symbols in Tables 2 and 3 are: *xu* = exactly like *xuthus, hip* = exactly like *hippocrates, pol* = exactly like *polyxenes,* int = intermediate, *xu—* = most like *xuthus, hip—* = most like *hippocrates, pol—* = most like *polyxenes,* FW = forewing, HW = hindwing, p.m. = postmedian.

My collaborator who reared these hybrids made no notes on the larvæ. However, the larvæ of F_1 *polyxenes* × *xuthus* hybrids are undoubtedly similar or identical to those of F_1 *xuthus* × *hippocrates* hybrids described below, so there should be no difficulty in identifying the hybrid larvæ. We are not concerned with recognition of wild-caught hybrids of *xuthus* × *polyxenes,* since the ranges of the two species are so widely exclusive that natural hybridization can not occur. This paper was written in England, and I did not have the actual hybrids nor the pupal shells with me. In the near future I expect to examine the genitalia and pupae of both kinds of hybrids. There are marked pupal and genitalic differences between *P. xuthus* and the members of the *polyxenes* - *machaon* group.

Table 3. INTERSPECIFIC DIFFERENCES BETWEEN ♂ *PAPILIO XUTHUS* AND *P. HIPPOCRATES* AND THEIR EXPRESSION IN THE HYBRID

Character	*xuthus*	*hippocrates*	Hybrid
1. Ground color:	creamy white	yellow	*xu*—
2. FW pale streaks:	1 large below discal cell, 1 large at anal margin, 4 small in discal cell	only marginal streak present; basal 1/3 of FW dark with peppering of yellow	*hip*—
3. 2nd pale wedge from FW apex in p.m. row:	with black median spot	spotless	*hip*
4. 2 transv. pale spots in FW discal cell:	>thrice as long as wide	<twice as long as wide	*hip*—
5. Black striping along veins of FW & HW:	broad	narrow	*xu*
6. HW anterior cell:	bisected by broad median black patch	no black patch on basal 2/3	*hip*
7. HW submarg. lunules:	slender	fat	*hip*
8. HW anal eyespot:	median "pupil"	no "pupil"	int
9. Length of pale zone of HW anal eyespot:	much shorter than dark zone anterad	longer than dark zone anterad	*xu*
10. Hair along anal margin of HW:	short, inconspicuous	long, prominent	*xu*
11. Outer tail fringe:	pale	dark	*hip?*
12. Basal ½ antennal club:	big dorsal pale spot	faint pale spot	*xu*

The Cross of ♀ P. xuthus × ♂ P. hippocrates

1. ADULT.

With Brood 307 (♀ *xuthus* × ♂ *hippocrates*) the mother was from a wild larva found on tangerine at Osaka, Japan, and the father was from a pupa from Hiroshima, Japan. 97 ova were laid about 20-30 June 1957. Of the first 72, 9 hatched. The single pupa produced a male on 4 August. We tried to hand-pair this male with a rather old *P. xuthus* and then a *P. hippocrates*. The hybrid seemed to try feebly to copulate with the first female but would not even try with the second. The *xuthus* female was then successfully paired with another male. The general viability of the hybrid was obviously low. This male was soon killed as a study specimen (Plates 2 and 3).

The same parental combination also produced some fertility in Brood 309, and 4 larvæ hatched. Two were preserved for morphological study. Of the two kept for rearing, one died without feeding and the second accepted *Ptelea trifoliata* leaves, fed slowly, and died at the time of the first molt. The reciprocal cross (Broods 305 and 349) showed no fertility, although the copulations were of effective duration and adequate samples of eggs were laid and closely observed.

In its general aspect, the F_1 hybrid from ♀ *xuthus* × ♂ *hippocrates* closely resembles summer *xuthus* and looks quite different from its (spring) ♀ parent and from *hippocrates*. But note from Table 3 that this hybrid is similar to *xuthus* in 5 detailed characters, to *hippocrates* in 6, and is intermediate in 1. As with *polyxenes* × *xuthus* hybrids, this male lacks the median black spot in the pale wedge nearest the forewing apex and thus differs from both its parent species. Experimental hybrids are essential to the recognition of natural hybrids in any group of animals. This hybrid, which should be looked for among supposed variants in Japanese collections, is easily identified in summer individuals by the following combination: ground color very pale, forewing cell below faintly streaked, pale streak partially present in posterior cell of forewing but absent just behind discal cell, "pupil" of anal eyespot present but shifted to caudad edge of pale zone, this pale zone much shorter than dark zone in front of it, no median black patch in anterior cell of hindwing, and dorsal pale patch present on basal half of antennal club.

2. PUPÆ.

The pupa of *P. xuthus*, seen in profile, has the mid-ventral bend about 135°; the eye-horns are very large and round-tipped and the notch between them is deep; the mid-dorsal thoracic process is long, rounded, and directed forward; and the subdorsal tubercles on abdominal segments 4-7 are low.

The pupa of *P. hippocrates* has a mid-ventral bend of about 150°; the eye-horns are small and pointed and the notch between them is very shallow; the mid-dorsal thoracic process is short, square-tipped, and directed nearly at a right angle to the axis of the pupa; and the subdorsal tubercles on segments 4-7 are very prominent.

The pupa of the F_1 hybrid has a mid-ventral bend like *xuthus;* the eye-horns are rounded and large but not very long, and the notch is shallow; the mid-dorsal thoracic process and the subdorsal tubercles on segments 4-7 are shown on the color plate. The mid-dorsal markings of the abdomen resemble those of *hippocrates,* not *xuthus*.

3. LARVÆ.

Mr. Edward J. Austin kindly undertook to rear the larvæ of this cross. He photographed the F_1 hybrid larvæ in color, and I have been able to analyse the larval characters using his excellent photographs of the hybrids and of pure *P. xuthus* which he reared simultaneously. The larvæ of *xuthus* and *hippocrates* are so completely different in color pattern that there is little use in making a character-by-character tabulation of differences.

The first instar larva of *hippocrates* is blackish, with a white transverse saddle-mark on abdominal segments 3 and 4, extending down the sides only to the spiracles. After the first instar the subdorsal tubercles on the meso- and metathorax and abdominal segments 1, 2, 5-9 are bright orange, and lateral white patches are present on the thorax and the anterior and posterior parts of the abdomen. In the last (5th?) instar the meso- and metathorax and abdominal segments 1-8 each has: a black transverse dorsal band with a pair of dorso-lateral orange spots; and a black spiracular band and a smaller subspiracular band, each with an orange spot dorsad; there is a prominent black intersegmental band behind each of these 10 segments; the ground color is greenish or whitish; and the head is pale, with bold black lines.

The first instar of *P. xuthus* has the usual white saddle-mark, but it continues cephalad on the sides of abdominal segment 2 and is medially narrowed caudad on segment 5. In the second instar there are large lateral white patches on the thorax, abdominal segments 2-3, and segments 7-8; the tubercles are not orange. The last instar is green; the head is pale, apparently unmarked; there is a continuous black subspiracular stripe along the entire body, bordered ventrally with white; on the metathorax there is a transverse black dorsal band with a lateral eyespot and bordered caudad by an ocellated pale stripe reminiscent of *P. eurymedon* Boisduval, of the *glaucus* group; on abdominal segment 1 is a slender black oblique line continuing across the dorsum and becoming very broad laterally where it fuses with the subspiracular stripe; on each side is a bold black oblique band from the anterior edge of segment 4 (meeting the subspiracular stripe) to the posterior edge of segment 5 but apparently not quite meeting the opposite stripe mid-dorsally; on segment 6 is a 3rd black oblique like that on segment 1 but not becoming very broad laterally; on segment 8 is a slender oblique black mark with the same position and form as on segments 1 and 6; each of the 4 abdominal obliques has a white cephalad edge, most prominent on segments 6 and 8; there are 2 pairs of subdorsal orange tubercles in the black oblique on segment 5.

The F_1 hybrid appears to be much like *xuthus* in the first 2 instars but has the prominent orange tubercles of *hippocrates* in the 2nd instar. The mature larva has an intermediate aspect; the body is green; none of the black bands is oblique, but the dorsal transverse bands on abdominal segments 1, 5, and 6 are continuous with the sub-spiracular mark and are much broader than the bands of 2, 3, 4, 7, and 8; the intersegmental band is weaker than in *hippocrates;* the black subspiracular stripe seems to be discontinuous; 2 pairs of subdorsal tubercles are orange on the metathorax and abdominal segments 1-8; the head appears to be marked like *hippocrates.*

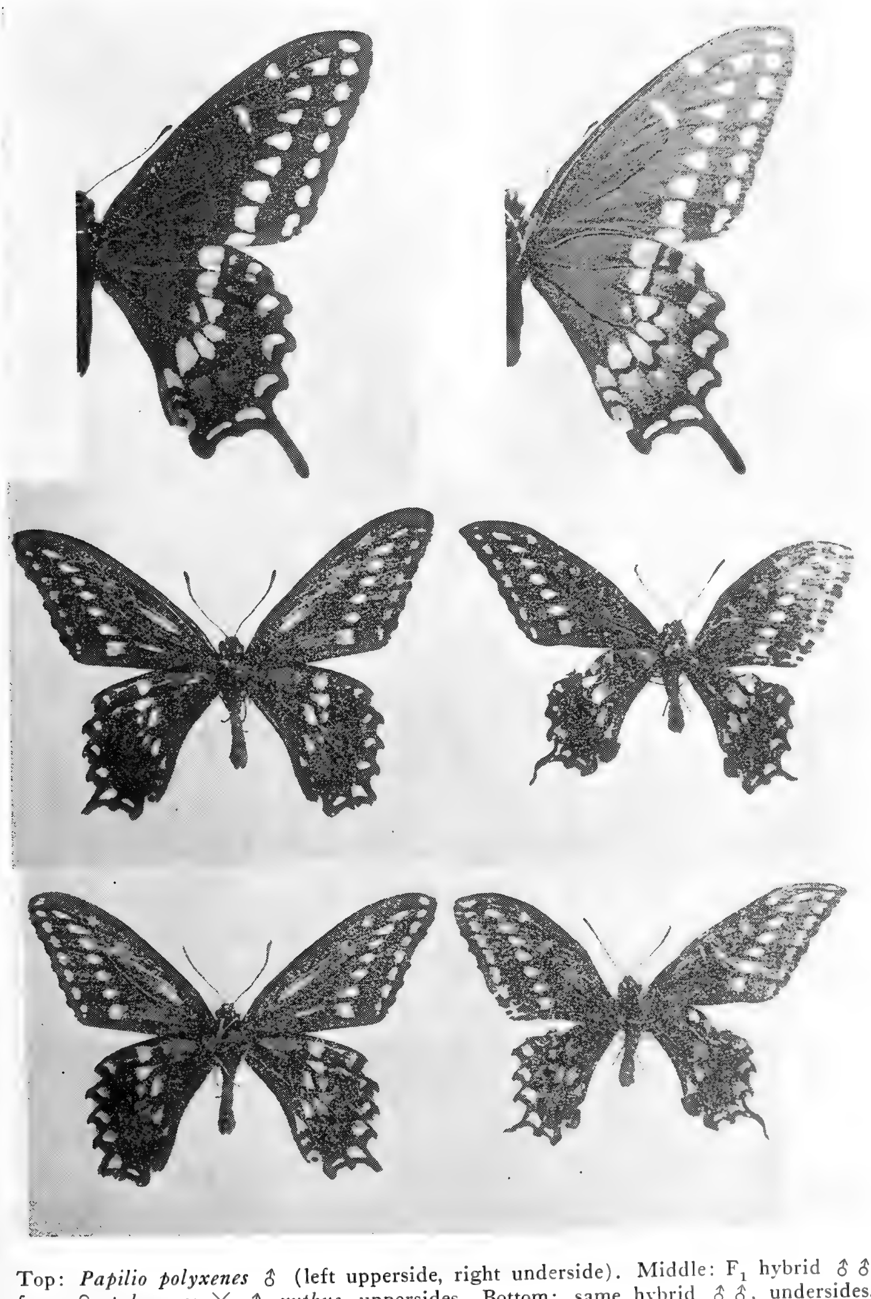
The F_1 hybrid larvæ, when given a choice, preferred *Citrus, Ptelea,* and *Xanthoxylum* over Carrot (*Daucus*). One larva, however, accepted the latter and fed readily on it for several days with no indication of deleterious effects. The hybrid was actually started on tangerine but mainly reared on *Xanthoxylum,* as were the pure *xuthus* larvæ.

DISCUSSION

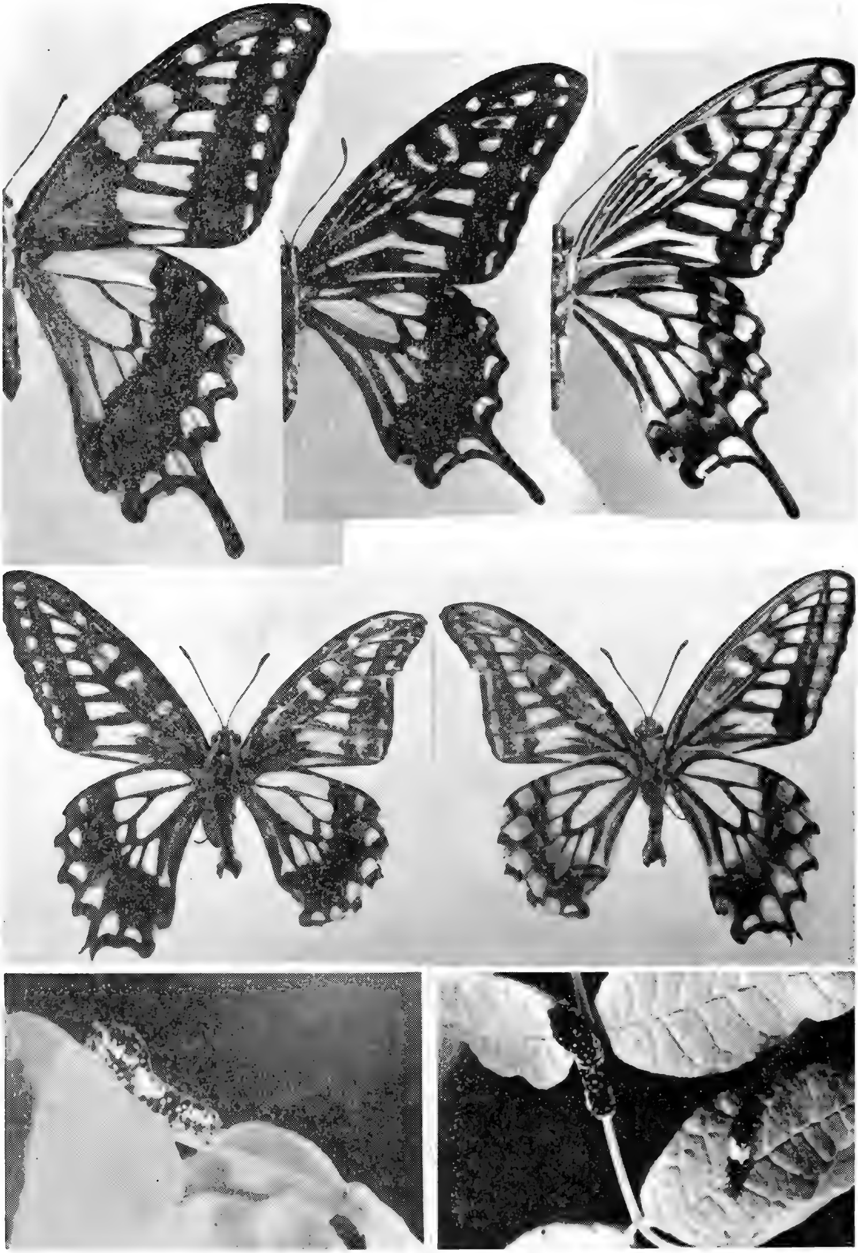
The extreme inviability of F_1 hybrids of *Papilio xuthus* crossed with both *P. polyxenes* and *P. hippocrates* was unexpected to me. Species as closely related as recent taxonomists have presumed these to be are expected to show much greater compatibility, on analogy with Sphingidæ, *Colias,* and Saturniidæ. It suggests that *xuthus* is not as closely related to the *polyxenes-machaon* complex as has been assumed by all taxonomists for many years. A search of the literature when I was looking at characters of the hybrid larvæ gave a promising new line of evidence. Not only are the larvæ of *P. xuthus* different from *polyxenes* and *machaon* in every aspect of color pattern, but *xuthus* closely resembles figures of *Papilio helenus* Linné and has some similarities to the figures of larvæ of *P. demoleus* Linné, *P. polytes* Linné, *P. polymnestor* Cramer, and perhaps *P. dravidarum* Wood-Mason and *P. liomedon* Moore (Fryer 1911 and Talbot 1939). The larva of *P. xuthus* is also similar to that of the African *demodocus* Esper figured by CLARK (van Son 1949), and SEITZ (1906) noted the resemblance of the *xuthus* larva to those of *bianor* Cramer, *demetrius* Cramer, and *demoleus.* JORDAN (1908) mentioned but did not consider phylogenetically the fact that the oblique-banded type of *Papilio* larva is found in "*xuthus, polytes, memnon, ægeus, bianor,* etc." The very brief larval descriptions JORDAN gave for *euchenor* Guérin, *liomedon, demolion* Cramer, *gigon* Felder, *nephelus* Boisduval, *ambrax* Boisduval, *phestus* Guérin, *ægeus* Donovan, *bridgei* Mathew, *rumanzovia* Eschscholtz, and *protenor* Cramer all apply to most characters of *xuthus.* All these species, like *xuthus,* feed on Rutaceæ, whereas *polyxenes, machaon,* and most of their near relatives feed on Umbelliferæ. There are a few of the latter feeding on Rutaceæ (*e.g., rudkini* Comstock and *machaon syriacus*) or on *Artemisia* (*oregonia* Edwards and *bairdii* Edwards).

The pupa of *P. xuthus* is also very different from that of the *polyxenes-machaon* group but its form is suggested by those of *P. demodocus, dravidarum, paris, polytes, polymnestor,* etc. (but not *P. helenus*).

The hybridization results, combined with these larval and pupal similarities, leave little doubt that *xuthus* is much closer to other species of *Papilio* than to *polyxenes, machaon, hospiton* Géné, and their near relatives. Presumably the genitalic characters will give a reliable guide to affinities and will give the same answers as do the larvæ, pupæ, and hybrid compatibility. It will be fascinating to see the results of attempts to cross *xuthus* with *bianor, demetrius, helenus, polytes, memnon* Linné, *castor* Westwood, and other easily available Oriental and African species. It would be surprising indeed if the hybrids of several *xuthus* combinations with these species were not as viable and fertile as those with *polyxenes, hippocrates,* and *glaucus.*



Top: *Papilio polyxenes* ♂ (left upperside, right underside). Middle: F_1 hybrid ♂♂ from ♀ *polyxenes* × ♂ *xuthus,* uppersides. Bottom: same hybrid ♂♂, undersides.



Top left: ***Papilio hippocrates,*** summer generation, upperside; top center: ***P. xuthus*** ♂, summer gen., upperside; top right: same ♂, underside. Middle: ♂ F_1 hybrid from ♀ *xuthus* × ♂ *hippocrates* (left upperside, right underside). Bottom: young larvæ of F_1 hybrid ♀ *xuthus* × ♂ *hippocrates* (from color transparencies by E. AUSTIN) — right, two instars dorsal view; left, lateral view of larger of two larvæ.

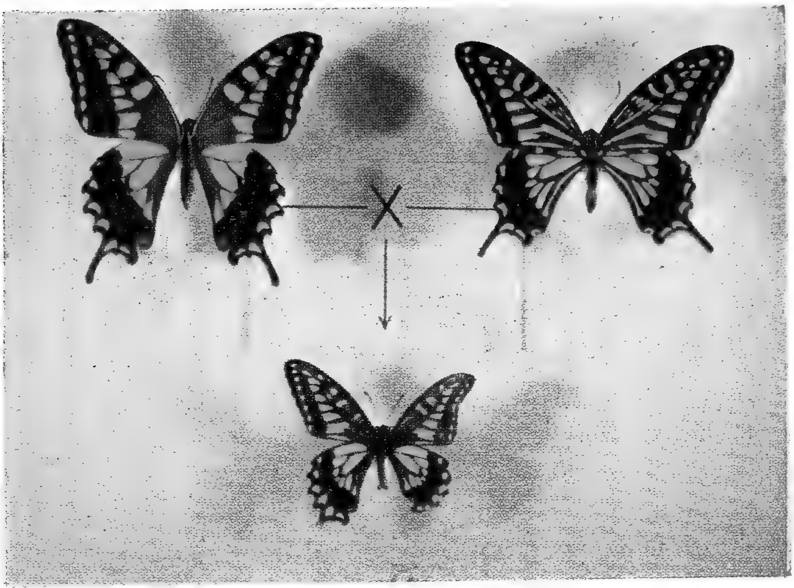


Fig. 1. *P. hippocrates* (left), *P. xuthus* (right), and F_1 hybrid (below).

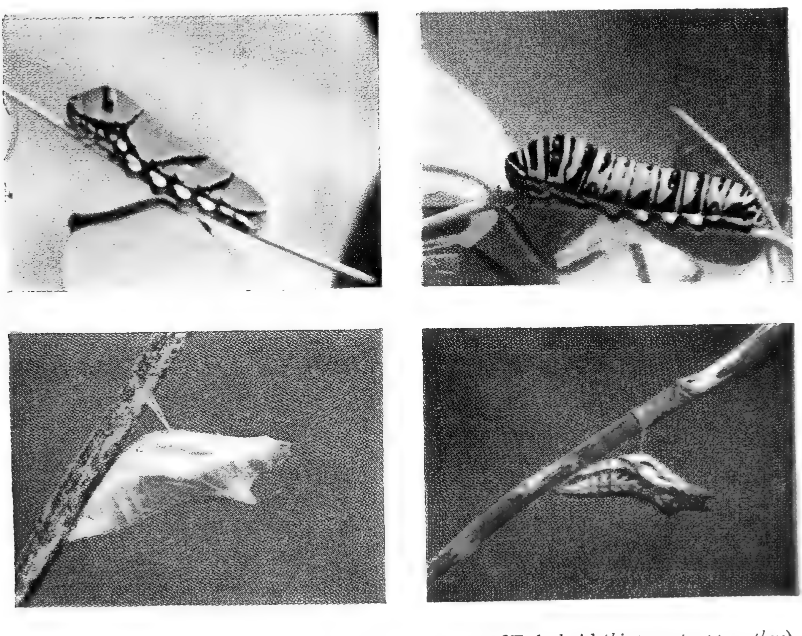


Fig. 2. Left, larva and pupa of *P. xuthus;* right, same of F_1 hybrid (*hippocrates* × *xuthus*).

How can we account for the general similarity of adults of *xuthus* to those of *machaon* (and to the *glaucus* group)? Imaginal color patterns are notoriously poor phylogenetic indicators in *Papilio*, due in many species to Batesian mimicry. The details of the color pattern of *xuthus* are close to the "dissimilis" form of *P. clytia* Linné, which is a tailless mimic of *Danaus*. This does not indicate that *xuthus* and *clytia* are closely related but rather that the color patterns may have little taxonomic significance. In fact, a mimetic explanation deserves consideration. There may be no causal relationship behind the color-pattern resemblances of *xuthus* to the *machaon* group or the *glaucus* group.

SUMMARY

1. *Papilio xuthus*, generally considered a close relative of *P. polyxenes* and *P. machaon*, was hand-paired with them 10 times. Eggs were laid by 8 of the females and a small proportion of the eggs were fertile in 3 crosses. F_1 hybrids were reared to maturity in two: 2 ♂♂ F_1 of ♀ *polyxenes* × ♂ *xuthus*; 1 ♂ F_1 of ♀ *xuthus* × ♂ *hippocrates*. These 3 ♂♂ had low viability and matability.

2. Some fertile eggs were laid by a ♀ *P. glaucus* hand-paired with a ♂ *P. xuthus*, but the embryos died early.

3. The adult F_1 hybrids of ♀ *polyxenes* × ♂ *xuthus* have the general appearance of *polyxenes*; of 14 conspicuous differences between the two parental species, the hybrids are like *polyxenes* in 11, *xuthus* in 1, and are intermediate in 2.

4. The characters of the adult, pupa, and larva of the F_1 hybrids of ♀ *xuthus* × ♂ *hippocrates* are compared to those of the parental species. The adult has the general appearance of *xuthus*, but in 12 detailed characters it resembles *xuthus* in 5, *hippocrates* in 6, and is intermediate in 1. The pupæ and larvæ also have a mixture of the characters of both parents and have an intermediate aspect.

5. Differences and hybrid incompatibility between European *P. machaon* and its so-called race *hippocrates* of Japan and the adjacent mainland are discussed; *hippocrates* should be considered a separate species.

6. The extreme hybrid incompatibility between *P. xuthus* and undoubted members of the *polyxenes-machaon* group, combined with complete dissimilarity in structures and color-patterns of the larvæ and pupæ, indicate that *xuthus* has been incorrectly associated with *machaon*. The larvæ and pupæ of *xuthus* are so similar to those of *P. helenus*, *P. demodocus*, and other African and Indo-Australian species, that it is probable that *xuthus* is nearer these species and can be expected to show higher hybrid compatibility with them.

References

Clarke, C. A., & J. P. Knudsen, 1953. A hybrid swallowtail. *Ent. Rec. Journ. Var.* 65: 76-80, pls.4-10.

Clarke, C. A., & P. M. Sheppard, 1956. A further report on the genetics of the *machaon* group of swallowtail butterflies. *Evolution* 10: 66-73, 1 fig.

Eller, K., 1939. Fragen und Probleme zur Geographie und zur Rassen- und Artbildung in der *Papilio machaon*-Gruppe. *Verh. VII. int. Kongr. Ent.* 1: 74-101, 2 pls, 5 figs.

Federley, Harry, 1938. Chromosomenzahlen Finnländischer Lepidopteren. *Hereditas* 24: 397-464, 47 figs.

Fryer, J. C. F., 1911. Notes on the larvæ of *Papilio polytes, P. demoleus, P. helenus* (race *mooreanus*), and *P. polymnestor* (race *parinda*). *Spolia Zeylanica* 7: 217-220, 4 figs.

Jordan, K., 1908-09. 1. Family: Papilionidæ, Swallowtails, *in The Macrolepidoptera of the World,* vol.9: 11-109.

Lorkovič, Zdravko, 1941. Die Chromosomenzahlen in der Spermatogenese der Tagfalter. *Chromosoma* 2: 155-191, 13 figs.

Maeki, Kodo, 1958. A use of chromosome numbers in the study of taxonomy of the Lepidoptera and notes on the internal reproductive anatomy. *Lepid. News* 11: 8-9.

Remington, Charles L., 1956. Interspecific relationships of two rare swallowtail butterflies, *Papilio nitra* and *Papilio hudsonianus,* to other members of (the) *Papilio machaon* complex. *Amer. Philos. Soc. Year Book* 1955: 142-146.

-----------, 1958. Genetics of populations of Lepidoptera. *Proc. X. Int. Congr. Ent.* 2: 787-805, 13 figs.

Seitz, A., 1907. 1. Genus: *Papilio,* Swallowtails, *in The Macrolepidoptera of the World,* vol.1: 8-15.

Talbot, G., 1939. *Butterflies,* vol.1, *in The fauna of British India, including Ceylon and Burma.* 600 pp., 3 pls. Taylor & Francis, Ltd., London.

van Son, G., 1949. The butterflies of southern Africa. Part I. Papilionidæ and Pieridæ. *Transvaal Mus. Mem.* 3: 237 pp., 41 pls., num. figs.

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FOODPLANT OF *HYPAUROTIS CHRYSALUS* (LYCÆNIDÆ) IN COLORADO

Since no definite record of the foodplant of *Hypaurotis chrysalus* (Edwards) seems to have been published, I am recording some casual observations made on this point several years in western Colorado. I watched individual females lay single eggs in crevices in bark of the common scrub oak, *Quercus gambelii* Nutt., at the western approach to Rabbit Ears Pass in Routt County, at about 10 miles west of Glenwood Springs in Garfield County, and at about 8 miles east of Somerset in Gunnison County. On 10 August 1954, I took several wild females from the Garfield County locality and confined them with twigs of the oak, in the manner we often use for Theclines. One egg was laid on 12 August and one the next day, both in rough paches of bark. The females then died of overheating in the sun. The eggs were refrigerated that winter but did not hatch when brought out in spring.

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A NEW SPECIES OF *CHLOSYNE* (NYMPHALIDÆ) FROM WESTERN MEXICO

by David L. Bauer

Mexico is particularly rich in species of the genus *Chlosyne,* and this previously undescribed insect is a large, beautiful black-and-white species. A number of other *Chlosyne* with black-and-white upper surfaces of the wings have been named. They are: *C. melanarge* Bates of the *definita-erodyle* group; *C. hyperia* Fabricius and *hippodrome* Geyer which form their own group; *C. marianna* Röber of the *janais* group; and *C. adelina* Staudinger, *quehtala* Reakirt, *crocale* Edwards, and *nigrescens* Cockerell all belong to the *C. lacinia* group. In addition there is a black-and-white member of the *rosita* Hall group, which is being described in another paper (Bauer, in press). The new species differs significantly from all of the above entities. First the male and female genitalia were examined and found to be of the *C. janais* Drury type, Fig. 2. The genitalic structure separates it from all the above except *C. marianna.* It differs from *marianna* on the upper surface of the wings in the number and size of the white spots, and on the under surface in the maculation which shows considerably more yellow on the secondaries. After comparison with series of the above-named insects in the F. M. Brown, Oxford University Museum, and my own collections, and checking the literature, original descriptions, figures, and keys to the genus, I take pleasure in naming this insect —

Chlosyne gloriosa Bauer, NEW SPECIES

MALE. Primaries produced between veins M_1 and M_2, also at end of vein Cu_2, causing an elongate angular look. Upper surface of primaries: blue-black with a prominent series of large white median spots beginning at costa and ending at vein M_3; these four white spots stand out boldy. The postmedian series is represented by small white dots, usually obsolete from vein M_3 to costa and becoming obsolete toward the inner margin. There is also a dash of white in the cell at its base, and two small white dots in the cell along its costal edge. The under surface of the primaries is charcoal black. All the white spots of the upper surface are repeated and larger. The postmedian series is complete. In addition there is a white spot in the cell near where veins M_3 and Cu_1 branch, and also a white dot between veins Cu_2 and 2A in the postbasal area. There are three pale yellow submarginal spots from veins M_2 to Cu_2, and a dash of the same color at the base of the costa.

Upper surface of the secondaries: solid blue-black in color, and the edge of wing is scalloped between the ends of the veins. The scalloped effect is augmented by a row of white scales adjacent to the white fringe as in *hyperia.* Under surface of the secondaries is colored as follows. The base of the costa is yellow; next, a basal black band from costa to inner margin; followed by a postbasal yellow stripe, which begins on the costa but does not reach the inner margin. Next, a broad submedian black band extending from costa to inner margin and containing a narrow linear yellow spot near the costa and another wider one in the cell. Following this an irregular narrow yellow band from costa to inner margin, but interrupted before it reaches the inner margin, and along its outer edge there is a series of jet black spots which partially invade it, and are partially in the wide charcoal-black median band. This wide charcoal-black median area also includes the postmedian area and along its inner edge there is a series of five irregularly sized mahogany-red spots extending from vein M_1 to 2A. The mahogany-red spot nearest the inner margin is the largest. In this same broad median dark area there is a series of postmedian white spots extending from the costa to the inner margin. Along the outer edge of this broad median dark area is a series of large yellow submarginal spots followed by a narrow scalloped black line. Between the ends of the veins at the base of the white fringe are one or two rows of pale yellow scales much as in *hyperia*. The inner margin is narrowly edged with yellow and vein 3A is scaled with yellow.

Fringes: snow-white broken by black only at the ends of the veins.

Palpi: black with white on the sides.

Antennæ: black flecked with white and with a dash of white on the club.

Head: black with a dot of white between the eyes and white edging around the eyes.

Thorax: black above, clothed with some white hairs beneath.

Abdomen: black above, three longitudinal pale yellow lines ventrally.

Legs: forelegs white tinged with rufous; remaining two pairs deep orange.

Female: almost identical to male holotype. The above description will serve for both, except that the primaries are slightly more angular.

HOLOTYPE male: Tepic, Nayarit, Mexico; August 16, 1954; leg. DAVID L. BAUER. Expanse of forewings 50 mm.; length of forewing base to apex 26 mm.; length of hindwing base to outer margin 18.5 mm.

ALLOTYPE female: Tepic, Nayarit, Mexico; August 16, 1954; leg. DAVID L. BAUER. Expanse of forewings 61.5 mm.; length of forewing base to apex 32 mm.; length of hindwing base to outer margin 23.5 mm.

PARATYPES: 13 males and 6 females all collected at Tepic, Nayarit, Mexico; August 16, 1954; leg. DAVID L. BAUER.

The holotype and allotype are deposited in the Peabody Museum of Natural History, Yale University. One paratype is deposited at the Instituto de Biologia, Mexico City, Mexico, one paratype at the American Museum of Natural History, New York, N. Y., and one paratype in the Kent Wilson collection. The rest of the paratypes will remain in the author's collection.

The type series is remarkably constant in pattern on the upper surface of the wings. On the under surface the pattern is somewhat variable in the number of submarginal spots on the primaries, and in the amount of yellow in the submedian maculation on the secondaries.

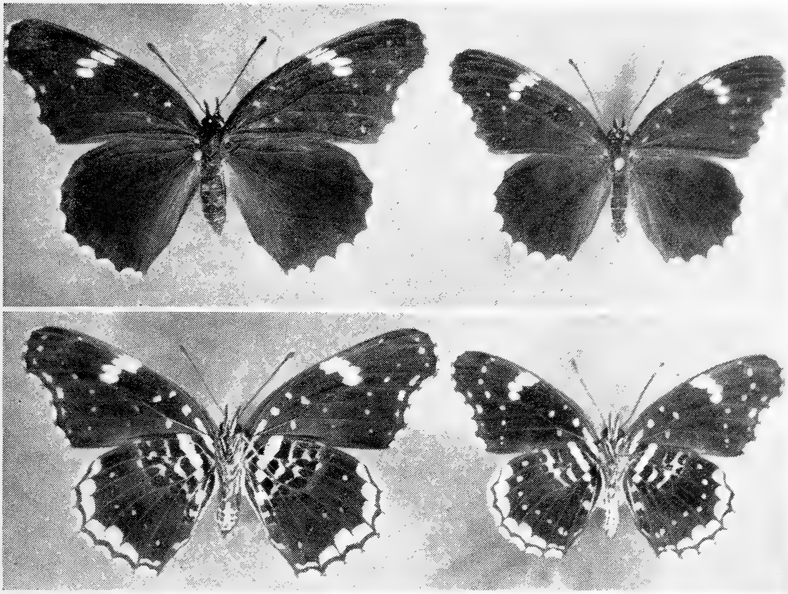

Fig. 1. *Chlosyne gloriosa*: Allotype ♀ left, Holotype ♂ right; upperside above, underside below.

DISCUSSION

The named members of the *C. janais* group are now:

Chlosyne janais Drury	*Chlosyne marianna marianna* Röber
Chlosyne gloriosa Bauer	*Chlosyne marianna irrubescens* Hall.

Chlosyne janais is the best known member of the group. It also has the most extensive distribution, being found from southern Texas and Sinaloa, Mexico, southward to Panama. Its large size, black white-spotted primaries, and characteristic bright orange-red discal patch on the secondaries, distinguish it from the other members of the group, but not from similarly maculated forms of *C. lacinia* and *C. rosita*. Holland (1931) on plate XVIII: fig. 10 figured a specimen of *C. lacinia* not *janais*. *C. janais* can be separated by the absence of the orange-red spot at the anal angle on the under surface of the secondaries, which is so persistent in the *C. lacinia* group. It can be separated from all members of the *C. rosita* group by the presence of the submarginal spots on the underside, which are always absent in the *C. rosita* group.

Chlosyne marianna marianna is entirely dull black, spotted with white, on its upper surface. It has been persistently confused with *C. hyperia,* with which it flies. It differs from *hyperia* in the duller black of the upper surface, smaller but more profuse white spots on the upper surface particularly at the base of the primaries, and on the under surface of the secondaries, where five reddish postmedian spots are the rule and not six as in *hyperia*. *C. m. marianna* is found primarily in the Rio de las Balsas basin south and west of Mexico City; however, it may prove to have a much wider distribution when more

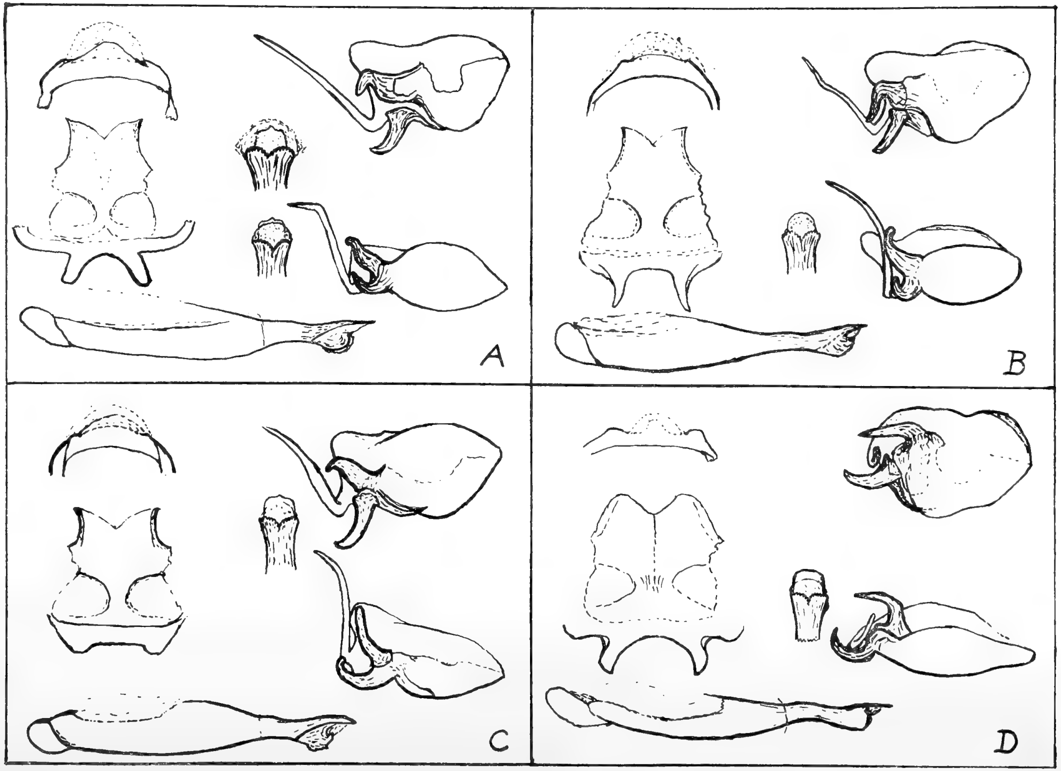

Fig. 2. Genitalia of *Chlosyne*: A) *C. janais* (El Salto, S.L.P., Mexico, July 1954, *leg.* D. L. Bauer; B) *C. gloriosa* (Tepic, Nay., Mexico, Aug. 1954, *leg.* D. L. Bauer); C) *C. marianna* (Mexcala, Guer., Mexico, el.2000′, 29 July 1956, *leg.* Kent Wilson); D) *C. hyperia* (Ojo de Agua, el.1600′, V.C., Mexico, 12 May 1941, *leg.* J. & R. Potts). Clasps at right; tegumen, etc. left; ædeagus bottom.

extensive collecting is done. It differs from similarly colored members of the *C. lacinia* and *rosita* groups by the same characters as does *C. janais*. It is not a subspecies of *janais*, because it flies with it in several localities.

Chlosyne marianna irrubescens Hall (1917) is a little-known form or subspecies. FORBES (1928) omitted it from his key because of inadequate description and no material seen. It was described from Cuautla, Morelos, Mexico. The most pertinent part of HALL's description is "similar to *C. hyperia* var. *marianna* Röber, but the hind wings above with a large round spot of mahogany-red in the middle of the wing." In other words take a typical *marianna*, add a mahogany-red spot in the center of the secondaries, and you have *irrubescens*. I have specimens of just such an insect before me. It can be separated from similarly maculated specimens of *lacinia* and *rosita* (and there are such specimens) by the same characters as those by which *janais* and *marianna* are distinguished from them. In the state of Guerrero, Mexico, occasional specimens taken with typical *marianna* have small spots of mahogany-red on the secondaries, and the two seem to inter-grade in the region. There is no approach to *janais* with its clear-cut orange red patch, for the mahogany-red of *irrubescens* merges gradually with the black ground.

Chlosyne gloriosa differs from *marianna* in the more angular shape of the fore wing, the deep blue-black color, and the much larger median white spots on the primaries. All the other white spots tend to be reduced in size or to be obsolete. It can be separated from *C. hyperia*, with which it flies, by the number of reddish spots on the under surface of the secondaries (see *marianna* above), and the extensive yellow maculation in the basal area of the same. It differs from *lacinia* and *rosita* in the same way as do *janais* and *marianna*. The type locality is the only one from which it is known so far. It was abundant just north of Tepic, where specimens were first sighted sipping moisture from the highway and along the edges in company with *C. hyperia*, *C. eumeda*, and *lacinia* forms. The day was cloudy and we soon went looking for better weather, not realizing that we had left many specimens of a new species.

ACKNOWLEDGEMENTS

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References

Bauer, D. L., in press. Descriptions of two new *Chlosyne* (Nymphalidæ) from Mexico, with a discussion of related forms. *Journ. Lepid. Soc.* 14.

Forbes, W. T. M., 1928. A key to the Neotropical forms of the genus *Chlosyne* (Lepidoptera, Nymphalidæ). *Ann. ent. Soc. America* 21: 98-100.

Hall, A., 1917. New butterflies of the family Nymphalidæ. *Entomologist* 50: 161-163.

Holland, W. J., 1931. *The butterfly book*, rev. ed. Garden City, N. Y.: Doubleday. 424 pp., 77 pls.

Röber, J., 1913-1924. *in* Seitz' *Macrolepidoptera, American Rhopalocera* 5: 1139 pp., 203 pls. Alfred Kernen Verlag, Stuttgart.

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HOST PLANTS OF *STRYMON MELINUS ATROFASCIATA*

In the *Lepidopterists' News* (vol.8: p.101) I described my rearing the spring brood of *Strymon melinus* on certain wild clover species. At that time I supposed that the summer generation would most likely use a similar host. I noticed that the clovers, *Trifolium oliganthum* Steud. and *T. tridentatum* Lindl., flowered only in early spring, but there are other plants of the same genus which remain in flower throughout the summer.

I reared these first *S. melinus* larvæ during a period of extreme abundance of the species. Later it became scarce, and I discontinued my experiments for a few years. But it was during this time that an interesting clue came to light. While collecting Diptera from the flowers of *Anaphalis margaritacea* Benth., I twice found a whitish lycænid caterpillar in my net. For some reason, I failed to rear either of these larvæ. However, the time of year, late August, the plant concerned, and the general appearance of the caterpillars, eliminated every possibility but *S. melinus* and *S. sylvinus* Bdv.

Strymon melinus being quite plentiful once more in the spring of 1958, I was ready to try them again, with the aid of my new clues. But I now found the plants I used before had disappeared from the area inhabited by the butterflies. So I tried such legumes as I could find, a yellow-flowered clover, probably introduced, and *Hosackia parviflora* Benth. To this I added, mostly on a hunch, a wild strawberry, *Fragaria bracteata* Heller. The butterflies oviposited on all these plants, but when given the opportunity the larvæ nearly all moved to the flowers and green fruit of the strawberry.

I had the usual bother with cannibalism. This occurs usually when some of the larvæ have gone into the prepupal instar; they are then eaten by their more backward companions. Most of the larvæ that were not so destroyed finished their metamorphosis, and all of the imagines were perfect.

The summer brood, as I expected, oviposited readily on *Anaphalis*. I was able to get five pupæ from this lot, and the adults emerged after the winter.

Looking back on my experiments of 1953, I realize now that, had I offered the *S. melinus* flowers of raspberry, instead of fruit, I might have raised some larvæ then. But this can apply to the spring brood only; there is no *Rubus* species native to Vancouver Island which flowers at the time the summer butterflies emerge. Another Rosaceous plant suggested by J. R. J. L. JONES in his B.C. check list, *Cratægus*, is also probably introduced. At any rate is it seldom seen far from cultivated land and is not found in areas most frequented by *S. melinus*. It may seem from the above that *S. melinus* is not very particular what it eats. I think rather that the larvæ must feed on pollen or other flower parts, during the early instars at least, and this fact forces the butterflies to choose plants which flower at the correct season. Thus the two broods have come to use very different hosts. In Europe, *Celastrina argiolus* (L.) has long been known to behave in this manner, and I believe it does so in North America also, where there is more than one brood per year.

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CONCERNING SUBSPECIATION IN WESTERN NORTH AMERICAN *EUPHYDRYAS* (NYMPHALIDÆ)

by STANLEY G. JEWETT, JR.

The description of *Euphydryas editha remingtoni* by WILLIAM N. BURDICK in a recent issue of this journal (1959) has prompted the following comments.

I am keenly interested in *Euphydryas* and am gradually accumulating a sizeable collection of this genus from various places in western North America. Of equal importance is the knowledge being acquired of the ecological conditions under which the different forms exist. Material from this region is not presently easy to identify, and it will probably be some time before an entirely satisfactory systematic treatment can be made. As in the case of many other insect groups reliance should probably not be placed solely on morphological characters for specific and subspecific differences.

The pioneer work of GUNDER (1929), HOVANITZ (1942), and HOVANITZ and GARE (1951) serves as a good basis for understanding the taxonomy of the many forms. But recent, and as yet uncompleted, work by DAVID L. BAUER and myself on the genitalia and biology of material from western North America opens questions on the validity of the specific classification proposed by both GUNDER and HOVANITZ. Present literature is wholly inadequate to distinguish clearly most subspecies.

Euphydryas gillettii Barnes and *E. editha* Boisduval are distinctive species readily separable on a number of characters, including details of the male genitalia. The former is quite stable in color pattern throughout its range, but many subspecies of the latter occur throughout the Cordillera. The really difficult taxonomic problems arise when attempting to classify the *chalcedona - anicia* complexity. The pattern of the male genitalia is variable as shown by GUNDER's (1929) figures. Two distinct forms of this group fly together at some sites in the Pacific Northwest, and apparently each seeks its own species of *Pentstemon* upon which to deposit eggs (BAUER observation). A great deal more material and knowledge of their ecological requirements are needed before the specific and subspecific identification of these forms can be determined accurately. Perhaps several species should be recognized. Or perhaps two subspecies now occur at the same location, one or both having originally developed elsewhere. The problem is intriguing and will require much careful work for ultimate solution.

The great variation in color pattern among many species of butterflies has led some lepidopterists, for example, GILLHAM (1956), to question seriously that a great many subspecific names for butterflies serve a useful purpose. I confess my own present inability to establish parameters within which to apply subspecific names for *Euphydryas,* but I believe that this can be accomplished after more material and ecological data are available for study. Few would question the desirability of separating such different-appearing insects as *E. editha taylori* Edwards, a Transition Life Zone subspecies found from Vancouver Island to the upper Willamette Valley in Oregon and topotypical material of *E. editha colonia* Wright, a Canadian Life Zone subspecies found on Mt. Hood, Oregon, and nearby mountain areas. These subspecies are so very different in appearance that there is very little likelihood of ever confusing a single insect belonging to either. The problem is much more difficult when attempting to define the differences among such subspecies as *remingtoni* Burdick, *lawrencei* Gunder, *edithana* Strand, and *aurilacus* Gunder, all of which also belong to the species *editha*. There is also a question of the usefulness of subspecific names for forms, even though morphologically quite distinct, such as *E. editha lawrencei* Gunder which so far as known occupies a geographic range consisting of a few acres on a single mountain.

BURDICK's new subspecies of *editha* from the slopes of Mt. Thielson, Oregon, at an elevation of about six to seven thousand feet represents a population intermediate in size between that of the colony near the eastern shore of Diamond Lake, perhaps distant by a mile or two and perhaps 1,500 feet lower in elevation, and the colony at the upper limit of Canadian Life Zone on Mt. Thielson, perhaps a mile distant and 1,500 feet higher in elevation. I am confident that examination of the male genitalia would prove that it belongs to the species *editha*. It certainly represents an insect quite different from any described subspecies of *editha*, and it is to be hoped that it will be found at other localities in the Oregon Cascades. The population at the lake has not yet been named — and I believe that it is inadvisable to do so at present — but GUNDER (1931) described the dwarf form near timberline on this mountain and called it *lawrencei*. I have a good topotypic series of this (about 50 specimens) and a series from the colony at the lake (about 200 specimens). This latter population is very similar in size and color to several others which exist in Canadian and Transition Life Zones northward to the vicinity of Camp Sherman on Metolius River, Oregon. Material from several colonies in this general region are in my collection or in that of other Oregon collectors.

BURDICK has made a significant contribution in proposing an outline for use in describing subspecies of *Euphydryas*. Most of the items listed are good differentiating characters. Additional ones, both objective and subjective, might be added to enhance the descriptions. For example, data on wing shape, analysis of genitalic differences, and data on ecology and food plants. It is of paramount importance to describe the male genitalia to insure specific identification. Care should be taken to describe morphological differences from and similarities to subspecies described from adjacent geographic areas. Areas of gradation from one subspecies to another should be indicated in so far as possible.

In view of the great variability shown in the *editha* and *chalcedona-anicia* groups, I suggest that further naming of subspecies be held in abeyance until some competent worker prepares a monograph of the genus for the western North American forms based on all available material in both institutional and private collections.

Literature Cited

Burdick, W. N., 1959. A new race of *Euphydryas* from the Cascade Range of Oregon (Nymphalidæ). *Lepid. News* 12: 165-170.

Gillham, N. W., 1956. Geographic variation and the subspecies. *Syst. Zoology* 5: 110-120.

Gunder, J. D., 1929. The genus *Euphydryas* Scud. of boreal America (Lepidoptera, Nymphalidæ). *Pan-Pacific Ent.* 6: 1-8.

Gunder, J. D., 1931. Some new butterflies (Lepid., Rhopalocera). *Bull. So. California Acad. Sci.* 30: 47.

Hovanitz, Wm., 1942. Genetic and ecologic analyses of wild populations in Lepidoptera. I. Pupal size and weight variation in some California populations of *Melitæa chalcedona*. *Ecology* 23: 175-188.

Hovanitz, Wm., & Sister Mary Jude Le Gare, 1951. Genetic and ecologic analyses of wild populations in Lepidoptera. II. Color pattern variation in *Melitæa chalcedona*. *Wasmann Jour. Biol.* 9: 257-310.

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THE EQUATION OF SUBSPECIATION

by L. Paul Grey

Algebra is the accepted bedfellow of logic, nowadays; the following ideas have no claim to originality but in the present application perhaps will provide amusement for an idle moment.

Variability in wild populations, from the minor differences peculiar to local strains up to the unique character combinations of independent subspecies, are assumed to be *divergencies* which are products of isolation in *time* and isolation by *barriers*, which is to say,

$$d = tb.$$

Granting this to be a logical proposition the ratios derived from transpositions should hold true also. And, of course, from two knowns the third unknown is predictable, both if

$$t = \frac{d}{b} \quad \text{or} \quad b = \frac{d}{t}.$$

Divergence can be evaluated by a specialist, not precisely but quite well to such logical symbols as "large", "medium", and "small", which may be put into the above equation with propriety, using the numerical symbols "100", "50", and "10".

Some idea of "how large the barrier" and "how long (large or small) the time" can be gained from evaluating one against the other, first to a "standard *t*" and then to a "standard *b*". The number taken is immaterial to the answer gained from comparison with known "*d*" since only ratios are concerned, but for convenience "50" may be used.

From permutations of the equation, using these numbers, one gets numerical answers representing consequences logically following from the prime assumptions, answers which can be read as, *e.g.,* "time being fixed, barrier effects have been small if divergence is small", and "barrier being fixed divergence will be small or large proportionately as time has been small or large", and so on.

Next, it is possible to show the divergence theoretically to be expected, by putting in large, medium, and small values for *b* against a standard *t* and vice versa.

Specialists usually are bursting with theories of subspeciation rates, times of isolations, severity of present and paleographic barriers, and the like; possibly this formula could be juggled to give them some comfort, or, in the hands of a real mathematician (I am weak in long division) further elaborated to bulwark grandiose claims.

My pets (*Speyeria*) are negligibly subspeciated on the severely barriered Milk River Plateau highlands of interior Montana; the formula says that time has been very small.

Again, many subspeciations in the Pacific Coast Ranges will not equate unless a large *t* or *b* is assumed. Balancing against an unknown standard for either, and being able to see more of "barrier" than is known of "time", one of the applicable answers implies that "divergence becomes large as barrier is increased, time being fixed". If *b* as observed is too small to satisfy, the implication becomes "reach into paleogeography for some more barrier".

A still more generalized equation covering the same ground is

$$m \text{ plus } t = CS_2$$

which means nothing more than that, given Time, Mathematicians will be able to catch up with Common Sense.

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ESPECIALLY FOR FIELD COLLECTORS

(Under the supervision of FRED T. THORNE, 1360 Merritt Dr., El Cajon, Calif., U.S.A.)

THE BREEDING OF THE THECLINI AND COLLECTING THEIR EGGS IN WINTER

by TAKESHI KUZUYA

INTRODUCTION

The Theclini is a tribe of the Lycænidæ whose range extends over Korea, Japan and Amurland; the main habitat, so-called the headquarters, lies between the Himalayas and West China. A few species belonging to this tribe are also found in Europe and America.

This tribe, the Theclini, is thought to be closely akin to the Arhopalini and the Strymonini, and comprises approximately 90 species. In Japan, 23 species have so far been known, forming the most remarkable group among the Japanese butterflies. Brilliant and varied in color, these theclinids are much to the taste of many Japanese lepidopterists.

The taxonomical revision of these theclinids had already been made by SIBATANI and ITO by 1946, but, as far as the life-history is concerned, very little had been known until recently.

DEVELOPMENT OF THE STUDIES IN THE LIFE-HISTORY OF THE THECLINI

Before 1945, there had been reared only a few, more or less common species such as *taxila, lutea, sæpestriata, pryeri, attila, orientalis* and *ultramarinus*. Yet the breeding was not begun with eggs, but with caterpillars collected on their foodplants.

As regards the hibernating stage, C. TERANISHI reported in 1936 that *sæpestriata* winters as eggs. He found its eggs in late fall from the twigs of *Quercus acutissima,* the leaves of which had already fallen off. Then in 1937 T. NIIMURA reported the ovipositing habit of *J. lutea.* Consequently, it became possible to deduce the life-cycle of the Theclini from these facts. Now that the problem of hibernation had been solved, it was easy to conclude that they would be in the larval and pupal stages from April to June, or to the middle of July; everybody knows that the Theclinids are on the wing in early summer, once a year.

The study of the life history of Japanese butterflies has been pursued very enthusiastically since the end of war. Thanks to K. HAYASHI, breeding has become so popular that in a few years the life-history of almost all Japanese Hairstreaks came to be universally known to the lepidopterists. He was convinced, by experience, that the eggs of other Theclinids could be found alike, if the collectors living in the neighborhood of the haunts would earnestly search for the eggs laid near the winter buds of supposed foodplants. By observing or collecting the female butterflies in the field, the possibility of finding the eggs on those trees was very great.

This method advocated by K. HAYASHI of collecting the eggs in winter was immediately applied, and brought forth many discoveries. Of the collectors, high school students near the haunts were most diligent egg-hunters. They could collect many kinds of eggs, including those that had been unknown before. The latter ones were reared up to the perfect insects. In this way the eggs, larvæ, pupæ and also new haunts of almost all Theclinids came to be known within two or three years. The most famous Theclinids in connection with life-history are:

yuasai, a new species described in 1946 for the first time;

fujisanus, one of the rarest Hairstreaks in Japan;

hayashii, a new species distinguished from a sibling by the difference between the two caterpillars; and their foodplants;

ataxus, a brilliant, rare Theclinid (this is called the "Wonderful Hairstreak" in India).

It would be interesting to mention here how the eggs of each of these butterflies were found, but this matter will be put aside.

The Outline of the Life-History of the Theclini

The food of the Theclinids is the young leaf of deciduous trees, which belong to the family Fagaceæ, Betulaceæ, Juglandaceæ, Rosaceæ, Oleaceæ etc.; only *ataxus* feeds on an evergreen tree.

The perfect insects are generally on the wing in June in flat countries, and in mountainous districts, in July. The butterflies, especially the females, may often be found near their foodplants. The eggs are laid on various parts of the tree, such as buds, twigs, branches and trunk, but never on leaves. The place for oviposition, however, is considerably different according to the species. The eggs remain attached there for eight to nine months, but meanwhile a few of them may drop and be destroyed. The hibernated eggs hatch in April or May, just when their foodplants are in buds. The newly-hatched caterpillars first eat their way into the opening buds. After the leaves have spread, the larvæ are usually found on the underside of them, or on the twigs.

The larval stage lasts for three or four weeks, and after the third moult the caterpillar eats very fast and greedily, making ready for pupation. The fully grown larvæ pupate on the underside of the leaves, on the twigs or trunk or elsewhere. The perfect insects come out in about twenty to twenty-five days.

As regards the food, there is an exceptional species — *jonasi.* It lives certainly on leaves, but is ready to catch and devour a kind of aphides too (cf. *Lepid. News* 7: pp. 45-46; 1953).

The three Japanese Strymonids, viz. *mera, w-album,* and *pruni,* are quite similar to the Theclinids in their life-history.

Good Points of Collecting the Eggs in Winter

This method has greatly facilitated obtaining breeding-materials. If we want to breed a Theclinid, we may, for instance by *beating,* get some caterpillars, but to collect the eggs is superior to this in many points.

To specify the merit:

i. Breeding begun with the egg-stage enables us to observe the caterpillar all through its life.

ii. Winter is the most suitable season for searching for eggs, as there would be no other things to be collected than hibernating eggs, larvæ or pupæ.

iii. Above all, it is comparatively easy to collect the eggs, and in some cases pretty many eggs can be obtained. In winter no eggs are distinct in color, so that detecting the tiny Theclinid eggs might seem to be quite difficult. But a collector will soon find it not always so after a few visits to the wood where the butterflies frequent. If a Theclinid lives in flocks in a limited part of the haunt, its eggs can be found very easily. Generally speaking, however, the rarity of adult insects is not necessarily in proportion to the difficulty of detecting their eggs.

It often happened in Japan that eggs of a Theclinid were discovered where the parent butterflies had never been collected. For example, the first record in the Suzuka-range of rare *fujisanus* was not of the perfect insect, but of the egg laid upon the winter bud of a beech tree, which was collected in January, 1952; later, however, the butterfly was also caught there. Without this method, it would be extremely difficult to obtain perfect *fujisanus.*

How To Find The Eggs In The Wood

As mentioned before, the foodplant of a species can probably be found out by observing the female butterflies. We may, though not often, come across a female butterfly in the act of laying. Then we have only to watch her.

In general, what are of great importance to the collector are the place where many females have been caught, and the tree on which they have been sitting. In this regard, however, the male butterflies do not suggest a good place for collecting eggs. It seems that the males like to fly very high, often far away from their pupation places.

Needless to say, the collector is required to be able to identify the foodplants in winter, since most of them are deciduous. Moreover, he had better endeavor to observe in advance the behavior of the female butterflies and remember both the exact place and the tree. This would possibly save him much time, and would produce satisfactory results.

Table 1. The foodplant and ovipositing habit of each species of Theclini. (Original by K. Hayashi, 1952; revised by the author, 1955.)

	Species	Foodplants	Places of Oviposition[1]	Number of eggs laid at a time[2]
1.	*Shirozua jonasi*	*Quercus dentata* *Q. acutissima* *Q. serrata*	D. (where aphids swarm)	I. (rarely II)
2.	*Japonica lutea*	various *Quercus*	B	I or II
3.	*J. sæpestriata*	*Q. acutissima* *Q. serrata*	B, A	I
4.	*Coreana ibara*	*Fraxinus longicuspis*	D	II
5.	*C. raphealis*	*Fraxinus*	?	II
6.	*Artopoetes pryeri*	*Ligustrum ibota*	B, C	II, III
7.	*Araragi enthea*	Juglandaceæ	B	I or II
8.	*Antigius attilia*	*Quercus* spp.	B, C, A, D	I or II
9.	*A. butleri*	*Q. dentata* *Q. crispula*	in cracks of bark	II
10.	*Wagimo signata*	*Quercus* spp.	A	II
11.	*Iratsume orsedice*	*Hamamelis*	A	I
12.	*Favonius orientalis*	*Quercus* spp.	on branching points, or on trunk	I or II
13.	*F. jezoenis*	*Q. crispula*	D	I
14.	*F. hayashii*	*Q. dentata*	A, B, C, D	I
15.	*F. yuasai*	*Q. acutissima*	A	I
16.	*F. ultramarinus*	*Q. crispula* *Q. dentata*	A	I
17.	*F. saphirinus*	*Q. dentata*	B, A	I or II
18.	*F. fujisanus*	*Fagus*	B, A	I
19.	*Neozophyrus taxila*	*Alnus* spp.	D, A, B, C	III or II, I
20.	*N. aurorinus*	*Quercus crispula*	A	I
21.	*N. smaragdinus*	*Prunus* (cherries)	B, C, D	I
22.	*N. ataxus*	*Cyclobalanopsis acuta*	A	I
23.	*N. hisamatsusanus*	unknown	?	?

Supplement on Japanese species of *Strymonidia*.

1.	*Strymonidia mera*	*Rhamnus*	B	I or II
2.	*S. w-album*	*Ulmus*	various parts	I
3.	*S. pruni*	*Prunus*	?	?

[1] Places of oviposition: A — near the winter buds; B — on the twig; C — on the branch; D — on a rough surface, or in cracks of the trunk.

[2] The number of eggs deposited at a time: I — single, sometimes double; II — several; III — many, laid in batches.

Each Theclinid has its own way of laying. The eggs are laid near the winter buds (Type A); on the twig (B); on the branch (C); on the rugged surface, or in the crack, of the trunk (D); the number of eggs deposited at a time being single (I); several (II); many, laid in batches (III). See Table I. for the foodplant and ovipositing habit of each species. In addition to the Theclinids, two Strymonids (*mera, w-album*) are on the Table.

The eggs of most of these species that have a tendency to live in flocks are easily obtained. They are usually laid at the base of the winter-buds or on them, otherwise in the forks of twigs as well as on the twigs. As for the species having wide-spread but sparse distributions, a greater effort must be made in order to obtain their eggs, and the same thing applies to such butterflies that lay their eggs on the rugged surface or on the twigs at very high levels.

The eggs are never evenly laid on the trees in a haunt. Almost always there are but a few trees which the females prefer for oviposition. An experienced collector would readily find them out.

The female butterfly does not deposit her eggs exclusively at higher levels of the tree, but often lays at lower levels as well. Table II will perhaps serve as an example. There is shown in this the relation between the number of eggs and the height at which they were found.

Table 2. Relation between the height from the ground and number of eggs of *Neozephyrus ataxus* (from Takita, K., 1952).

Height (in cm.)	Number collected
lower than 25 cm.	3
25——— 75	19
75———125	25
125———175	17
175———225	12
higher than 225	9

As a matter of fact, this method consists in laborious climbing and attentive observation. In search of eggs we will have to cut off or bend branches, and in some cases the whole tree should be cut down for the sake of close and efficient examination. But it is not preferable to cut further than the branch.

Preservation Of The Collected Eggs; Treatment Of The Newly-hatched Larva

The rate of hatching of the collected eggs may be low, if they are preserved in a room. The twigs or pieces of bark with the eggs should be hung outdoors, more or less exposed to rain and snow.

The time of hatching exactly corresponds to the budding season of the foodplant. Toward this time all the eggs must be examined about twice a day, lest the minute young caterpillars should creep out unnoticed and be lost. On, hatching, the larva makes an opening in the center (*i.e., micropyle*) of the egg. The larva remains in the egg-shell for a pretty long time after having finished the opening. When an egg is seen making the hole, it would be better to put all the eggs of the same species into a glass receptacle or petri-dishes, together with some opening buds as food. If a hatched caterpillar is found on the twig or fragment of bark, it should at once be transferred to a bud on the soft hairs of a small brush, or on a feather. It is desirable to put a piece of gauze between the dish and the lid, or else the larva may escape through the gap. Once the caterpillar begins to eat, there would be no particular difficulties about the breeding. The only trouble is that the caterpillar of some species may turn *cannibals* as they grow bigger, yet this would quite easily be avoided.

Epilogue

In the preceding paragraphs I have introduced the method of collecting the eggs of the Japanese Theclinids and Strymonids. As for the Theclinids that are absent in Japan, three species, namely *quercus, betulæ* and *roboris* are said to feed in Europe on *Quercus, Prunus,* and *Fraxinus* respectively; in America there are two Theclinids — *grunus* and *chrysalus,* and the known foodplant for both is also *Quercus.*

The Himalayas, from 7,000 up to 8,000 feet in height, are the haunts of many splendid Theclinids. Their life-histories are still neglected, excepting *birupa* and *odata.* The former lives on *Rhododendron,* and the latter, on a certain walnut tree. In my opinion, it certainly seems that many Himalayan Theclinids are *Cyclobalanopsis* eaters like *ataxus.*

In conclusion, if these notes give a clue to the breeding of the Theclinids whose life-history is still unknown, and if this method were to accelerate success in breeding the North American Strymonids as well, nothing would be greater than my delight and satisfaction.

Acknowledgements

I am greatly indebted to Mr. K. Hayashi for his kindness in permitting me to cite his excellent works, and I wish to express my grateful thanks to Messrs. T. Iwase and T. Takakura for their helpful advice in preparing this paper.

P. S. According to Dr. T. Esaki (*Kontyu* 21: pp. 33-35; 1954): *F. ultramarinus* in this text should be treated as *F. cognatus jozanus* (Matsumura), and *F. hayashii* in this text should be treated as *F. ultramarinus* Fixsen. "*N. ataxus*" in Japan is a good species (*N. kirishimaensis* Okajima) separable from *N. ataxus* Doubleday & Hewitson.

References (as of October, 1955)

1. On Japanese Theclini:

Hayashi, K., 1952. How to collect the hibernating Zephyrid eggs for breeding (1)-(3) [in Japanese]. *Shin Konchu* 5(1): pp.31-34, 4 pls., 2 figs.; 5(2): pp.12-15, 4 pls., 2 figs.; 5(3): pp.35-40, 4 pls., 7 figs., 2 tables.

Inoue, M., & K. Hayashi, 1952. Photographic album of butterflies in life [in Japanese]. *Shin Konchu* 5 (9) (special issue): pls.28-35.

Iwase, T., 1954. Synopsis of the known life-histories of Japanese butterflies. *Lepid. News* 8: p.97.

Niimura, T., 1937. On the ovipositing habit of *Japonica lutea* (Hewitson) [in Japanese]. *Mushi no Sekai* 1(9/10): p.50.

Oda, K., 1954. Life-history of *Coreana raphaelis flamen* Leech in Japan [in Japanese]. *Butterflies & Moths* 5(3/4): pp.22-24, 6 figs.

Okada, Y., 1949. Revised catalogue of the Theclini (Lycænidæ) of Japan, Korea, Sakhalin, and Formosa. *Lepid. News* 3: pp. 79-80.

Saito, K., M. Osanai, H. Yamauchi, & M. Hara, 1952. Some investigation on a Lycænid butterfly, *Wagimo signata* (Butler 1881) [with English résumé]. *The Chûhô,* No.7: 32 pp., 7 pls.

Sibatani, A., 1946. Zweiter Beitrag zur Systematik der Lycænien aus Japan und angrenzenden Gegenden nebst Bemerkungen über einige Formen aus Formosa (Lep. Lycænidæ). *Bull. Lepid. Soc. Japan* 1(3): pp.61-86.

Sibatani, A., & S. Ito, 1942. Beitrag zur Systematik der Theclinæ im Kaiserreich Japan. *Tenthredo* 3: pp.298-334.

Takahashi, A. K., Takita & T. Kawachi, 1952. On the life-history of *Neozephyrus ataxus kirishimaensis* Okajima (Lycænidæ) [with English résumé]. *Kontyû* 19 (3/4): pp.32-37, 1 pl.

Takahashi, A., 1955. On the life-history of *Iratsume orsedice* (Butler, 1881) [with English résumé]. *Kontyû* 23(4): pp.170-181, 2 pls., 1 fig., 5 tables.

Teranishi, C., 1936. *Japonica sæpestriata* (Hewitson) hibernates in the egg stage [in Japanese]. *Kansai Konchu Zasshi* 4(1): pp.1-2, 1 pl.

2. On Japanese *Strymonidia*:

Okano, M., 1946. The life-history of *Strymon mera* Janson [in Japanese]. *Bull. Tôhoku Ent. Soc.* 1(2): pp.7-11.

Osanai, M., 1951. On the life-history of *Strymon w-album fentoni* Butler [with English résumé]. *The Chûhô,* No.5: 12 pp., 1 table, 2 pls.

3. On the Theclini other than Japanese:

Davenport, D., & V. G. Dethier, 1938. Bibliography of the described life-histories of the Rhopalocera of America north of Mexico. *Ent. Americana* (New Series) 17: p. 172 [food-plant of *Habrodais grunus*].

Frohawk, F. W., 1924. *Natural history of British butterflies,* vol.2: pp.38-47, pls. 42, 43. London.

-----------, 1934. *The complete book of British butterflies*: pp.272-279, pl.24 [life-history of *Thecla betulæ* and *T. quercus*]. London.

Peile, H. D., 1937. *A guide to collecting butterflies of India*: pp.193-195 [foodplants of *Zephyrus birupa* and *Chætoprocta odata*]. London.

Remington, C. L., 1960. Foodplant of *Hypaurotis chrysalus* (Lycænidæ) in Colorado. *Journ. Lepid. Soc.* 13: 164.

Seitz, A., 1908. *Die Gross-Schmetterlinge der Erde,* Vol. 1 (Stuttgart): p.262 [describes briefly the food-plant and early stages of *Læosopis roboris*]. Stuttgart.

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REARING RARE FORMS OF *CATOCALA* AND *APANTESIS*, AND A PLEA FOR MORE REARING OF LEPIDOPTERA

by JOSEPH MULLER

Among several rare species of Lepidoptera I raised this season (1959) to the adult stage, I am especially proud of the following two.

One I raised from last year's eggs of a female *Catocala parta* Guenée form "perplexa." Fifty-three specimens raised from eggs of "perplexa" turned out to be 35 (23♂♂, 12♀♀) form "perplexa" (66%), 2 (1♂, 1♀) typical *C. parta* (4%), and 16 (10♂♂, 6♀♀) melanic form "forbesi" (30%). One ♂ specimen of the latter had dark yellow secondaries and may go for ab. "petulans."

The others were the offspring of a female *Apantesis figurata* Drury form "preciosa". The number of specimens raised was twenty-four, and the most interesting part is that all are females! Most of these look different from each other, only two looking alike. There are eight specimens of form "preciosia". Five of those eight specimens have normal markings on the primaries, and yellow secondaries with black band and black dot. One specimen differs, as the yellow in the secondaries is blackish. Two specimens have black primaries with two yellow dots each.

Five specimens are form "excelsa". Four are typical "excelsa" with a reddish dot in black secondaries; the other has all-black primaries with two yellow dots in the secondaries.

Five specimens are typical *figurata.* Three of them have the regular striped markings on the primaries and red secondaries with black band and black dot. Two specimens had black primaries with yellow dots.

The remaining six specimens are form "preciosa" also, but instead of black band and dot they all have black secondaries with yellow dots. Three of them have the primaries black too, with two yellow dots each. All the regular markings differ from each other also, be it the size, amount, or length of line in the primaries, or the size of dots in the primaries and secondaries, so that none but two look alike.

I am sure that most collectors must agree that it would take many years, maybe a lifetime, to collect series of the above-mentioned forms. How many times must one travel to different parts of the country to sugar for *Catocala* and how many times does one pick off single specimens of *Apantesis* on black-lights to make up a series of the mentioned forms?

I hope that this little article will spur other collectors to do more rearing of Lepidoptera. Not only great surprises await one, especially with many melanic forms showing up lately, — it also is a challenge to the collector, not to speak of the proud feeling one has after a successful breeding job well done. Many species are difficult to raise. Some of the most important pointers are: use fresh healthy food only; replace it in time; keep containers clean; do not crowd too many in one container; close holes in bottom of jar tightly when food-plant is in water; watch temperature and especially condensation of moisture when larva is in the first instars; do not handle when molting; and keep using bigger containers as the larva grows larger. In most cases the breeder must use his own judgment and have some inventive ideas.

The biggest challenge to the collector is getting hibernating larvæ through the winter and keeping them going in spring, or feeding larvæ of which the foodplant is not known and rearing them to the adult stage.

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MITOURA JOHNSONI IN OREGON AND CALIFORNIA

The rare hair-streak *Mitoura johnsoni* was described by SKINNER (1904) from specimens taken in British Columbia and the Seattle area. To the writer's knowledge there are no published records of its occurrence south of this region. LEIGHTON's checklist of the butterflies of Washington (1946) quotes only the original Seattle locus. DON B. FRECHIN, reporting for the 1951 and 1952 season summaries in the *Lepid. News,* states (1951) that this form was in evidence, but scarce, in the Olympic Mountains, and (1952) that it made a showing in the Puget Sound area.

It is therefore of interest to report the capture of *M. johnsoni* in the Cascades of Oregon and northern California. The writer collected two freshly emerged females on May 23, 1959, at Lost Prairie, Linn Co., Oregon, a mountain meadow (alt. 3400 ft.) along the South Santiam Highway, 14 miles west of the Cascade summit. On June 2 another female and a male were taken at the same location. On July 4, 1959, a male and female were collected at Tombstone Prairie (alt. 4200 ft.), just three miles west of Lost Prairie, by R. E. WOODLEY. A California record was provided by Dr. M. DOUDOROFF, who sent the writer a female of *M. johnsoni* taken at Silver Lake in Lassen County (18 miles east of Mt. Lassen), July 2, 1955.

In the interest of recognizing this butterfly when found, it should be pointed out that HOLLAND (*Butterfly Book,* 2nd ed.) erroneously describes it as "bluish black on the upper side." It is, of course, reddish brown above (*vide* SKINNER's original description, *Ent. News* 15: 298). HOLLAND's black-and-white figures are of little help, since the markings closely resemble those of *M. spinetorum.* COMSTOCK's colored figure (*Butterflies of California*) shows only the under side, which could pass for *spinetorum.* The crucial difference lies in the color of the upper surface.

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RECENT LITERATURE ON LEPIDOPTERA

(Under the supervision of PETER F. BELLINGER)

B. SYSTEMATICS AND NOMENCLATURE

Toxopeus, L. J., "On two *Appias* species from Celebes and a note regarding *Delias sthenobæa* (Boisd.) (Rhopalocera, Pieridæ)." *Zool. Meded.*, Leiden, vol. 31: pp. 63-66, 1 pl. 1950. Describes as new *A. paulina zondervani* (Tondano, N. Celebes); notes on *paulina* species complex. Sinks *D. zebuda* to *D. sthenobæa*. [P.B.]

Toxopeus, L. J., "*Charaxes baya* (Moore) and *Charaxes scylax* Felder in Java (Lep., Nymphalidæ)." *O. S. R.—Publ.*, no. 35: pp. 5-6. ? 1953. Notes on the identity of these spp., which are possibly conspecific and represent successive invasions of Java (where they fly together). [P.B.]

Toxopeus, L. J., "Notes on the genus *Amathusia* F. (Lep., Rhop.)." *O. S. R.—Publ.*, no. 34: 16pp., 3 pls. ? 1953. Describes as new *A. duponti* (Buitenzorg, W. Java), *A. lieftincki* (Tjimadur, S. Bantam, W. Java), *A. l. rosieri* (Giesting Colony, Lampong District, S. Sumatra). Systematic notes, with key to Javan spp. *A. phidippus* feeds on palms, not banana. [P.B]

Travassos, Lauro, "Contribuição ao conhecimento dos Arctiidæ. XXXVI. Sôbre o gênero *Graphæa* Schaus, 1894" [in Portuguese]. *Rev. brasil Biol.*, vol. 16: pp. 443-452, 26 figs. 1956. Describes as new *G. paramarmorea* (Nova Teutonia, Brazil), *G. pseudomarmorea* (Juquiá, S. Paulo state, Brazil); redescribes generotype, *G. marmorea*. [P.B.]

Travassos, Lauro, "Contribuição ao conhecimento dos Arctiidæ. XXXVII. Gênero *Demolis* Hampson, 1901" [in Portuguese]. *Rev. brasil. Biol.*, vol. 17: pp. 9-16, 21 figs. 1957. Transfers *Evius albitegula* to *Demolis;* redescribes *D. albitegula* & generotype, *D. albicostata.* [P.B.]

Travassos, Lauro, "Contribuicão ao conhecimento dos Arctiidæ. XXXVII [sic!]. Gênero *Castrica* Schaus, 1896 (Lepidoptera, Heterocera)" [in Portuguese]. *Rev. brasil. Biol.,* vol. 17: pp. 227-234, 18 figs. 1957. Redescribes generotype, *C. phalænoides.* [P.B.]

Travassos, Lauro, "Estudos sôbre Adelocephalidæ Burmeister, 1878 (Lepidoptera, Heterocera)" [in Portuguese]. *Rev. brasil. Biol.,* vol. 17: pp. 309-316, 21 figs. 1957. Decribes as new *Scolesa pseudoargyracantha* (Campos do Jordão, Lefèvre, S. Paulo, Brazil); redescribes *S. argyracantha.* [P.B.]

Travassos, Lauro, & Lauro Travassos Filho, "DYSSCHEMATIDÆ, novo nome para Pericopidæ Walker, 1869 (Lep. Heterocera)" [in Portuguese; English summary]. *Papeis avulsos Dep. Zool. São Paulo,* vol. 10: pp. 77-91. 1951. The lectotype of *Pericopis* is congeneric with the type of *Dysschema* (monobasic), which has priority; this requires a change in the family name. Authors sink *Chetone* to *Notophyson,* & give extended synonymy & references for Dysschematidæ, *Dysschema, D. hypoxantha, D. eurocilia, Sermyla, S. transversa, Thebrone, T. tricolora, Notophyson, N. tiresias, N. c. catalina,* & *N. c. angustilineata.* Position of *buckleyi* Druce uncertain. [P.B.]

Travassos, Lauro, & Lauro Travassos Filho, "Contribuiçao ao conhecimento dos Arctiidæ (Lepidoptera, Heterocera). XXXIII. *Rhina* [sic!] *euricosilvai,* n. sp." [in Portuguese]. *Rev. brasil. Ent.,* vol. 1: pp. 213-219, 2 pls. 1954. Describes as new *Rhipha euricosilvai* (Campos do Jordão, 1200 m., São Paulo, Brazil). [P.B.]

Travassos Filho, Lauro, "Redescrição de *Corematura* Butler, 1876 e de suas duas espécies (Lepidoptera, Ctenuchidæ)" [in Portuguese; English summary]. *Arq. Zool. Est. São Paulo,* vol. 8: pp. 89-108, 4 pls., 27 figs. 1952. Redescribes *C. postflava* & *C. chrysogastra.* [P.B.]

Travassos Filho, Lauro, "*RICCIA* novo gênero para *Corematura aliaria* (Druce, 1890) e descrição do alótipo dessa espécie. (Lep. Ctenuchidæ)" [in Portuguese; English summary]. *Papeis avulsos Dep. Zool. São Paulo,* vol. 11: pp. 279-288, 7 figs. 1953. Describes new genus & redescribes type. [P.B.]

Travassos Filho, Lauro, "Notas de nomenclatura. II. Prioridade de Druce (1898) em alguns gêneros de Ctenuchidæ (Lep.) atribuidos a Hampson (1898)" [in Portuguese; English summary]. *Arq. Zool. Est. São Paulo,* vol. 8: pp. 333-340. 1954. 6 genera described by Hampson, 1898, were used earlier in the same year by Druce, without descriptions but with only 1 sp. included in each. Both Druce & Hampson selected *mimica* as the type of *Pseudopompilia.* In the case of the other 5 genera, Druce's type (in parentheses) was different from Hampson's: *Holopæa* (*cærulea*); *Mesothen* (*ignea*); *Psilopleura* (*polia*); *Urolasia* (*opalocincta*); *Phœnicoprocta* (*metachrysea*). These names, being monobasic & published before 1931, are valid with the types indicated [P.B.]

Trawöger, Alois, *Eriogaster lanestris* L. nova ssp. *montana* (Lepidoptera, Lasiocampidæ)" [in German]. *Zeitschr. weiner ent. Ges.*, vol. 41: pp. 248-251, 1 pl. 1956. Described from Innsbruck, 600 m., Austria. [P.B.]

Tweedie, M. W. F., "*Lithacodia deceptaria* Scop., and *Nycterosea obstipata* (F.) in east Sussex." *Ent. Gazette*, vol. 8: p. 28, 2 figs. 1957. Photos of adult of *L. deceptaria*. [P B.]

Urbahn, Ernst, "Die asiatische Geometride *Cabera leptographa* Wehrli in der Mark Brandenburg gefunden" [in German]. *Zeitschr. Lepid.*, vol. 2: pp. 25-35, 2 pls., 1 fig. 1952. Species new to Europe. Carefully compares & distinguishes *C. leptographa, C. exanthemata,* & *C. pusaria.* [P.B.]

Urbahn, Ernst, "Die Jungenstände und das Weibchen von *Cabera leptographa* Wehrli (Geometridæ)" [in German]. *Zeitschr. Lepid.*, vol. 2: pp. 97-104, 1 pl., 3 figs. 1952. Describes previously unknown ♀, & all early stages; compares latter & ♀ genitalia with those of other spp. of *Cabera*. [P..B.]

Ureta R., Emilio, "Nuevas especies de Pieridæ (Lep. Rhopalocera) de Chile y Argentina" [in Spanish]. *Bol. Mus. nac. Hist. nat. Chile*, vol. 26: pp. 57-71, 2 pls., 1 fig. 1955. Describes as new *HYPSOCHILA*, & type *H. wagenknechti* (Rio Seco, Cordillera de Elqui, 3200 m., Prov. Coquimbo, Chile), *H. w. sulfurodice* (Lequena, San Pedro, 3900 m., Prov. Antofagasta, Chile), *H. galactodice* (El Roble, source of Rio Nuble, Chellán, Chile); *CHIONANEMA* (subgenus of *Hypsochila*), & type *H.* (*C.*) *peñai* (Laguna Verde, 5200 m., Cord. de Antofagasta, Chile); *Phulia illimani ilyodes* (Mucar, Cord. de Antofagasta, Chile). *H. wagenknechti* not actuallly new here, & should be credited to Peña, who raised *wagenknechti* (described as a "form" by Ureta) to subspecific rank. [P.B.]

Vázquez G., Leonila, "Estudio y descripción de una especie nueva de psiquido, *Oiketicus mortonjonesi spec. nov.*" [in Spanish]. *An. Inst. Biol.*, Mexico, vol. 20: pp. 399-406, 10 figs. 1949. Type locality "Road between Ixtapan de la Sal and Tonatico, Mexico". Describes larva, case, & pupa; foodplants *Prosopis juliflora* & *Baccharis ramulosa*. [P.B.]

Vázquez G., Leonila, "Un nuevo psiquido mexicano del género *Oiketicus*" [in Spanish]. *An. Inst. Biol.*, Mexico, vol. 22: pp. 323-333, 3 pls., 5 figs. 1951. Describes as new *O. zihuatanejensis* (Zihuatanejo, Guerrero, Mexico). Describes larva, case & pupa; foodplants *Cæsalpinia palmeri* & *Bursera* sp. [P.B.]

Vázquez G., Leonila, "Observaciones sobre pieridos mexicanos con descripción de algunas formas nuevas. V. Las especies del género *Itaballia* en México" [in Spanish]. *An. Inst. Biol.*, Mexico, vol. 24: pp. 439-444. 1953. Redescribes *I. demophile calydonia, I. pisonis kicaha,* & *I. viardi;* names a "form" of last. [P. B.]

Vázquez G., Leonila, "Reconsideración taxónomica de *Prestonia clarki* Schaus — *Phœbis* (*Prestonia*) *clarki* (Schaus) — Lepidoptera-Pieridæ" [in Spanish]. *An. Inst. Biol.*, Mexico, vol. 26: pp. 477-487, 1 fig. 1955. Detailed redescription & new placement. [P.B.]

Vázquez G., Leonila, "Papilios nuevos de Mexico. IV" [in Spanish]. *An. Inst. Biol.*, Mexico, vol. 27: pp. 473-485, 12 figs. 1956. Describes as new *Battus philenor insularis* (Clarion Is., Revillagigedo group); *Graphium belesis occiduus* (Zihuatanejo, Guerrero). Also names 6 new "forms" in *Battus, Papilio,* & *Graphium*. [P.B.]

Verity, Roger, *Les variations géographiques et saisonnières des papillons diurnes en France.* I. 200 pp. Paris: Rev. Franc. Lepid. 1947-1951. First part covers Hesperiidæ, Lycænidæ, & Riodinidæ. Describes as new *Heodes* (*Chrysophanus*) *tityrus* "race" *catherinei* (Hautes-Pyrénées), *H.* (*C.*) *t.* "race" *oceanitis* (Deps. Gironde & Vendée), *H.* (*C.*) *t.* "race" *mixtalpina* (Vallée du Boréon, 1800-2200 m., Alpes-Maritimes), *H.* (*C.*) *t.* "race" *minutepunctata* (Nîmes; La Valbonne); *Maculinea arion* "race" *microchroa* (Lardy; Angoulême), *M. a.* "race" *pyrenæafuscans* (Gèdre, Hautes-Pyrénées); *Lycæides idas* "race" *subsaturior* (Mont Aigoual, Gard), *L. argyrognomon* "race" *tapinægus* (Charente, etc.); *Polyommatus icarus* "race" *claracælestis* (Charente-Maritime), *P. eros* "race" *micreros* (above Vernet-les-Bains, Col Vert, Hautes-Pyrénées); *Lysandra amandus* "race" *pyrenæorum* (Gèdre, Hautes-Pyrénées), *L. coridon* "race" *ruscinonis* (Vernet-les-Bains); *Agriodiætus damon* "race" *meridioccasus* (Lozère); *NEOCOVATIA* (subgenus of *Strymonidia*; type *acaciæ*). Proposes *aurescens* n.n. for *Adopaea acteon clara* Tutt; *magnaglandon* n.n. for *Ag-*

riades glandon oberthüri Stgr. Also names a seasonal form. Describes local variation of all French spp. of these families, in great detail but with little precision, since most variants are described in purely relative terms. No information on types of new entities. [P.B.]

Verity, Roger, *Les variations géographiques et saisonnières des papillons diurnes en France*. II. Pp.201-364. 1952. Second part covers Papilionidæ, Pieridæ, Libytheidæ, Apaturidæ, & Nymphalidæ: Limenitinæ & Melitæinæ. Describes as new *Melitæa (Cinclidia) phœbe subtusca* (Nans-les-Pins, 300 m., Sainte-Baume, Var). [P. B.]

Verity, Roger, *Les variations géographiques et saisonnières des papillons diurnes en France*. Part 3, pp. 365-472. 1957. L. Le Charles ed. The book is devoted to the geographical and seasonal variations of the species of Nymphalidæ and Satyridæ Lethinæ of the French fauna. Describes as new: *Brenthis ino* "race" *sesquierilda* (E. Pyrenees); *Pararge ægeria* "race" *paulumægeria* (Morbihan, Sarthe, & Maine-et-Loire areas); *Agapethes galathea nereus* "subrace" *macronereus* (Gard and Bouches-du-Rhone areas). No indications of holotypes, of type localities, or of collections where types are preserved. [P.V.]

Verity, Roger, "The two subgeneric names of butterflies *Disparia* Vrty. and *Simplicia* Vrty. replaced, being homonyms." *Ent. Rec. & Journ. Var.*, vol. 69: p. 225. 1957. Proposes *THERSAMOLYCÆNA* (type *Lycæna dispar*) & *SIMPLOSPINOSIA* (type *Erebia epiphron*) to replace these names. [P.B.]

Viette, P., "Contribution à l'étude des Hepialidæ (7e note). Le genre *Trichophassus* Le Cerf" [in French]. *Bull. Soc. ent. France*, vol. 54: pp. 72-73, 3 figs. 1949. Redescribes type, *T. giganteus*. [P.B.]

Viette, P., "Contribution à l'étude des Hepialidæ (8e note). Sur la validité du genre *Zelotypia* Scott" [in French]. *Bull. Soc. zool. France*, vol. 74: pp. 47-49, 2 figs. 1949. Redescribes genus, said to be distinct from *Leto*, & type *Z. stacyi*. [P.B.]

Viette, P., "Une nouvelle Geometridæ de Nouvelle Calédonie (lépidoptère)" [in French]. *Bull. Soc. zool. France*, vol. 74: pp. 241-244, 5 figs. 1949. Describes as new *NOUMEA* (Boarmiinæ; monobasic), *N. fletcheri*. [P. B.]

Viette, P., "Contribution à l'étude des Hepialidæ (18me note). Description d'un nouveau genre et d'une nouvelle espèce" [in French]. *Bull mens. Soc. linn. Lyon*, vol. 19: pp. 169-170, 2 figs. 1950. Describes as new *PARAHEPIALISCUS* (monobasic), *P. baluensis* (Mt. Kina Balu, N. Borneo). Key to related genera. [P. B.]

Viette, P., "Contribution à l'étude des Hepialidæ (20e note). Le genre *Druceiella* Vtt." [in French]. *Bull. Soc. zool. France*, vol. 75: pp. 165-169, 11 figs. 1950. Describes as new *D. amazonensis* (Obidos, Brazil). Key to the 4 spp. Selects *prosopus* as type of *Pseudophassus*. [P.B.]

Viette, Pierre E. L., "Contribution à l'étude des Hepialidæ (21e note). Description d'une nouvelle espèce" [in French]. *Bull. Inst. Roy. Sci. nat. Belg.*, vol. 26, no. 44: 2 pp, 1 fig. 1950. Describes as new *Endoclita javaensis* (Nongkodjadjar, Tengger, W. Java, 4,000 ft.). [P.B.]

Viette, Pierre E. L., "Contribution à l'étude des Hepialidæ (22eme note). Hepialidæ du Musée de Leiden" [in French]. *Zool. Meded.*, Leiden, vol. 31: pp. 67-77, 18 figs. 1950. Describes as new *PAROXYCANUS*, & type *P. novæguineensis* (Paniai, New Guinea), *P. meeki* (Biagi, Mambare, Br. New Guinea, 5,000 ft.); *PHILPOTTIA* (type *Pielus umbraculatus*); *Callipielus chiliensis* (Valdivia, Chile). Transfers some spp. of *Porina* to *Paroxycanus*. Describes ♂ & ♀ genitalia of *Palpifer sordidus* & *Endoclita sericeus*. [P.B.]

Viette, P., "Sur quelques espèces de geométrides décrites par Guenée (1857)" [in French]. *Bull. mens. Soc. linn. Lyon*, vol. 19: pp. 201-206. 1950. Selects lectotypes for numerous spp. from specimens in Paris Museum. [P.B.]

Viette, Pierre E. L., "Contribution à l'étude des Hepialidæ (Lepidoptera). (23eme note)" [in French]. *Ann. naturhist. Mus.*, Vienna, vol. 58: pp. 140-144, 7 figs. 1951. Describes as new *Æpytus petropolisiensis* (Petropolis, Brazil); *PARAGORGOPIS*, and type *P. pittionii* (Petropolis), *P. foetterlei* (Petropolis), *P. schausi* (Araras, S. Paulo, Brazil); *LAMELLIFORMIA* (see also 25th note, below) (type *Dalaca prytanes*); *Philænia brasiliensis* (Petropolis). [P.B.]

Viette, P., "Contribution à l'étude des Hepialidæ (Lépid.) (24me note)" [in French]. *Bull. mens. Soc. linn. Lyon*, vol. 20: pp. 95-96, 3 figs. 1951. Notes on genera *Cibyra*, *Hampsoniella*, *Pseudodalaca*, *Æpytus*, & *Schæfferiana*; & on types of some spp. in these genera, with figures of ♂ genitalia. [P.B.]

Viette, Pierre E. L., "Contribution to the study of Hepialidæ (25th note). On some new or little known species in the British Museum. *Ann. & Mag. nat. Hist.*, ser. 12, vol.

4: pp. 1272-1282, 5 figs. 1951. Describes as new *PUERMYTRANS* (monobasic), *P. chiliensis* (Chile); *THIASTYX* (monobasic), *T. catharinæ* (New Bremen, Santa Catharina, Brazil); *HEPIALYXODES* (monobasic), *H. rileyi* (Ypiranga, S. Paulo, Brazil); *YLEUXAS* (monobasic), *Y. bradleyi* (Carabaya, 6000 ft., S. Domingo, Peru); *Eudalaca sanctahelena* (St. Helena). Also gives description of *LAMELLIFORMIA* (see 23rd note, above), in expectation that this paper would appear first. Records of 11 other spp. from Latin America. [P. B.]

Viette, P., "Sur la classification de quelques arctiides de la faune français (Lep.)" [in French]. *Bull. Soc. ent. France,* vol. 56: pp. 97-98. 1951. Lists 14 genera, with references, type spp., & information on how latter were selected. [P.B.]

Viette, P., "Sur quelques noctuelles décrites par Guenée (1852-54)" [in French]. *Bull. mens. Soc. linn. Lyon,* vol. 20: pp. 159-162. 1951. Selects lectotoype for some 160 spp., from specimens in Paris Museum. [P.B.]

Viette, P., "Les Lithosiidæ de Nouvelle Calédonie et des Nouvelles-Hébrides (Lep. Heter.)" [in French]. *Ann Soc. ent. France,* vol. 19: pp. 81-96, 29 figs. 1952. Redescribes 12 known spp. with figures of genitalia & of some adults. [P.B.]

Viette, P., "Note de nomenclature" [in French]. *Bull. Soc. ent. France.,* vol. 57: p. 95. 1952. Proposes *EUNOUMEANA* n.n. for *Noumea* Viette (above, 1949), nec Fauvel. [P.B.]

Viette, P., "Results of the Archbold Expeditions. Contribution à l'étude des Hepialidæ (Lep.) (28eme note). Nouveaux genres et espèces néo-guinéens" [in French]. *Treubia,* vol. 21: pp. 257-262, 2 figs. 1952. Describes as new *ZAUXIEUS* (monobasic), *Z. toxopeusi* (Scree Valleey Camp, 3800 m., central New Guinea); *THEAXIEUS,* & type *T. diakonoffi* (Iebele Camp, 2250 m.), *T. roepkei* (Mist Camp, 1600 m.). [P.B.]

Viette, P., "Sur la synonymie de quelques noms de lépidoptères" [in French]. *Bull. Mus. Hist. nat.,* Paris, vol. 24: pp. 555-556. 1952. New synonymy in Cossidæ: *Hypopta saharæ* (=*Eremocossus senegalensis*), *Cossus aries* (=*C. tahlai, C. bongiovannii*); Pyralididæ: *Actenia vidualis* (=*Pyralis mariæ ludovicæ*), *Orobena fulgura* (=*Pionea jeannelalis*); & Noctuidæ: *Nagia syba* (=*N. megaruma*), *Phytometra ernestinana* (=*Xanthoptera coccinifascia*). [P. B.]

Viette, P., "Les types de tordeuses de Meyrick appartenant au Muséum de Paris" [in French]. *Bull. Soc. ent. France,* vol. 57: pp. 148-152. "1952" [1953]. Lists Meyrick's types of Carposinidæ, Ceracidæ, Phaloniidæ, Tortricidæ, & Eucosmidæ in Paris Museum, & some types of tineoids omitted from earlier list; many specimens are lectotypes. [P.B.]

Viette, P., "Nouvelles descriptions de pyrales malgaches" [in French]. *Bull. Mus. nat. Hist. nat.,* Paris, vol. 25: pp. 483-488. 1953. Describes as new *Bocchoris isakalis* (near Fort Dauphin, Isaka Forest, SE Madagascar); *Pyrausta lambomakandroalis* (Lambomakandro Forest, SW Madagascar); *Sylepta malgassanalis* (Ankarampotsy, E. Madagascar); *Polygrammodes faraonyalis* (Vohilava, Faraony Valley, E. Madagascar); *Entephria vohilavalis* (same); *Hyaloplaga ankarapotsyalis* (Ankaraampotsy, E. Madagascar); *Stenia decaryalis* (Moramanga, E. Central Madagascar), *S. orientalis* (Ankarampotsy). [P.B.]

Viette, P., "Nouvelles pyrales de Madagascar (Lep. Pyralidæ)" [in French]. *Bull. Soc. ent. France,* vol. 58: pp. 130-134, 7 figs. 1953. Describes as new *NHOABE,* & type *N. mocquerysalis* (near Antanambé, NE Madagascar), *N. millotalis* (Perinet region, E. Central Madagascar); *MARIONANA* (monobasic), *M. paulianalis* (Pertinet region); *Makela maisongrossalis* (near Maroantsetra, Voloina, NE Madagascar). [P.B.]

Viette, P., "A propos de *Bradypodicola hahneli* Spuler, trouvé sur un parasseux (Lep. Pyralidæ)" [in French]. *Bull. Soc. zool. France,* vol. 79: pp. 448-451, 2 figs. 1954. Places genus in Chrysauginæ; describes ♂ & ♀ genitalia. Reviews 3 known genera whose larvæ live on sloths. [P. B.]

Viette, Pierre E. L., "Les types de tinéides (s.l.) de Zeller de l'Afrique du Sud" [in French]. *Ark. Zool.,* n.s., vol. 8: pp. 531-539, 12 figs. 1955. Lists types of spp. described by Zeller (1854); describes & figures ♂ genitalia of some; notes necessary changes in nomenclature, but erects no new entitles. [P.B.]

Viette, P., "Notes sur quelques types de Latreille" [in French]. *Lambillionea,* vol. 56: pp. 88-92. 1956. Note on some South American species of hesperiids described by Latreille and the presence of their types in the Paris Museum. [P.V.]

Viette, P., "Nouveaux Gelechiidæ de Madagascar (Lepidoptera)" [in French]. *Naturaliste malgache,* vol. 8: pp. 209-224, 9 figs. "1956" [1957]. Descriptions of new Gelechiidæ from Madagascar: *Hypatima antsianakella, H. perinetella, H. manjakatompo; Dichomeris millotella, D. paulianella, D. zymotella; Syncopacma sikoraella; Holaxyra eosella; Trichotaphe xeresella; Lecithocera randimella, L. hildebrandtella, L. cameronella; Acræologa descarpentriesella, A. grandidierella.* [P.V.]

Viette, P., "Quelques types de pyrales d'A. Caradja au Muséum national, Paris" [in French]. *Entomologiste,* vol. 13: p. 6. 1957. List of the types of Pyralidæ described by A. Caradja in the Paris Museum. [P.V.]

Viette, P., "Un *Euclasta* nouveau d'Afrique orientale (Lep. Pyraustidæ)" [in French]. *Bull. Soc. ent. France,* vol. 62: pp. 36-37, 1 fig. 1957. Description of a new species of East African *Euclasta, E. gigantalis* (Mt. Elgon, Kenya). [P.V.]

Villiers, A., "Papilionides" in *Les lépidoptères de l'Afrique noire française* [in French]. *Inst. franc. Afr. noire, Initiations africaines,* vol. 14, no. 2: 49 pp., 79 figs. 1957. This book, published, like the Lycænidæ of Mr. H. Stempffer (cf. supra) in the "African Initiations", is devoted to the Papilionidæ of West Africa. Keys for the determination of the two genera & the species. In spite of the publications of Peters & of Berger, we regret the absence of references to the original descriptions & the synonyms. [P.V.]

Warnecke, Georg, *Eugraphe* (*Agrotis*) *subrosea* Steph.: die Unterschiede der österreichischen Lokalform *kieferi* Reb. und der nordwestdeutschen *rubrifera* Warnecke" [in German]. *Zeitschr. wiener ent. Ges.,* vol. 37: pp. 81-84. 1952. Distinguishes these sspp.; discusses distribution. [P.B.]

Warren, B. C. S., "A note on the genitalia of *Colias australis* Verity." *Ent. Rec. & Journ. Var.,* vol. 66: p. 36; correction, p. 73. 1954. Figures ♂ genitalia of lectotype, which does not quite match that of *australis* in the usual sense. [P.B.]

Warren, B. C. S., "*Erebia tyndarus* Esp. and *Erebia cassioides* Rein. & Hohenw. (Lep. Satyridæ) two distinct species." *Ent. mo. Mag.,* vol. 90: pp. 129-131. 1954. Separates spp. on grounds of overlapping range of *E. t. tyndarus* & *E. c. murina.* Summarizes races of *tyndarus, cassioides,* & *hispania.* Reaffirms fundamental importance of clasper structure for specific separation, with the extreme statement: "In the selection of structural characters, if these are not correlated to the specific characters of the claspers, it is proof that they are not linked to specific nature". Misstates facts about differences in chromosome number. [P.B.]

Warren, B. C. S., "*Erebia tyndarus* and allied species: the solution of some long-outstanding problems (Lep., Satyridæ)." *Entomologist,* vol. 88: pp. 227-231, 252-259. 1955. Describes as new *E. cassioides campestris* (path to Hochalmblick Hut, Mallnitz region, Hohe Tauern). Sinks *E. nivalis* to *E. c. cassioides, E. transylvaniensis* to *E. n. neleus; E. cassioides* of Lorkovic & de Lesse is *E. n. dolomitensis.* Presents a revised grouping of the *tyndarus* & *cassioides* sections. [P.B.]

Warren, B. C. S., "Notes on the species-groups in the genus *Erebia.*" *Entomologist,* vol. 88: pp. 28-30. 1955. Objects to de Lesse's association of some spp. on basis of ♀ genitalia & pattern, & points out variability of these characters; regards resemblances & differences in ♂ claspers as primary, and in other characters as secondary, throughout the genus. [P.B.]

Warren, R. G., "A wild hybrid of *Erannis leucophæaria* (Schiff.) × *E. marginaria* (Borkh.). Lep. Selidosemidæ." *Ent. Gazette,* vol. 8: p. 150. 1957.

Watkins, Norman A., "*Polyommatus icarus* Rott. pairing with *Lysandra coridon* Poda." *Ent. Rec. & Journ. Var.,* vol. 66: p. 23. 1954. Larvæ obtained from ♀ *P. icarus;* time to hatching abnormally long, but larvæ not described & not certainly hybrid. [P.B.]

Watson, Allan, "A revision of the genus *Deroca* Walker (Lepidoptera, Drepanidæ)." *Ann. & Mag. nat. Hist.,* ser. 12, vol. 10: pp. 129-148, 1 pl., 32 figs. 1957. Describes as new *D. hyalina latizona* (Hong San, SE Kiangsi, China), *D. hidda bifida* (Likiang, N. Yunnan, China), *D. pulla* (Ta-tsien-lou, China), *D. inconclusa carinata* (Tapaisha, S. Shansi). Redescribes genus & all spp. & sspp.; figures upper surface & genitalia; key to spp. [P.B.]

Watson, Allan, "A revision of the genus *Tridrepana* Swinhoe (Lepidoptera: Drepanidæ)." *Bull. Brit. Mus.* (*nat. Hist.*), vol. 4: pp. 407-500. 2 pls., 155 figs. 1957. Describes as new *T. fulvata brevis* (Khasis, Assam), *T. lunulata prolata* (Talesea, New Britain), *T. sigma* (central Buru, Kaka, Tagalago, 2700 ft.), *T. acuta* (Kandy, Ceylon), *T. trialba* (W. Celebes, Paloe, G. Rangkoenau, 900 ft.), *T. spatulata* (Luzon, Rizal, Montalban, Philippines), *T. albonotata angusta* (SE Borneo, Samarinda), *T. a. rotundata* (W. Bali, Mondoktoempang, 2500 ft.), *T. a celebensis* (W. Celebes, Paloe, G. Tompoe, 2700 ft.), *T. æquinota* (central Buru, Kako Tagalago, 2700 ft.), *T. obscura* (Tenggerm Singolongoe, 5000 ft., E. Java), *T. unispina* (Moupin, Szechuan, W. China), *T. septempunctata nitidior* (SW Sumatra, N. Korintji Valley, 5000 ft.), *T. olivacea crocata* (New Britain, Talesea), *T. argentistriga brevilinea* (SW Celebes, G. Lampobattang, Parang-bobo Goa, 5000 ft.), *T. rectifascia* (Mindanao, Lanao, Kolambugan plains, Philippines), *T. finita* (Li-kiang, N. Yunnan, China), *T. rubromarginata indica* (Sikkim, Tonglo, 10,000 ft.), *T. maculosa* (Li-kiang, N. Yunnan, China), *T. marginata* (Li-kiang), *T. flava contracta* (Malay States, Butik Kutu, 3300 ft.), *T. f. unita* (N. Celebes, Minahassa). Redescribes all spp.; gives keys to species groups & to spp. [P.B.]

Weber, Paul, "*SCHNEIDERERIA pistaciella* gen. spec. nov. (Lepid. Gelechiidæ), ein Schädling an Pistazien" [in German]. *Mitt. schweiz. ent. Ges.,* vol. 30: pp. 68-72, 5 figs. 1957. Type locality 40 km. NE of Damascus, Syria; reared from larvæ on *Pistacia vera.* Comparative notes on *Recurvaria* & *Epithectis.* [P.B.]

Wegner, A. M. R., "A note on *Callambulyx rubricosa piepersi* Sn. (Lep. Sphingidæ)." *Treubia,* vol. 20: pp. 51-53, 1 pl. 1949. Describes & figures first known ♂. [P.B.]

Wegner, A. M. R., "On a collection of Rhopalocera from Panaitan Island, with description of a new species." *O. S. R.-Publ.,* no. 36: pp. 3-7, 1 pl. [1953]. Describes as new *Tanæcia interrupta,* & gives an annotated list of some 70 spp. from an island in Sunda Strait. [P.B.]

Wiltshire, E. P., "Middle East Lepidoptera. XIII. Two new species from Jordan." *Entomologist,* vol. 89: pp. 237-240, 1 pl., 2 figs. 1956. Describes as new *Sideridis chersotoides* (Zerqua R. colony); *Cryphia troughti* (same). Figures adults & ♂ genitalia. [P.B.]

Wiltshire, E. P., *The Lepidoptera of Iraq.* 162 pp., 17 pls., 6 figs. London: Nicholas Kaye Ltd. 1957. Describes as new: *Lithosia muscula brevifurca* (Shaqlawa, 2500 ft., Kurdistan); *Mamestra rhodocaris herkia* (Hajji Omran); *Lithophasia cyaraxes* (Haj Omran, near Rayat); *Antitype carducha* (Shaqlawa, 2500 ft., Kurdistan); *Epipsammia boursini* (Shaqlawa); *Minucia bimaculata pulchrior* (Tang-Ab, near Firuzabad, SW Iran; larva on *Pistacia*); *Nychiodes rayatica* (Haj Omran, 6000 ft.); *Cossus cossus omrana* (Haj Omran, 6000 ft.), *C. c. kossai* (Shaqlawa, 2500 ft.); *Dyspessacossus fereidum ahmadi* (Shaqlawa, 2500 ft.). Also describes 5 "forms". List of 937 spp., with habitat, distribution, & biology of each summarized. There is a foodplant index, & economically important spp. are indicated. Many spp. are figured, & Amsel's figures of genitalia, etc., of numerous micros are reproduced. See review in *Lepid. Journal* 13: 33; 1959. [P. B.]

Wise, K. A. J., "Two cases of synonymy in the nomenclature of Lepidoptera." *New Zealand Ent.,* vol. 1: pp. 31-32. 1954. Lists the synonymy of *Caloptilia* (Gracilariidæ) & *Achæa janata* (Noctuidæ). [I.C.]

Wise, K. A. J., "Pests of stored products in New Zealand. I. Family Phycitidæ (Lepidoptera). *New Zealand Journ. Sci. Tech.* (*B*), vol. 36: pp. 523-530. 1955. Lists *Ephestia sericarium, E. elutella, E. cautella,* & *Plodia interpunctella,* & the products attacked. Includes keys to their identity based on wing and genitalic characters. No figures. [I.C.]

Wise, K. A. J., "A new species of *Lithocolletis* (Lepidoptera: Gracilariidæ) from New Zealand." *Proc. R. ent. Soc. London* (*B*), vol. 26: pp.26-28, 1 pl., 7 figs. 1957. Describes as new *L. hardenbergiella* (Aukland; larva mining leaves of *Hardenbergia*). [P.B.]

Wolff, Niels L., "*Nepticula benanderella* n. sp. (Lep., Nepticulidæ)." *Opusc. ent.,* vol. 20: pp. 49-53, 8 figs. 1955. Described from Listerlandet, Blekinge, & from Yngsjö, Skane, Sweden; larva on *Salix repens.* Notes on related spp., with figures of genitalia. [P.B.]

Wolfsberger, Josef, "Eine neue Unterart von *Cidaria incursata* Hb. aus Graubünden (Lep. Geometr.)" [in German]. *Mitt. schweiz. ent. Ges.,* vol. 26: pp. 233-235, 6 figs. 1953. Describes as new *C. i. altarhætica* (Davosertal, Switzerland). [P.B.]

Wolfsberger, Josef, "*Hadena* (*Mamestra*) *texturata kitti* Schaw. in den Alpen" [in German]. *Zeitschr. weiner ent. Ges.,* vol. 39: pp. 115-122, 1 pl., 1 map. 1954. Maintains that *kitti* is correct name for race, although name was proposed as "var. (ab?)" by Schawerda & presumably has priority at the subspecies level only from the time of its elevation to that level. Lists known records; distinguishes sp. from *H. reticulata.* [P.B.]

Zimmerman, Elwood C., "*Heliothis* in Hawaii (Lepidoptera: Phalænidæ)." *Proc. Hawaiian ent. Soc.,* vol. 16: pp. 170-176, 3 figs. 1956. Distinguishes the immigrant *H. zea*

& the native *H. hawaiiensis* (*new status*). Records foodplants & parasites. *H. inflata* recorded from Hawaii in error. [P.B.]

Zopp, J., "*Celerio*-Studien II. Das Genus *Rhodafra* R. u. J., und seine Stellung zu *Celerio* Oken" [in German]. *Zeitschr. weiner ent. Ges.*, vol. 39: pp. 37-40. 1954. Reduces *Rhodafra* to subgenus of *Celerio*. Note on similarity of genital structure in Chœrocampinæ. [P. B.]

Zopp, Johannes, "Neue Lycæniden-Formen I" [in German]. *Zeitschr. wiener ent. Ges.*, vol. 39: pp. 128-129. 1954. Describes as new (as "f. (subsp?) n.") *Thestor mauretanicus maroccanus* (Beni-Amar, Morocco); also names 3 "forms" in *Thestor*. [P.B.]

D. VARIATION AND GENETICS

Ae, Shigeru, "Study of heredity in *Colias hyale poliographus* Motschulsky (Pieridæ)" [in Japanese]. *Iden*, vol, 6: pp. 15-19, 10 figs., 5 tables. 1952.

Amsel, H. G., "*Eidophasia messingiella* F. R. f. *dorsomaculata* Doets (1950) = f. *dorsana* Caradja (1920) (Plutellidæ)" [in German]. *Zeitschr. Lepid.*, vol. 3: p. 50. 1953.

Ashwell, Derek A., "Experiments with *Abraxas grossulariata* L." *Proc. Trans. south London ent. nat. Hist. Soc.*, 1953-54: pp. 129-142, 6 figs. 1955. Describes various crosses involving 2 recessives, one of which is sex-linked. Numerous gynandromorphs produced in some broods. Notes on biology & on rearing techniques. [P.B.]

Baynes, E. S. A., "Albino *Maniola jurtina* Linn. ssp. *iernes* Graves." *Irish Nat. journ.*, vol. 10: p. 135. 1951.

Benz, F., "Transmission héréditaire d'une mutilation artificielle de la chenille de *Celerio euphorbiæ* L.?" [in French]. *Bull. Soc. ent. Mulhouse*, 1956: pp. 53-58. 1956. A reply about Loritz's experiences on the hereditary transmission of artificial ablation of the horn of the larva of this sphingid. This ablation is not hereditary [P.V.]

Berhorn, Christel, "Genetische Untersuchungen am Flügelgeäder der Mehlmotte *Ephestia kühniella* Zeller" [in German]. *Zeitschr. indukt. Abstammungslehre*, vol. 82: pp. 448-478, 22 figs. 1948. Describes effects of mutant genes in modifying venation of hind wing under various rearing conditions. [P.B.]

Bernardi, G., "Etude de quelques formes individuelles des *Anthocharis euphenoides* Stgr. et *belia* L. (*eupheno* L.) (Lep. Pieridæ)" [in French; summary in Esperanto]. *Bull. Soc. ent. Mulhouse*, 1947: pp. 97-106, 18 figs. 1947. Names a new "form" & arranges many others in logical order according to nature of pattern alteration. [P.B.]

Bilek, A., "Etwas für Aberrationsfreunde" [in German]. *Ent. Zeitschr.*, vol. 59: p. 16, 2 figs. 1949. Figures aberration of *Parnassius apollo*. [P.B.]

Blackie, J. E., "Aberration of *Arctia caja* L." *Entomologist*, vol. 88: p. 63. 1955.

Bleszyński, Stanislaw, "Matériaux à la connaissance de la faune des lépidoptères des Monts Tatras en Pologne" [in Polish; French summary]. *Documenta physiogr. Poloniæ*, no. 11: pp. 1-8. 1948. Records 35 spp. new to the Polish part of High Tatra; describes a new variety of *Crambus margaritellus* from Forest "Bialego" in Polish High Tatra Mts. [J.M.]

Boursin, Ch., "Description d'une forme nouvelle de *Trichiura cratægi* L. (Lep. Lasiocampidæ)" [in French]. *Bull. mens. Soc. linn. Lyon*, vol. 26: p. 111. 1957. Description of a new form of *T. cratægi* from West France. [P. V.]

Bowden, S. R., "Diapause in female hybrids: *Pieris napi adalwinda* and related subspecies (Lep.)." *Entomologist*, vol. 90: pp. 247-254, 273-281. 1957. In offspring of southern *P. napi* ♂♂ crossed with the arctic *P. n. adalwinda* or the alpine *P. bryoniæ*, ♀♀ consistently emerged before ♂♂. Partly sex-linked genetic factors producing "strong" diapause in the arctic & alpine forms is suggested. [P.B.]

Bryk, Felix, "Über eine Unterdrückung der Flügelzeichnung bei unserem Schwalbenschwanze (Lep. Papilion.)" [in German]. *Opusc. ent.*, vol.18: pp.65-67, 1 fig. 1953. Names a "form" of *Papilio machaon* with ground color extended distally. [P. B.]

Burmann, Karl, "Etwas über die Nordtiroler *Phibalapteryx calligraphata* H.S. (Macrolepidoptera, Geometridæ)" [in German]. *Zeitschr. wiener ent. Ges.*, vol. 36: pp.153-155. 1952. Thinks named brown "form" of this sp. is merely a worn specimen. Notes on Austrian populations. [P. B.]

Burmann, Karl, "Die Veränderlichkeit von *Symmoca signella* Hb. (Gelechiidæ)" [in German]. *Zeitschr. Lepid.*, vol.1: pp.181-184. 1954. Describes variation, naming 5 "forms". [P. B.]

Caruel, Marcel, "Révision des formes et aberrations du Catalogue des Rhopalocères [de France]" [in French]. *Rev. franç. Lépid.*, vol.13: pp.84-87, 117-121; vol.14: pp.147-153, 261-264; vol.15: pp.21-32, 58-61. 1951-55. Lists & briefly describes named infrasubspecific forms of French Papilionidæ & Pieridæ; work terminated by death of author. [P. B.]

Caspari, Ernst, & Ingbritt Blomstrand, "The effects of nuclear genes on the structure and differentiation of cytoplasmic particles." *Cold Spring Harbor Symp. quant. Biol.*, vol.21: pp 291-301, 10 figs. 1957. Includes review of genetic control of pigment formation in testis sheath of *Ephestia kühniella*. [P. B.]

Castle Russell, S. G., "The influence of thunderstorms on variation of Lepidoptera." *Ent. Rec. & Journ. Var.*, vol 64: pp.199-203. 1952. Suggestion made after experiences with finding aberrant specimens immediately following storms. [P. B.]

de Castro, Luis, "*Charaxes jasius* L.; ab. *paucivenata*, f. nova" [in Spanish]. *Bol. R. Soc. españ. Hist. nat.*, vol.27: pp.277-278, 1 fig. 1950. Describes specimen with reduced venation. [P. B.]

Clarke, C. A., "Pupal coloration in *Papilio machaon* Linn." *Proc. Trans. south London ent. Hist. Soc.*, 1952-53: pp.100-103. 1954. Preliminary report, establishing that pupal color (brown or green) is not inherited. [P. B.]

Clarke, C. A., & P. M. Sheppard, "A further report on the genetics of the *machaon* group of swallowtail butterflies." *Evolution*, vol.10: pp.66-73, 4 figs. 1956. Gives evidence on genetic mechanisms controlling larval pattern characters, from interspecific & intersubspecific crosses. Reports excess of ♂♂ in one of latter crosses. Records hybrid larvæ of *P. machaon* × *P. bairdi*. [P. B]

Cockayne, E. A., "A new aberration of *Plusia gamma* Linnæus (Lep. Agrotidæ)." *Entomologist*, vol.88: p.75, 1 fig. 1955. Named.

Cockayne, E. A., & Harold B. Williams, "On *Cryphia perla* L. ab. *albida* Colthrop." *Ent. Gazette*, vol.7: pp.73-75, 2 figs. 1956. Figures types. [P. B.]

Collier, A. E., "A successful rearing of *Lysandra coridon* Poda ab. *syngrapha* Kef." *Ent. Rec. & Journ. Var.*, vol.68: pp.281-282. 1956. F_2 of normal ♂ × "syngrapha" ♀ was nearly 1:1:1, ♂♂ : normal ♀♀ : "syngrapha" ♀♀. [P.B.]

Davies, D. L., "Variation in *Colias croceus* (Fourc.) ab. *helice* Hb." *Ent. Rec. & Journ. Var.*, vol.69: pp.205-206. 1957. Describes progeny of 2 ♀♀; appearance of 2 "albissima" among many "helice" suggests that the former variant is environmentally produced. [P. B.]

Dowdeswell, W. H., E. B. Ford, & K. G. McWhirter, "Further studies on isolation in the butterfly *Maniola jurtina* L." *Heredity*, vol.11: pp.51-65, 2 maps. 1957. Continuation of study of frequency of number of spots on underside of ♀ hind wing in local populations in the Scilly Isles. Populations on the larger islands are similar & constant, except for 2 small isolated populations which, like the populations of the smaller islands, are distinct. In one small island a change in ecology (removal of cattle) has led to shifts in inhabited areas and changes in spot number. [P. B.]

Downey, John C., "Ecology and selection in a polytypic species of butterfly." *Bull. ent. Soc. Amer.*, vol.3: p.22. Sept. 1957. Abstract; *Plebejus icarioides*.

Egelhaaf, Albrecht, "Der Gehalt an freiem Tryptophan und Kynurenin bei den Genotypen *a*+ und *a* von *Ephestia kühniella* während der Entwicklung" [in German]. *Zeitschr. Naturforsch.*, vol.12b: pp.465-472, 6 figs. 1957. Tryptophane & kynurenin content measured in all stages of these allelic forms. In *a* mutant kynurenin is always absent & trytophane is higher than in wild type; gene *a* blocks transformation of tryptophane to kynurenin. [P. B.]

Fischer, Ch., "*Polygonia c-album* Linné" [in French]. *Bull. Soc. ent. Mulhouse*, 1947: pp.21-22. 1947. Summarizes seasonal & individual variation. [P. B.]

Fischer, Ch., "Quelques remarques sur *Polyommatus* (*Lycæna*) *icarus* Rott. Comparaison entre les exemplaires d'Alsace et ceux du Midi" [in French]. *Bull. Soc. ent. Mulhouse*, 1948: pp.57-58. 1948. Notes differences between spring forms of these populations. [P. B.]

Fischer, E., "Versuche zur Aktivierung letaler Keimkombinationen" [in German]. *Vierteljahrsschr. naturf. Ges. Zurich*, vol.97: pp.29-38, 1 pl. 1952. Study of hybrids of *Celerio galii* ♂ × *C. euphorbiæ* ♀. [P. B.]

Foltin, Hans, "Die Bildung und das Vorkommen nigristischer bzw. melanistischer Formen in Oberösterreich" [in German]. *Zeitschr. wiener ent. Ges.*, vol.37: pp.89-95. 1952. Surveys theories of origin of melanic forms of Lepidoptera; records spp. with melanic forms occurring in upper Austria. [P. B.]

Foltin, Hans, "*Melitæa cynthia* Hb. Die Nominatform und die hochalpine Rasse *alpicola* Galv. Nachtrag zu der in dieser Zeitschrift 6. Jg. Sonderheft 1954 S. 11 erschienen Arbeit" [in German]. *Ent. Nachrichtenbl. österr. und schweizer Ent.,* vol.8: pp.17-21. "1956" [1957]. Gives descriptions of all named forms of these 2 races. [P. B.]

Fukaya, Masatsuga, "Strains of the Rice Stem Borer in Japan." *Ber. Ohara Inst. landwirtschr. Forsch.,* vol.9: pp.375-376. 1951. 2 strains differ in length of diapause. [P. B.]

Gäbler, Hellmuth, "Über die Zunahme der dunklen Farbvarietäten der Nonne" [in German]. *Forschungen und Fortschr.,* vol.21/23: pp.176-177. 1947. Reports increase in frequency of melanic *Lymantria monacha* in previous 40 years. [P. B.]

Gerhardinger, Klaus, "Temperaturversuche mit *Thais polyxena* Schiff. Ein Nachtrag" [in German]. *Ent. Nachrichtenbl. österr. und schweizer Ent.,* vol.2: pp.52-55, 74-76, 87-89. 1950. Supplement to earlier paper. Compares 200 adults from pupæ subjected to temperature shocks with 200 control specimens from same population, & draws conclusions as to which of numerous variants are genetic and which are produced by the temperature shocks. Names a "form" belonging, probably, to latter group. [P. B.]

Goodson, A. L., "A new aberration of *Cœnonympha pamphilus* Linnæus (Lep. Satyridæ)." *Entomologist,* vol.88: p.75, 1 fig. 1955. Named.

Goto, Kinjuro, "A perfect melanic aberration of *Limenitis glorifica* Fruhstorfer (Nymphalidæ)" [in Japanese]. *Konchu no Kagaku,* vol.1: p.2, 1 fig. 1952. Named as new aberration (type, Kyoto). [T. I.]

J. MISCELLANY

Skell, F., "Ludwig Osthelder†" [in German]. *Mitt. münchner ent. Ges.,* vol.44/45: pp. 526-531. 1955. Obituary and list of his publications. [P.B.]

Ueda, Tsuneichi, "Two Korean entomologists, Cho-Fukusei and Seki-Chumei (Seok)" [in Japanese]. *Shin Konchu,* vol.5, no.4: pp.14-15, 1 fig. (photograph of Seok's family). 1952. Both are noted lepidopterists. Mr. Seok has been reported killed since 1950, while no information is available on the whereabouts of Mr. Cho. [T.I.]

Vallette, Guillaume, & Hector Huidobro, "Pouvoir histaminolibérateur du venin de la chenille processionnaire du pin *(Thaumatopœa pitiocampa* Schiff.)" [in French]. *C. R. Soc. Biol.,* vol.150: pp.658-661, 1 fig. 1956. Poison from larval hairs of this moth resembles some snake venoms in ability to liberate histamine in mammalian tissues. [P.B.]

Wagner, Warren H., "Austin Hobart Clark." *Lepid. News,* vol.9: pp.151-157, 1 fig. 1955.

Warnecke, Georg, "Über den X. Internationalen Kongress für Entomologie in Montreal, Kanada, 17.-25. August 1956. (Mit besonderer Berücksichtigung der Sektion für Geographische Verbreitung)" [in German]. *Zeitschr. wiener ent. Ges.,* vol.42: pp. 5-12, 19-27, 8 maps. 1957. Report on Congress; explanation of similarity of North American & European fauna, based on geologic history (particularly glacial history) of holarctic region. [P.B.]

Weiss, H. B., "An interview with Herman Strecker in 1887." *Journ. N. Y. Ent. Soc.,* vol.41: pp. 201-210. 1953. Reproduces an anonymous interview with Strecker at his home in Pennsylvania. Entertaining and of historical value. [W.C.]

Wenzel, Rupert L., "Collection of moths given to Museum." *Chicago nat. Hist. Mus. Bull.,* vol.26, no.2: p.7. 1955. Reports bequest of the McElhose collection. [P.B.]

Wiegand, H., "Bestimmungstabelle der wichtigsten Kiefernschädlinge nach den arteigenen Kotformen der Frassstadien" [in German]. *Forstwirtsch., Holzwirtsch.,* vol.3: pp.93-94, 8 figs. 1949. Key to excreta of insects attacking pine, including spp. of *Hyloicus, Orgyia, Lymantria,* & *Dendrolimus.* [P.B.]

Wyatt, Colin W., "Unvergessliche Ergebnisse" [in German]. *Zeitschr. wiener Ent. Ges.,* vol.42: pp.49-53, 2 figs. 1957. Collecting memories, especially of Kashmir. [P.B.]

Yamafuji, K., F. Yoshihara, & M. Eto, "Morphological changes in adipose cells in Silkworms after administering nitrite of oxime" [in English; German summary]. *Enzymologia,* vol.15: pp.204-206, 1 pl. 1952. *Bombyx mori.*

van der Zanden, G., "Massaal optreden van *Acherontia atropos?* (Lep.)" [in Dutch; English summary]. *Ent. Berichten,* vol.17: p.136. 1957. Note on old picture showing large numbers of *A. atropos* in an apiary. [P.B.]

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Journal of The Lepidopterists' Society

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STUDIES OF THE CHROMOSOMES OF NORTH AMERICAN RHOPALOCERA. 1. PAPILIONIDÆ

by Kodo Maeki and Charles L. Remington

This is the first of a series of papers on the numbers and morphology of the chromosomes of butterflies north of the Isthmus of Panama, with discussions of the phylogenetic significance of the cytological data. The first few papers will include, family by family, material collected in three lots during the 1959 season: 1) around the Rocky Mt. Biological Laboratory in western Colorado; 2) in northwestern Mexico, mainly at Ciudad Victoria (Tamaulipas) and El Salto (San Luis Potosi); and 3) around New Haven, Connecticut. Maeki collected most of the material in Colorado, assisted by Remington and Roger W. Pease, Jr. The Mexican collection was made by Remington. The Connecticut specimens were taken by Maeki, Remington, and Pease. Eric E. Remington brought in important living males in all three regions, and Dr. J. R. Turner took several of the Ciudad Victoria males. New studies will be reported in supplementary papers. Our findings with the cytology of interspecific hybrids will appear elsewhere.

Methods

The techniques will be outlined only in this first paper, because they were used identically for all the families of butterflies which we studied.

The tests provide by far the easiest material in which to investigate the chromosomes of butterflies. First, meiotic divisions exhibit the chromosome complement in haploid condition, so that unequivocal counts of the rather large number of chromosomes are much easier to obtain than in somatic or pre-meiotic divisions. Second, several or many dividing cells can usually be found in the male gonads, whereas female meiosis is limited to the maturation divisions in the egg near the time of entry of the sperm. Third, with Rhopalocera, unlike most other Lepidoptera, male meiosis is usually in process in some cysts of the testes even in old, flown adult males; notable exceptions are the Parnassiinæ, Zerynthiinæ, Asiatic *Graphium,* some Hesperiidæ, and Megathymidæ, where meiosis is nearly over by the time of eclosion.

The collection of testes is a simple procedure. The testes, which are fused into a single mid-dorsal unit in most Rhopalocera, lie near the dorsal wall of the abdomen about one-half to two-thirds of the distance from the base to the anal end. Wild-caught males are held firmly but unharmed and a small incision is made with sharp, fine scissors in the abdominal wall, over the normal site of the testes. A gentle squeeze of the abdomen is usually sufficient to exsert the testes, with little other tissue emerging. The testes of many species differ strikingly in color from the other abdominal contents and are then readily recognized. They are pinched off with a fine forceps and placed in a vial of fixative. We used Allen's P. F. A. — 3, which has the following formula:

Picric acid —	75 cc
Formalin —	15 cc
Glacial acetic acid —	10 cc
Urea —	1 gram

A key number is placed in the vial with the testes. The same number is immediately noted along with locality and date on the paper envelope in which the subsequently killed male is placed for permanent reference. The testes are left in the fixative overnight, for up to 24 hours, and then transferred for storage into a vial of 80% ethyl alcohol.

A few preliminary examinations of freshly collected testes were made by squash preparations in aceto-orcein and aceto-dahlia stain-fixative, but only with species of which we had large samples. All the studies here reported are based on permanent preparations, made at the Gibbs Research Laboratories at Yale University, as follows: the testes were imbedded in paraffin, sectioned at 10μ thickness, stained in Heidenhain's iron hæmatoxylin, and counterstained with Light Green. The slides were studied with a Leitz LABOLUX microscope. Suitable nuclei were drawn with camera lucida, with the microscope having 100× objective and 20× oculars and the drawing set-up giving on the paper a total magnification of 5800×. The photographs were taken with a Leitz MIKAS camera through the above microscope, using the 100× objective and a 10× ocular; the actual magnification on the negative is 333×. One series of counts had to be made primarily from sections of the ovaries of *Parnassius smintheus,* a species in which we found only a single partially satisfactory division in adult males (see below).

The slides and specimens from which the gonads were taken are being kept for permanent reference in the research series in the Peabody Museum of Natural History of Yale University. The key numbers on these slides and specimens are noted below in square brackets — [ ] and will allow future workers to examine our material.

In addition to the eleven species of Papilionidæ described below, we fixed and sectioned testes of 3 *Papilio rutulus* from Colorado, 2 *P. glaucus* L. from Connecticut, and 1 *P. anchisiades* Esper from El Salto but found no dividing cells. The first two species were very old specimens, but the *P. anchisiades* was obviously a young, fresh male, and it may be that this species normally completes meiosis before eclosion.

Results

1. *Parnassius smintheus* Doubleday. The haploid chromosome complement is $n = 30$. This was determined in diploid condition by 6 countable nuclei undergoing oogonial division in the ovaries of a young female with no sphragis (presumably unmated) collected at Copper Lake, el. 10,500′, Gunnison Co., Colo., on 7 August [199]. In each of these nuclei the $2n$ complement of 60 was visible. The apparent differences in size shown in the drawing are probably due to the orientation of the chromosomes and not to actual differences. The base number was verified in haploid condition from one cell in diakinesis in which 30 chromosomes were seen; this was in a male from Cumberland Pass, 11 August [224]. Testes were also collected from 11 males from Copper Lake (27 July), Cumberland Pass (11 August), and Treasure Mt. (21 August), but no other suitable dividing cells were present. There were many maturation divisions with abnormal meiosis leading to the formation of apyrene sperm. It is usual for *Parnassius* males to have little or no further normal meiosis after eclosion from the pupal shell. In order to study spermatocyte divisions we will need to collect testes from larvæ and pupæ. This species has recently been listed under the Palearctic *phœbus* (Fab.), but we consider this a premature step not justified without biological evidence.

2. *Battus philenor* (Linné). The haploid chromosome number is 30. Counts were made in 41 nuclei in 2 males, taken at Ciudad Victoria, Tamps., Mexico, on 1 August [M12] and at El Salto, S. L. P., Mexico, on 4 August [M53]. All suitable nuclei were primary spermatocyte divisions. No normal nuclei at the secondary spermatocyte division were found. The chromosomes of *B. philenor* are all similar in size.

3. *Papilio ornythion* Boisduval. The haploid chromosome number is 30. Counts were made in 15 nuclei in the primary spermatocyte division and 13 nuclei in the secondary spermatocyte division, from 4 males taken at Ciudad Victoria, 2 August [M40-A3, M40-A4, M40-A6, M40-A7]. The size of all the chromosomes is similar. Four other males taken with the above 4 showed no meiotic divisions.

4. *Papilio cresphontes* Cramer. The haploid chromosome number is 30. Counts were made in 8 nuclei in the primary spermatocyte division and 3 nuclei in the secondary spermatocyte division, from 2 males taken at Ciudad Victoria, 1 August [M11-2, M11-3], and 15 nuclei in the primary spermatocyte division from a male taken at El Salto, 4 August [M51]. A third male collected at Ciudad Victoria with the first two showed no normal divisions. There appear to be 4 chromosomes distinctly smaller than the other 26; the latter are similar in size. The identifications for *P. cresphontes* and *P. thoas* were verified from the male genitalia, which differ widely.

5. *Papilio thoas autocles* Rothschild & Jordan. The haploid chromosome number is 27. Counts were made in 36 nuclei, all in the primary spermatocyte division, from a single male taken at Ciudad Victoria, 2 August [M40-B]. Estimating chromosome size can be imprecise due to effects of variation in

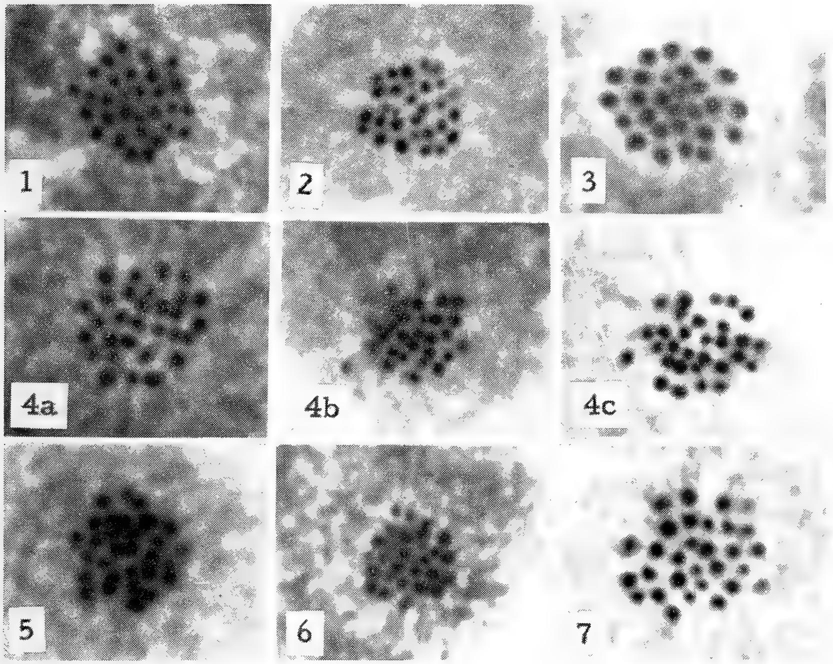
fixation and staining processes and the angle of the sections. Nevertheless, it is clear that only 2 very small chromosomes are present, and we estimate that there are 10 medium-sized, 13 large, and 2 very large chromosomes. Assuming that the ancestral condition for *thoas* was $n = 30$ with a caryotype similar to that of *cresphontes,* it is possible that the evolution of the present caryotype of *thoas* involved a) fusion of two of the four smallest chromosomes and b) fusions of four of the medium- or large-sized chromosomes to produce the two very large elements. As remarkable as the reduced chromosome number in *thoas* is the very large size of virtually all of its chromosomes, as compared to primary spermatocyte chromosomes in other *Papilio.* (See discussion below.)

6. *Papilio polyxenes* Fabricius. The apparent haploid chromosome numbers are 30 and 31. This is a remarkable situation and resembles the previously known case of *Pieris rapæ* in Japan, discussed below. Four males of *P. polyxenes* taken in New Haven Co., Connecticut, 23 August to 7 September, gave counts as follows for 32 nuclei:

Specimen	1st Division		2nd Division	
symbol	$n = 30$	$n = 31$	$n = 30$	$n = 31$
[389]	2	3	0	0
[393]	9	5	0	0
[312]	4	0	3	0
[345]	1	1	4	0
Total nuclei:	16	9	7	0

The thirty-first apparent chromosome is a smaller body than the other 30 and different in its behavior. This element divides during the primary spermatocyte division but somewhat later than do other chromosomes, and it is left out of the nuclei resulting from the second spermatocyte division. In the first division the small element is sometimes in the nucleus, giving a count of 31, and sometimes in the cell outside the nucleus, giving a nuclear count of 30. In some instances it does not appear to divide but at anaphase goes to only one daughter nucleus. (See further discussion below.) Aside from the small element, the chromosomes are all about the same size. No meiotic divisions were found in two other males from Connecticut.

7. *Papilio "brucei"* Edwards. The nomenclature of this species cannot yet be fixed; a new name may be required. It is the yellow-banded (*i.e., zelicaon*-like) Umbelliferæ-feeding *Papilio* of the mountains in Colorado, Wyoming, and probably elsewhere but is not the true lowland *zelicaon* Boisduval of the West Coast, nor is it the *Artemisia*-feeding middle-altitude true *brucei* of EDWARDS. Genetic studies of this complex will be described soon. The haploid chromosome number is 30. Counts were made in 5 nuclei of a single male taken at Gothic, Gunnison Co., Colorado, on 16 July [1]. No secondary spermatocyte divisions were found. The chromosomes are all similar in size. The testes are unusual in this species. They are connected only slightly, whereas the testes of other Papilioninæ are so broadly joined that the pair appears as a single ovoid unit.



Photographs of chromosomes in spermatocyte divisions.

Fig. 1 — *Battus philenor* (I); fig. 2 — *Papilio cresphontes* (I); fig. 3 — *P. thoas* (I); figs. 4a-c — *P. polyxenes*; fig. 5 — *P. "brucei"* (I); fig. 6 — *P. palamedes* (I); fig. 7 — *P. pilumnus* (I).

8. *Papilio troilus* Linné. The haploid chromosome number is 30. Counts were made in 6 nuclei in the primary spermatocyte division and 7 nuclei in the secondary spermatocyte division, all from one male taken at West Rock, New Haven Co., Connecticut, 24 August [390]. All the chromosomes are similar in size. No meiotic divisions were found in a second male collected on 3 September.

9. *Papilio palamedes* Drury. The haploid chromosome number is 30. Counts were made in 7 nuclei, all in the primary spermatocyte division, from 2 males taken at Ciudad Victoria, 1 August [M9-1, M9-2]. Two chromosomes are distinctly larger than the others and some were much smaller than the several medium-sized elements.

10. *Papilio pilumnus* Boisduval. The haploid chromosome number is 30. Counts were made in 8 nuclei in the primary spermatocyte division and 9 nuclei in the secondary spermatocyte division, all from one male taken at Ciudad Victoria, 2 August [10-2]. The size and form of all the chromosomes are similar. No meiotic divisions were found in a second male taken the same day.

11. *Graphium phaon* (Boisduval). The haploid chromosome number is 30. Counts were made in 5 nuclei in 1 male, taken at Ciudad Victoria on 2 August [M41-2]. These nuclei were all in the primary spermatocyte division. The chromosomes are all similar in size (compare with Japanese *Graphium* discussed below). It is of unusual interest that spermatocyte divisions were present in a flying (*i.e.,* imaginal) individual of *G. phaon.* In contrast, *G. sarpedon* and *G. doson* in Japan are like Parnassiinæ, Zerynthiinæ, and Megathymidæ in having meiosis essentially complete in the male prior to eclosion. The degree of proximity of New World and Oriental-Indoaustralian so-called *Graphium* is somewhat doubtful on grounds of gross morphology, and the chromosome size and meiotic timing do not strengthen the case for lumping the whole array in a single genus along with the typical *Iphiclides* Kite Swallowtails.

Discussion

The latest atlas of chromosome numbers (Makino, 1956) lists published counts for 197 species of Rhopalocera (butterflies) and 194 species of the remaining Lepidoptera (moths), including some corrections of taxonomic listing made by us. Several of these counts, especially by early workers, are surely incorrect, but additional counts have been recorded since 1956 by Saitoh, de Lesse, Lorkovic, and Maeki and the actual number of valid counts is probably about 200 for butterflies and 200 for moths. There are now about 130,000 described species of Lepidoptera of which about 10% are Rhopalocera. Undoubtedly relatively few new Rhopalocera remain to be named, whereas there may be as many unnamed as named moths. So it is obvious that cytotaxonomy of moths is hardly started, and even for butterflies only a preliminary sampling has been made (and that only for the Holarctic region).

Table 1 shows the chromosome numbers of the 32 species of Papilionidæ for which counts have been recorded. The 11 species described in the present paper are all new to cytology and are shown in capitals in the Table. For *G. podalirius* there is also a count of 54 to 58 at the diploid stage by Kernewitz (1915), but this considered an error in view of the precise haploid counts of 30 at both spermatocyte divisions by Lorkovic (1941). Munson (1907) reported for *P. rutulus* $2n = 28$ during spermatogenesis, but his Figure 89 clearly shows 32 in a "dividing spermatocyte." It will be surprising if *P. rutulus* differs much from $n = 30$. We collected testes from badly worn males in Colorado but failed to find any normal meiotic stages, and we therefore cannot yet correct or verify the Munson haploid counts. The diploid number is obviously wrong.

The Table shows how stereotyped the chromosome number is for the Papilioninæ, 30 being a rule seldom violated. Our discovery of $n = 27$ for *P. thoas* is remarkable in view of the frequency of $n = 30$, even in the sibling of *thoas, P. cresphontes,* and their near relative *P. ornythion.* The presence of unusually large chromosomes in *P. thoas* strongly suggests derivation of

Table 1. CHROMOSOME NUMBERS OF THE PAPILIONIDÆ.

Species	Number *(n)*	Division	Reference
A. Parnassiinæ:			
Parnassius apollo (L.)	30	♂ I, II; ♀ I	Federley, 1938 Lorkovič, 1941
PARNASSIUS SMINTHEUS Dy.	30	♂ I; oogon.	Present paper
Parnassius eversmanni Mén.	62	♂ I	Maeki, 1957
Parnassius mnemosyne (L.)	29	♀ I	Federley, 1938
B. Zerynthiinæ:			
Lühdorfia japonica Pryer	31	♂ I, II	Maeki, 1957
Lühdorfia puziloi Ersch.	30	♂ I, II	Maeki, 1957
Zerynthia hypermnestra (Scop.)	31	♂ I, II	Lorkovič, 1941
C. Papilioninæ:			
BATTUS PHILENOR (L.)	30	♂ I	Present paper
Byasa alcinous (Klug)	30	♂ I, II	Maeki, 1957
PAPILIO ORNYTHION Bdv.	30	♂ I, II	Present paper
PAPILIO THOAS L.	27	♂ I	Present paper
PAPILIO CRESPHONTES Cram.	30	♂ I, II	Present paper
Papilio bianor Cramer	30	♂ I, II	Maeki, 1953
Papilio helenus L.	30	♂ I	Maeki, 1953
Papilio maackii Mén.	30	♂ I, II	Maeki, 1953
Papilio protenor Cramer	30	♂ I	Maeki, 1953
Papilio memnon L.	30	♂ I, II	Maeki, 1953
Papilio xuthus L.	30	♂ I	Maeki, 1953
Papilio alexanor Esper	30	♂ I, II	Lorkovič, 1941
Papilio hippocrates Felder	31	♂ I	Maeki, 1953
Papilio machaon L.	30(-33)	♂ I, II	Regnart, 1930 Federley, 1938 Lorkovič, 1941
PAPILIO "BRUCEI Edw."	30	♂ I	Present paper
PAPILIO POLYXENES Fab.	30, 31	♂ I, II(30)	Present paper
PAPILIO TROILUS L.	30	♂ I, II	Present paper
PAPILIO PALAMEDES Drury	30	♂ I	Present paper
PAPILIO PILUMNUS Bdv.	30	♂ I, II	Present paper
Papilio rutulus Lucas	error	—	Munson, 1906
Graphium podalirius (L.)	30	♂ I, II	Regnart, 1930 Lorkovič, 1941
Graphium feisthameli (Dup.)	30	♂ I, II	Lorkovič, 1941
Graphium doson (Felder)	30	♂ I, II	Maeki, 1957
Graphium sarpedon (L.)	20	♂ I, II	Maeki, 1957
GRAPHIUM PHAON (Bdv.)	30	♂ I	Present paper

its reduced number by fusion of 6 of the ancestral elements into 3 *thoas* chromosomes, producing increased polyteny as well as actual length. Cytophotometric determinations of DNA might show whether this in fact occurred (Hughes-Schrader & Schrader, 1956). It will be important to examine the chromosomes of geographically distant populations of *cresphontes* and *thoas* (*e.g., pennsylvanicus* F. & R. Cherm. and *brasiliensis* R. & J.) to see whether the formulæ $n = 27$ and $n = 30$ are consistent species differences. $N = 27$ is not the lowest known formula for a papilionid; *Graphium sarpedon* has only 20, all large, ten of these probably derived by 1 + 1 fusion of 20 of the small ancestral chromosomes such as are now present in the closely related *G. doson* (*doson* has 20 small and 10 large chromosomes).

The extra element in *P. polyxenes* is our most notable finding in these new Papilionidæ. We intend to trace it in F_1 hybrids with species not normally having the element. MAEKI (1959) had shown that the Japanese so-called race of *Pieris rapæ* L. (subspecies *crucivora* Bdv.) has an extra element, plus 25 normal chromosomes. This extra element has characteristics of WILSON's "m-chromosome" (1925: p.839). The m-chromosome is very small and is sometimes present in the nucleus ($n = 26$) and sometimes in the extra-nuclear cytoplasm ($n = 25$). The European and American populations of *P. rapæ* lack the m-chromosome entirely. *Pieris melete* Mén. of Japan has a base number of $n = 27$, and as many as 4 minute supernumeraries may be present in the nucleus. From 0 to 2 supernumeraries may also be found in nuclei of *Melanitis phedima* (Cramer), a Japanese satyrid with a base complement of $n = 28$. The only *Papilio* with a regular complement of $n = 31$ is *P. hippocrates* (Maeki, 1953); in this species all the chromosomes are similar in size, and the indistinguishable 31st chromosome does not appear to be similar to a supernumerary or m-chromosome.

SUMMARY

1. Chromosome counts are presented for eleven species of Papilionidæ, all new to cytology. This brings to 32 the number of species of Papilionidæ for which chromosome counts are recorded. The new counts are for *Parnassius smintheus* (Colorado), *Battus philenor* (Mexico), *Papilio ornythion* (Mexico), *P. cresphontes* (Mexico), *P. thoas* (Mexico), *P. polyxenes* (Connecticut), *P. "brucei"* (Colorado), *P. troilus* (Connecticut), *P. palamedes* (Mexico), *P. pilumnus* (Mexico), and *Graphium phaon* (Mexico). The *Parnassius* count is primarily from diploid oogonial nuclei; adult males showed no meiotic divisions. All the *Battus, Papilio,* and *Graphium* counts are from primary and/or secondary spermatocyte divisions (haploid) in testes of adult males taken in the wild.

2. *Graphium phaon* differs from *G. doson* and *G sarpedon* of Japan in having meiotic divisions in the adult male and in having all the chromosomes similar in size.

3. The count for *Parnassius smintheus* is $2n = 60$. Eight of the ten Papilioninæ consistently have $n = 30$. One exception is *P. polyxenes* with $n = 30$ and 31 in primary spermatocyte divisions due to the common but not invariable presence of an additional minute element (m-chromosome) which is sometimes extra-nuclear in position. The count for *P. thoas* of $n = 27$ is the more noteworthy since its sibling species *P. cresphontes* has $n = 30$, like 14 of the 15 other *Papilio* species reliably reported. (The other exception is *P. hippocrates* of Japan with $n = 31$.) The relative sizes within the complement suggest that the $n = 27$ set is derived, from an ancestral set with $n = 30$, by fusion of two tiny chromosomes and $1 + 1$ fusions of four larger chromosomes. Another difference is that most of the chromosomes of *thoas* are much larger than in *cresphontes* and other species of *Papilio*.

Acknowledgements

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References

Federley, H., 1938. Chromosomenzahlen finnländischer Lepidopteren. I. Rhopalocera. *Hereditas* 24: 397-464, 47 figs.

Hughes-Schrader, S., & F. Schrader, 1956. Polyteny as a factor in the chromosomal evolution of the Pentatomini (Hemiptera). *Chromosoma* 8:35-151, 5 figs.

Kernewitz, B., 1915. Spermiogenese bei Lepidopteren mit besonderer Berücksichtigung der Chromosomen. *Arch. Naturgeschichte* (*A*) 81: 1-34, 3 pls., 14 figs.

Lorkovič, Z., 1941. Die Chromosomenzahlen in der Spermatogenese der Tagfalter. *Chromosoma* 2: 155-191, 13 figs.

Maeki, K., 1953. Chromosome number of some butterflies (Lepidoptera-Rhopalocera). *Jap. journ. genetics* 28: 6-7, 5 figs.

............., 1957. A cytological study in 16 species of the Japanese Papilionidæ (Lepidoptera-Rhopalocera) [in Japanese]. *La Kromosomo* 32: 1115-1122, 29 figs.

............., 1959. A chromosomal study in fifteen species of the Japanese Pieridæ (Lepidoptera-Rhopalocera). *Kwansei Gakuin Univ. annual studies* 7: 361-368, 32 figs.

Makino, S., 1956. *A review of the chromosome numbers in animals,* rev. ed. 300 pp. Hokuryukan, Tokyo.

Munson, J. P., 1906. Spermatogenesis of the butterfly, *Papilio rutulus. Proc. Boston soc. nat. hist.* 33: 43-124, pls.12-17.

Regnart, H. C., 1930. Additions to our knowledge of chromosome numbers in the Lepidoptera. *Proc. Univ. Durham philos. soc.* 9: 79-83, figs.

Wilson, E. B., 1925. *The cell in development and heredity,* 3rd ed. 1232 pp., 529 figs. Macmillan, New York.

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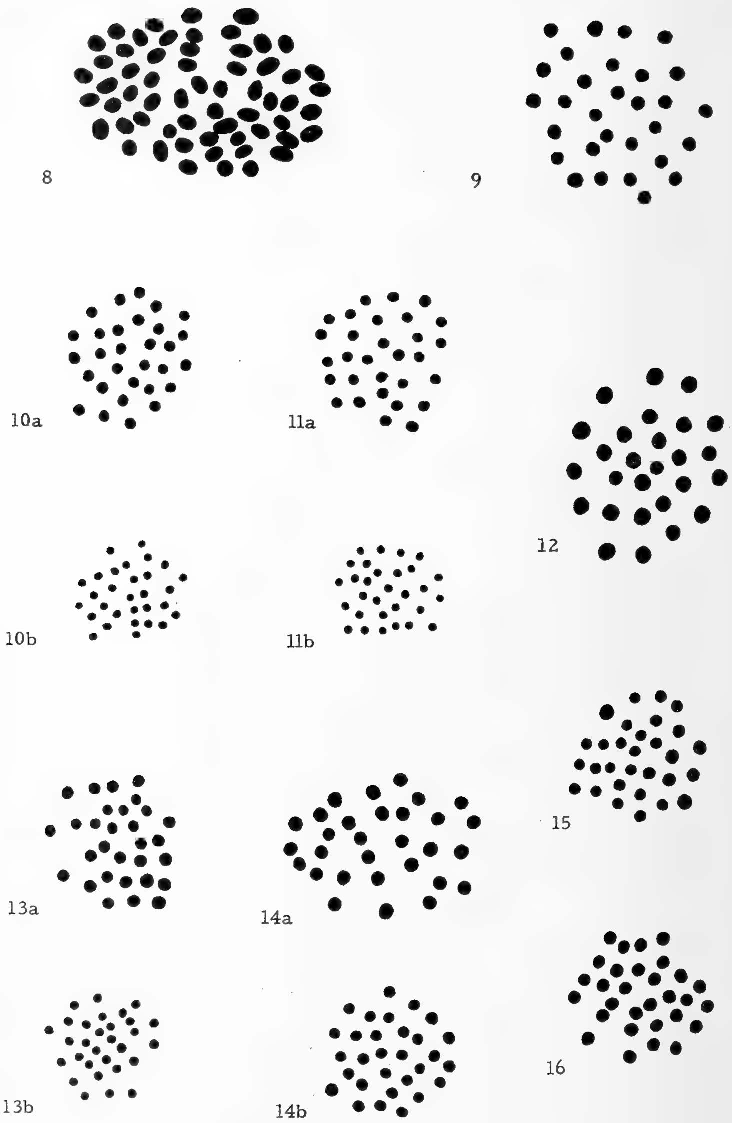


Fig. 8 — *Parnassius smintheus* oogonial division; fig. 9 — *Battus philenor* (I); fig. 10a — *Papilio ornythion* (I); fig. 10b — same (II); fig. 11a — *P. cresphontes* (I): fig. 11b — same (II); fig. 12 — *P. thoas* (I); fig. 13a — *P. pilumnus* (I); fig. 13b — same (II); fig. 14a — *P. troilus* (I); fig. 14b — same (II); fig. 15 — *P. palamedes* (I); fig. 16 — *Graphium phaon* (I). I = primary spermatocyte division; II = secondary spermotocyte division. Magnifications on Plates 1 and 2 all 3900 diameters.

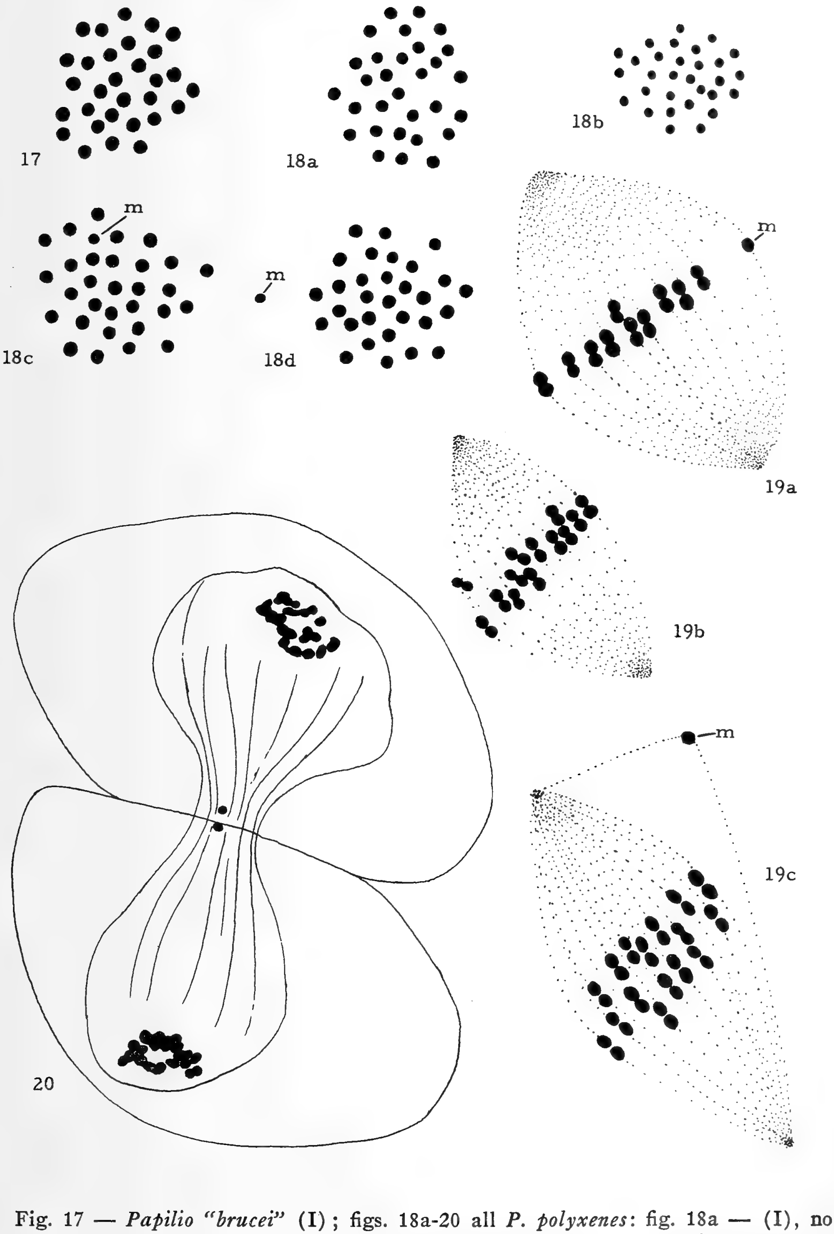


Fig. 17 — *Papilio "brucei"* (I); figs. 18a-20 all *P. polyxenes*: fig. 18a — (I), no m-chromosome; fig. 18b — (II), no m-chromosome; fig. 18c — (I), m-chromosome as regular member of complement; fig. 18d — (I), m-chromosome in cytoplasm; fig. 19a— m-chromosome unpaired at metaphase plate; fig. 19b — minute element not certainly recognizable; fig. 19c — m-chromosome outside nuclear spindle; fig. 20 — m-chromosomes dividing much later than regular chromosomes.

APPARENT WILD HYBRIDS AMONG THE MEGATHYMIDÆ

by Don B. Stallings, J. R. Turner, and Viola N. Stallings

As our studies of the Megathymidæ have progressed, our belief that a good many of the species are of relatively recent origin has strengthened. If this is the situation, then when two species do meet and fly during the same time we should expect more wild hybrids than would be the case of older and more divergent species meeting, since there would have been less time for the newer species to strengthen and complete the "barrier of sterility or inviability."

The problem of recognizing wild hybrids in the field is much more difficult than is generally realized (see Remington, 1958), and for this reason a lot of natural hybridizing of Lepidoptera has been missed.

Agathymus evansi (H.A.Freeman) and *Agathymus aryxna* (Dyar) both occur in Arizona in Ramsey Canyon with their flight periods overlapping. Both we and H. A. Freeman are certain that wild hybrids occur but we have not as yet been able to satisfy ourselves which are the true hybrids and which are merely individual variants.

We are presently working on a situation in Mexico with a large number of variants within a relatively small area in which we have not as yet ruled out the possibility of hybridization and possibly introgression among the species involved.

At the time we described *Agathymus carlsbadensis* (Stallings & Turner, 1957), we mentioned that in the Guadeloupe Mts. near Nickle, Texas, we reared a single specimen ex-larva that was not *A. carlsbadensis.* Since then we have secured four more such specimens and now have two males and three females. We are reasonably sure that these specimens are F_1 hybrids of *Agathymus mariæ* ♂ × *carlsbadensis* ♀. The reason that we feel pretty certain of the sex of each parent is that none of the larvæ or pupæ were secured from *Agave lecheguilla* Torr., which is the food-plant of *A. mariæ;* hence the female had to be *A. carlsbadensis* laying eggs on *Agave parryi* Engelm., the food-plant of *A. carlsbadensis.* Furthermore, this would be the expected cross, as generally *A. mariæ* flies after *A. carlsbadensis* and when the two do interbreed it should be a late female *A. carlsbadensis* and an early male *A. mariæ.* This cross was surprising to us due to the fact that *A. mariæ* is in a rather different species-group from that of *A. carlsbadensis.*

We now feel that *Agave chisosensis* Mueller does not occur in the Guadeloupe Mts. The plants in this area previously referred to as *Agave chisosensis* are, we believe, hybrids of *Agave lecheguilla* and *Agave parryi* (and here too, *Agave lecheguilla* is in a different subgenus from *Agave parryi*). As a matter of fact, wherever we have seen the so-called species *Agave chisosensis* we have found both *Agave lecheguilla* and a *parryi*-like plant. In the Guadeloupe Mts. we find *A. carlsbadensis* and the hybrids (but

never *A. mariæ*) using the hybrid plant. As noted in the paper describing *A. carlsbadensis,* our observations indicated that the hybrid plant was not as compatible to the larvæ as was true *Agave parryi,* resulting in a larger portion of the larvæ on the hybrid plants not maturing.

An examination of the accompanying plate will indicate how the presumed hybrids seem to have modified characters of both parent species. The color of the spots of the hybrids is lighter than in *A. carlsbadensis,* but darker than in *A. mariæ.* We find little variation among the three male presumed hybrids or in the two females. the hatching period of all five specimens falls in the last part of the *A. carlsbadensis* flight and the first part of the *A. mariæ* flight.

One of the strange things is that when we have shown these hybrids to lepidopterists not familiar with Megathymidæ they immediately associate them with *A. mariæ,* while FREEMAN and we associated them with *A. carlsbadensis.* To us the genitalia seem to have more of the *A. carlsbadensis* characters, although the narrow indentation at the base of the female vaginal plate is certainly a character of *A. mariæ.*

The presence of hybrids in this area suggests some interesting possibilition. REMINGTON (1958) states: "At least in *Papilio,* and perhaps in *Callosamia,* there is a most perplexing phenomenon: in many interspecific crosses the F_1 hybrids are highly fertile in backcrosses, and completely sterile in $F_1 \times F_1$ pairings." If this same situation exists with these hybrids then we should expect some *A. mariæ* genes passing over to the *A. carlsbadensis* population. This in turn suggests that perhaps some of the "specific" characters of *A. carlsbadensis,* used for distinguishing it from *A. neumoegeni* (Edwards), are in fact variations caused by this introgression.

FREEMAN has discovered a similar situation in the Hueco Mts. of Texas in which there appear to be hybrids between *A. mariæ* (Barnes & McDunnough) and *A. judithæ* (Stallings & Turner).

References

Remington, Charles L., 1958. Genetics of lepidopterous populations. *Proc. X. int. congress ent.* 2: 787-805, 13 figs.

Stallings, Don B., & J. R. Turner, 1957. Four new species of *Megathymus. Ent. news* 68: 1-17, 4 pls.

Caldwell, Kansas, U. S. A.

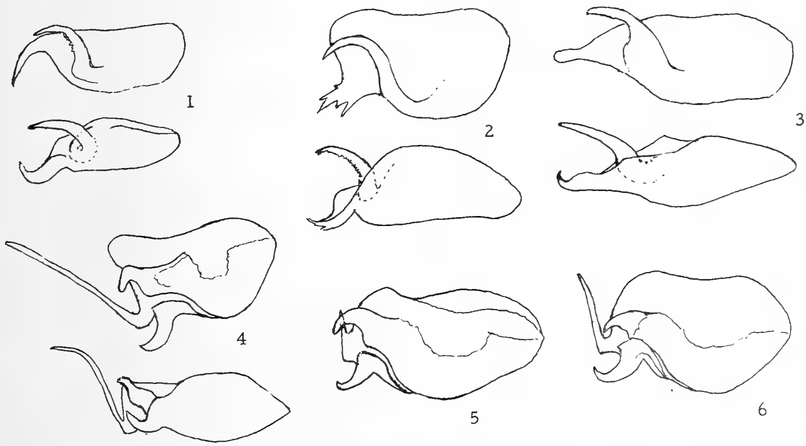
PLATE (p.205): top, *Agathymus carlsbadensis*; middle, wild presumed hybrids; bottom, *A. mariæ.* All from near Nickle, Texas (see text). Left side males, right side females.

A NEW GEOGRAPHICAL SUBSPECIES OF *CHLOSYNE HOFFMANNI* (NYMPHALIDÆ) FROM WASHINGTON STATE

by David L. Bauer

Chlosyne hoffmanni (Behr) is a new combination of generic and trivial names. It is fully waranted by the structure of both the male and the female genitalia of *hoffmanni.* These are of the same character as those of *janais* Drury, the type species of the genus *Chlosyne* Butler. They only distantly resemble the genitalia of either *cinxia* Linné, type species of the genus *Melitæa* Fabricius, see Higgins (1941: p.195), or of *athalia* Rottemburg, the type species of *Mellicta* Billberg, see Higgins (1955: p.4). There is a series of genera that range from *Euphydryas* Scudder to *Gnathotriche* Felder in which *Chlosyne, Mellicta,* and *Melitæa* are about midway between the extremes. Both *Mellicta* and *Melitæa* are closer to *Phyciodes* Hübner than *Chlosyne* is when judged by the genital structures of the type species. The *Chlosyne* are distinctive and stand closer to *Microtia* Bates and *Euphydryas.* Unfortunately no linear arrangement can show all the interrelationships shown by these genitalic structures. The whole series from *Euphydryas* to *Gnathotriche* could be united as a single polytypic genus, *Melitæa,* which would necessitate many subgenera, or, as seems more suitable to me, could be divided into several related genera based on genitalia, life history, and distribution.

The male valves of the type species of *Chlosyne, Mellicta,* and *Melitæa,* and of *Phyciodes mylitta* are shown in figures 1-4. The valve of *Chlosyne* is very close to that of *elva* Bates, the type species of the genus *Microtia* Bates. But the female genital structures are very different (Bauer, 1958: p. 97).



Male Valvæ: fig.1—*Melitæa cinxia* (L.); fig.2—*Mellicta athalia* (Rott.); fig.3—*Phyciodes mylitta* (Edw.); fig.4—*Chlosyne janais* (Drury); fig.5—*C. hoffmanni;* fig.6—*C. palla.* Lower drawing of figs.1-4 shows external view; other six show internal view.

I have seen specimens of Washington *Chlosyne hoffmanni* in various collections labeled *Melitaea hoffmanni segregata* Barnes & McDunnough, *M. palla* Boisduval, and *M. palla whitneyi* Behr. This confusion is the natural result of trying to place taxonomically an insect which does resemble these named varieties, but is not exactly like any one of them. This troublesome insect is found along the east slope of the Cascade Mountains in Washington state from Mount Adams north to the Canadian line. It probably occurs in British Columbia, but as yet I have seen no specimens from that province. It is found from elevations of around 5,000 ft. along the crest of the Cascades to as low as 1,500 ft. in several of the deep canyons. As would be expected with such an altitudinal variation there is a cline from brighter ground and reduced dark markings at lower elevations to contrasting ground coloring and heavy dark maculation at high altitudes. All of the specimens, regardless of the locality, bear the same distinguishing characteristics noted in the description that follows.

Chlosyne hoffmanni manchada Bauer, NEW SUBSPECIES

HOLOTYPE male: upper surface of the primaries bears the general pattern of the species in the *palla* group; the wide ruddy-orange marginal band is crossed by very weakly developed dark scaling on the veins; the submarginal ruddy-orange band is broken into a series of spots extending from the costa to the inner margin; these spots are largest in the central portion of the band; all these spots are heavily margined basad with dark scaling, which on some specimens reduces each spot to a mere dot; the next band is ruddy-orange and extends across the wing from the costa to the inner margin and is divided into quadrate spots by dark scaling along the veins; the amount of dark scaling along the veins varies from very heavy to almost obsolete; this series of quadrate spots is pupiled with dots of paler orange; the innermost band is slightly paler than the others and is divided into spots by either ruddy-orange or dark brown scaling along the veins; the basal third of the wings is marked as in *C. hoffmanni hoffmanni,* but the orange is ruddier, and there is a paler orange bar across the middle of the cell.

The under surface of the primaries is marked more like that of *C. calydon* (Mead) than either *C. h. hoffmanni* or *C. hoffmanni segregata* (Barnes & McDunnough).

The upper surface of the secondaries bears the maculation typical of the *palla* group; the broad ruddy marginal band is crossed by dark scaling along the veins and is heavily bordered basad with dark scaling; the submarginal series of ruddy-orange spots extends from the costa to the anal angle, and is heavily outlined with dark scaling; the third ("middle row" of Barnes & McDunnough, 1918) is the broadest, and is slightly darker ruddy-orange than the others; this third row is obsolete on the costa. The fourth, or innermost, spot band is the narrowest and is pale orange-fulvous in color; it tends to be obsolescent from the end of the cell to the inner margin; the remainder of the wing is as in *C. hoffmanni hoffmanni.*

The color and maculation of the under surface of the secondaries is similar to that of *C. p. palla* (Boisduval) and *C. p. whitneyi* (Behr). The maculation is not distinctive.

Fringes: mostly black with some white between the ends of the veins on the fore wings, while on the secondaries there is about an even amount of black at ends of veins and white between them.

Palpus: heavily clothed with hairs; the terminal half is ruddy-orange-brown shading gradually to white basally. The long hairs on dorsal and ventral surfaces dusky.

Antenna: predominantly ruddy-orange-brown ventrally; the color is paler at the base and deeper on the club; dorsally each segment is flecked with black and strongly marked with white at the juncture of the segments; the club is ruddy-orange-brown and flecked with white dorsally.

Head: black heavily flecked with ruddy-orange-brown dorsally; ventrally it is also flecked with creamy-white.

Thorax: black thinly covered with brownish hairs dorsally; the lappets, or tegulæ, are very hairy; the hairs are dark brown tipped with ruddy-orange-brown; ventrally the thorax is very heavily clothed with long creamy-white hairs.

Legs: predominantly ruddy-orange-brown, but the inner surface of the femur is scaled with white; there is a little black scaling on the coxa.

Abdomen: black dorsally; it is clothed with long brownish hairs anteriorly. There is some creamy scaling at juncture of the segments; the terminal brush of hairs, which hides the genital armature, is pale orange brown; ventrally the coloring is creamy-white with two broken longitudinal black lines.

ALLOTYPE female: almost identical with the male holotype; the description of the holotype will suffice, as the only real differences in appearance are a greater contrast in the ruddy-orange and paler orange coloring.

Fig. 7 — ♂ paratype from Tumwater Canyon, Wash., 12 June 1951, in Yale Peabody Museum; upperside left, underside right.

HOLOTYPE male: 1,600 feet elevation in Tumwater Canyon, Drury, Chelan Co., Washington, 23 June 1954, *leg.* David L. Bauer. Expanse of forewings 37.5 mm. Length of forewing base to apex 20 mm. Length of hindwing base to outer margin 15 mm.

ALLOTYPE female: 1,600 feet elevation Tumwater Canyon, Drury, Chelan Co., Washington, 16 June 1958, *leg.* David L. Bauer. Expanse of forewings 40 mm. Length of forewing base to apex 21 mm. Length of hindwing base to outer margin 16 mm.

PARATYPES as follows, all from Chelan Co., Washington: 11 ♂♂ same data as Holotype; 6 ♂♂ same data as Allotype; 6 ♂♂ 1,700 feet elev. Tumwater Recreation Area, 12 June 1951, *leg.* Donald P. Frechin; 1 ♂ 1,800 feet elev., Icicle Creek Canyon, 21 June 1955, *leg.* David L. Bauer; 1 ♂ 2,000 feet elev. upper Mission Creek, 30 May 1956, *leg.* David L. Bauer; 1 ♂ 1,500 feet elev. near Leavenworth, 4 June 1958, *leg.* David L. Bauer; 5 ♂♂ 2,500 feet elev. near Gaynor, 4 June 1958, *leg.* David L. Bauer.

The Holotype and Allotype are deposited in the Los Angeles County Museum, Los Angeles, California, one paratype in the American Museum of Natural History, New York, N. Y., and one paratype in the Peabody Museum, Yale University, New Haven, Connecticut.

The insect has also been collected and the specimens examined, from the following localities outside of Chelan County: Bird Lake, Mt. Adams, Yakima Co., 6-7 August 1953, *leg.* S. G. JEWETT JR.; Bear Creek, Yakima Co., 28 May 1958, *leg.* E. J. NEWCOMER; Sheep Lake, 5,500 feet elev., Yakima Co., 11 July 1958, *leg.* E. J. NEWCOMER; near Camp Gilbert, 2,700 feet elev., Okanogan Co., 10 June 1956, 3 July 1953, and 12 July 1955, *leg.* JOHN C. HOPFINGER. These are not made paratypes.

DISCUSSION

The type series of *C. h. manchada* has been compared carefully with the original description of *C. h. segregata* Barnes & McDunnough (1918) and the figures given of the type; the two paratypes figured by HOLLAND (1931) plate LVII: figs.28, 29; and a short series of topotypes. It has also been compared with series of specimens from other areas of Oregon: — the Deschutes National Forest, Suttle Lake, and Mt. Hood. It was found to be separable from all these Oregon specimens by means of one of BARNES and MCDUNNOUGH's key characters for *segregata,* which is stated in the original description as follows: "on the secondaries the middle row of the three extra discal rows tends toward obsolescence." In typical *manchada* this "middle row" is the broadest, and most prominent, persistent, and bright ruddy-orange-brown; while the rows on either side of it are the ones which tend toward obsolescence.

Like *segregata* it can readily be separated from typical *hoffmanni* from California by the much narrower innermost spot band of the secondaries, and by its checkered and spotted appearance.

When females are caught with the males, the dimorphic females of *palla* and its northwestern race *sterope* enable easy recognition and separation of *hoffmanni* and its geographical subspecies. But if one is to distinguish accurately between specimens of the nondimorphic *whitneyi* and *hoffmanni,* particularly the northwestern *hoffmanni manchada,* or if only males are available from a population, the male genitalia should be checked. Positive specific identification can be made because of the differences in the structure of the posterior process of the valva, see figures 5 and 6. The form of this posterior projection is unique to *hoffmanni* in the *palla* group, but is very similar to that of the eastern *C. gorgone* Hübner; however, these two species are so different in wing maculation there need be no confusion.

The foregoing information should help in the identification of the species of the *palla* group not only in the Pacific Northwest, but also throughout the Cascade-Sierra mountain chain. The chief confusion has involved *C. palla whitneyi* and *C. hoffmanni manchada,* but the paler form of *whitneyi* which flies along the east slope of the Cascade Mountains from British Columbia to Oregon has also been confused with *C. acastus*. WRIGHT (1905) figures this form as *acastus*. His locality, Pasco, Washington, is questionable, but the month, July, is correct. Genuine *acastus* flies during May in the Steens Mountains of southeastern Oregon.

CONCLUSION

The Columbia River gorge is a barrier to the southward spread of the butterflies *Erebia vidleri* Elwes and *Boloria chariclea* Schneider into Oregon, as they are not found in that state. *Chlosyne hoffmanni* has crossed this barrier, but the subsequent isolation has resulted in the development of the distinctive Washington population named in this paper. We can thus recognize three geographical populations of the species as follows:

Chlosyne h. hoffmanni (Behr) — Sierra Nevada Mts., California.
Chlosyne hoffmanni segregata (B. & McD.) — Cascade Mts., Oregon.
Chlosyne hoffmanni manchada Bauer — Cascade Mts., Washington.

ACKNOWLEDGEMENTS

Thanks are expressed to JOHN C. HOPFINGER, S. G. JEWETT JR., E. J. NEWCOMER, and DONALD P. FRECHIN for making material from various localities available for study. I am also indebted to F. M. BROWN, LLOYD M. MARTIN and C. L. REMINGTON for help with this manuscript. The photographs are from the Yale Peabody Museum.

References

Barnes, W., & J. H. McDunnough, 1918. Notes and new species. *Contrib. Nat. Hist. Lepid. Amer.* 4: 72.

Bauer, David L., 1959. A new subspecies of *Microtia dymas* from southern California. *Lepid. News* 12: 97-100.

Higgins, L. G., 1941. An illustrated catalogue of the Palearctic *Melitæa* (Lepidoptera: Rhopalocera). *Trans. Royal Ent. Soc. London* 91: 175-365, 16 pls. 215 figs., 7 maps.

-----------, 1955. A descriptive catalogue of the genus *Mellicta* Billberg (Lepidoptera: Nymphalidæ) and its species, with supplementary notes on the genera *Melitæa* and *Euphydryas*. *Trans. Royal Ent. Soc. London* 106: 1-131, 2 pls., 4 maps, 88 figs.

Holland, W. J., 1931. *The butterfly book,* rev. ed. 424 pp., 77 pls. Garden City, N. Y.: Doubleday.

Wright, W. G., 1905. *The butterflies of the west coast of the United States.* 257 pp., 31 pls. San Bernardino, Calif.: publ. by author.

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FURTHER NOTES ON THE DATES OF PUBLICATION OF SOME GENERIC AND SPECIFIC NAMES PROPOSED BY BOISDUVAL AND LE CONTE IN THE *LÉPIDOPTÈRES DE L'AMÉRIQUE SEPTENTRIONALE,* 1829-1833-[1834]

by Cyril F. dos Passos

Since the publication of a paper on this subject in *The Lepidopterists' News* (vol.12: pp.121-122; "1958" [1959]), a communication has been received from Mr. Paddy B. McHenry, of Burbank, California, giving the results of his study of a copy of Boisduval & Le Conte's *Lépidoptères de l'Amérique Septentrionale,* 1829-1833-[1834] in the Allen Hancock Foundation Library at the University of Southern California, *ex* Boston Society of Natural History Library. This copy appears to be complete, although the wrapper for livraison 8 is not of the original issue but of the Roret re-issue. As a result of this study it appears that three generic and seven specific names proposed in that work will have to be dated and cited from the plates rather than from the text, and that in five of those ten cases the dates of publication of one generic name and four specific names will be advanced by one year. This information is summarized as follows:

Generic names

Aganisthos	[1833]	pl.52
Agraulis	"	pl.42
Nymphidia	"	pl.37

Specific names

Apatura celtis	[1833]	pl.57
Apatura clyton	"	pl.56
Polyommatus cratægi	"	pl.37
Melitæa ismeria	"	pl.46
Vanessa j album	"	pl.50
Colias pelidne	1829	pl.21
Argus pseudargiolus	[1833]	pl.36

Mr. McHenry has questioned also the [June 1833] date of publication of signature 9 containing pp.81-88 and plates 25-27, and it may well be that these should be dated [27 July 1833], but that is a debatable matter concerning which all that can be said positively is that they could not have been published prior to 30 June nor later than 27 July 1833. No synonomy hangs on the solution of this problem.

Washington Corners, Mendham, New Jersey, U. S. A.

ISOLATION MECHANISMS IN POPULATIONS OF *HYALOPHORA* (SATURNIIDÆ)

by ROBERT D. WEAST

As is generally known, species comprising the large moths of the subgenus *Hyalophora* (=*Platysamia,* see MICHENER'S revision 1952), freely attract and interbreed when they come into contact with one another. The several species that I have worked with are *H. euryalus* Bdv. of the West Coast, *H. gloveri* Strecker of the Rocky Mountains, *H. cecropia* Linné east of the Great Plains, and local colonies of *H. columbia* J. B. Smith in Wisconsin, Michigan, and Maine.

In certain areas where two of the species make contact several things can happen: 1. the species intergrade, forming a fertile, self perpetuating race, *e.g., kasloensis* Cockerell occuring in parts of Idaho and Montana where *H. gloveri* and *euryalus* merge; 2. the two species remain pure, with occasional hybrids appearing, but having no noticeable effect on either species, *e.g., H. columbia* and *cecropia* in local areas; 3. one species replaces the other, *e.g., H. cecropia* replaces *gloveri* in certain areas where they make contact. In the early thirties W. R. SWEADNER did extensive work with this genus which culminated with his treatise "Hybridization and the phylogeny of the genus *Platysamia*" (1937). This intensive study revealed a good deal of information on the relationship of the several species and races plus their habitats, points of contact, and their hybridization.

To investigate the reasons for the above occuring as they do, I have for the past ten years been engaged in rearing the hybrids, backcrosses, and the pure species. The crosses have been made in the field by tieing females of one species in the territory of another, or by securing cocoons from various parts of the country and having the adults cage mate. The fact that all species of this subgenus fly during the same hours and that they easily mate and oviposit in captivity greatly facilitates their study.

I have noticed no significant differences in the hardiness of hybrid larvæ from that of the pure species. When highly selective feeders like *columbia, euryalus* or *gloveri* are crossed with *cecropia,* their range of acceptable foods is increased, but never to the wide selection of pure *cecropia.* When two restricted feeders like *euryalus* and *gloveri* are crossed, their food acceptance remains restricted to the acceptable foods of either pure species. The triple cross *gloveri* ♂ × *euryalus* ♀ × *cecropia* ♀ has a very limited food acceptance, even less than the *euryalus* × *cecropia.*

F_1 hybrid males are normally fertile and can be backcrossed to a pure parent species. F_2 backcrossed males are equally fertile. Surprisingly, the crossing of the three species just mentioned was fertile. Five such matings were secured in 1959 and thirty four large cocoons were reared. In 1960 I shall cross these males back to pure *gloveri, euryalus,* and *cecropia* females. If I am fortunate in collecting female Columbia cocoons in Wisconsin this winter they shall also be mated to the 3× males, attempting a four-species hybrid. It will be interesting to determine what amount of backcrossing will finally produce viable females, as they are normally barren.

A great deal of variability exists regarding the four species to hybridize. These are fertility and physiological differences, depending on the populations involved, for it is clearly one or the other, and sometimes it appears to be both. Here are a few examples as they occur, or could occur in nature. *H. cecropia* females mated to Arizona *gloveri* (Madera Canyon, Pima Co.) behave as if they weren't mated. They lay few eggs and continue to "send" during subsequent flight periods. Nevertheless, the few eggs laid by the five females in the experiment produced hybrid larvæ. In Helena, Montana, the same cross produces very low fertility, but the females will oviposit completely. *H. gloveri* from the Salt Lake City, Utah, area is more fertile with *cecropia* but still less than 50%. By contrast, *gloveri* from Wyoming are highly fertile with *cecropia*. The reverse pairing is equally fertile. *H. euryalus* females are highly fertile with *cecropia* males, but for some unknown reason they often die during or shortly after copulation. The reverse pairing is usually sterile, but I have had two such matings with high fertility. California *euryalus* females mated to northern *gloveri* produce good fertility, but like other hybrids only males are fertile. The fertile, self-reproducing form *kaslœnsis* occuring where the two species naturally meet in the north is the result of many years of contact, unlike the sudden meeting of two pure species. *Columbia* and *cecropia* occupy the same areas in United States where *columbia* occurs. Fertility is high when the two interbreed. The hybrid cocoons and adults are not exceptionally rare.

I believe several factors take place, singly or in combination, when two species occur in the same habitat. These reasons explain, in part, the extent of population isolation or lack of it in this subgenus: 1) females, upon being mated to another species' male, may re-mate with additional males until one of her own species mates with her; 2) physiological differences may prevent successful copulation even though the female may completely oviposit; 3) fertility of many pairings is low or absent; 4) cross-mated females still seek out and oviposit on plants of their own preference, and thus hybrid larvæ may refuse to eat, or thrive on what is available; 5) hybrid larvæ comprise but a small percentage of the total larval population, and the odds at survival to the adult stage are low; 6) 50% of the hybrid adults are barren females, and the remaining males are very few compared to the total number of pure males; for that reason, backcrossing is a rare occurance.

I am convinced that saturniid moths cannot occur at rare levels in their habitat, due to their short adult life and specialized breeding patterns. The lethal pressures of parasites and birds require that they maintain high numbers scattered over a considerable breeding area. In the light of this, hybrid influence and the drain of population numbers due to useless crossbreeding is, under most circumstances, not a major factor in survival. If, however, one species should be locally reduced to a low density, and should males of an adjacent species invade the territory (the wind commonly carries males well over ten miles) there might not be enough pure matings to withstand normal pressures. The less common of the two species would be replaced by the other.

Considerable evidence has been accumulated regarding the flight distance of males. Some good evidence is also available on oviposition flights of females. This information is important to a better understanding of the species' ability to invade new breeding areas.

It appears quite conclusive that males can detect females up to a distance of a half mile. Through the use of marked males returns are very high within those limits, but drop sharply at greater distances. In Texas I have seen a male *Eupackardia calleta* Westwood appear as a speck in the distance and fly directly to a female in my yard.

Although the actual detecting distance may be something like a half mile, males undoubtedly cover a much greater territory in random flights, being carried predominately over the greater distances by the wind. Here in Des Moines I can expect several hundred male *cecropia* to arrive at my breeding cage in the course of the flight season. One night alone 43 males were attracted. It can be presumed that for every male that arrived, a female emerged in the habitat, since the sex ratio is about 50-50. Thus, if a season total of 300 males arrive, an additional 300 females are to be found throughout the area. There simply are not 600 wild cocoons to be found within a two or three mile radius of my breeding cage. Careful cocoon collecting techniques reveal the density of living cocoons to be much less. The only explanation appears to be that the males have come from distances of many miles, perhaps fifteen miles.

To further illustrate this point, a closely related species, *H.* (*Callosamia*) *promethea* Drury, maintains a large colony in Milwaukee, Wisconsin. Fourteen miles west in Waukesha the species definitely does not breed. *H. promethea* females taken to Waukesha invariably attract old, frayed males, in all probability from the Milwaukee area.

On the Arizona desert I marked twelve male *cecropia* and released them at half mile intervals from a caged female. Half of these males returned; the last to arrive came in three days late from the five-and-one-half mile distance. There were no other Saturniidæ species to interfere with this experiment on the desert.

To see that males can easily traverse many miles, one has only to observe the day-flying males of *E. calleta* and *H. promethea* in open country. Upon taking wing they often quickly disappear from sight, their course being determined to a good extent by the wind. It is not unreasonable to assume that under certain conditions they can travel great distances. Should they come somewhere within the half mile attracting distance of a female they will, under favorable atmospheric and wind conditions, locate her.

Heavily laden females cannot fly great distances, although marked females have been taken at light as far as a half mile from the point of release. They had the full complement of eggs. It is good that a female cannot leave the successful niche at first, since chances of survival of the larvæ are good there — she made it. Females ordinarily commence laying within two city blocks from the point of emergence. After having completed most of their egg-laying they become stronger flyers and can undoubtedly travel several miles.

It appears then, that this genus of Saturniidæ has a quite plastic mobility, not being the sluggish flyers that they are commonly believed to be. They can overcome natural barriers of several miles, and two related species might make contact even though their respective habitats may be separated by many miles.

References

Michener, Charles D., 1952. The Saturniidæ (Lepidoptera) of the Western Hemisphere. Morphology, phylogeny, and classification. *Bull. Amer. Mus. at. Hist.* 98: 335-501, 1 pl., 420 figs.

Sweadner, W. R., 1937. Hybridization and the phylogeny of the genus *Platysamia. Ann. Carnegie Mus.* 25: 143-242, pls. 15-20.

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INTERNATIONAL COMMISSION ON NOMENCLATURE. NOTICE OF PROPOSED USE OF PLENARY POWERS

In accordance with a decision of the 13th International Congress of Zoology, 1948, public notice is hereby given of the possible use by the International Commission on Zoological Nomenclature of its plenary powers in connection with the following case, full details of which will be found in *Bulletin of Zoological Nomenclature,* Vol. 17, Parts 6/8, published on 8 April 1960:

Validation of the specific name *dardanus* Brown, 1776 (*Papilio*) (Class Insecta, Order Lepidoptera). Z.N.(S)1403.

Any zoologist who wishes to comment on this case should do so in writing, and in duplicate, as soon as possible, and in any case before 8 October 1960. Each comment should bear the reference number of the case in question. Comments received early enough will be published in the *Bulletin.* Those received too late for publication will, if received before 8 October 1960, be brought to the attention of the Commission at the time of commencement of voting.

All communications on the above subject should be addressed as follows:

The Secretary,
International Commission on Zoological Nomenclature,
c/o British Museum (Natural History),
London, S.W. 7., England.

W. E. CHINA, Assistant Secretary
International Commission on Zoological Nomenclature

A LIST OF GEOMETRIDÆ FROM BAKER COUNTY, OREGON

by James H. Baker

This list of Geometridæ is the result of some twenty years of collecting in Baker County, Oregon. The exact location is the site of our family cabin, located about eleven miles northwest of Baker, in the foothills of the Elkhorn Range, at an elevation of 3800 feet. The Elkhorn Range is a part of the Blue Mountains of the region.

Vegetation in the general vicinity is dominated by White Fir and Ponderosa Pine. Deciduous trees include willow, aspen, poplar and vine maple. Among the shrubs are currant, rose, sagebrush, snowberry bush, and elderberry. There is a good ground cover of ferns and assorted grasses. The area is ungrazed and is typical transition life zone.

Grateful acknowledgment is extended to those who have helped in the determinations. Dr. J. H. McDunnough was very helpful in the determination of the *Eupithecia,* and identifications of *Dysstroma* were made by D. C. Ferguson. And to Dr. Frederick H. Rindge of the American Museum of Natural History I am especially indebted for the correct determination of the various other genera. The sequence is that of the 1938 McDunnough Check List. Where two dates are given, these are my earliest and latest records.

Brephos infans oregonensis Swett — May 6.
Nemoria darwiniata Dyar — June 14, Aug.1.
Synchlora liquoraria Gn. — June 24, July 4.
Chlorissa banksaria Sperry — July 29.
Mesothea viridipennata Hulst — Apr.20, May 19.
Xystrota rubromarginaria Pack. — Apr.29, May 19.
Scopula quinquelinearia Pack. — July 3, Aug.31.
S. ancellata Hulst — July 21, Aug.1
S. fuscata Hulst — July 19.
S. sideraria Gn. — May 4, June 16.
S. subfuscata Taylor — May 16, Sept.4.
Cosymbia pendulinaria griseor McD. — July 2.
Nyctobia limitaria nigroangulata Stkr. — May 14.
Cladara atroliturata Wlk. — May 2.
Lobophora magnoliatoidata Dyar — June 10, July 10.
Neodezia albovittata tenuifasciata B. & McD. — July 14.
Triphosa hæsitata Gn. — Apr.8, Aug.20.
Hydria undulata Linné — July 10, July 24.
Coryphista meadi Pack. — May 9, July 4.
Eupithecia misturata Hulst — July 24, Sept.4.
E. castigata Hbn. — June 19, July 31.
E. albipunctata Haw. — May 26.

E. luteata bifasciata Dyar — June 19.
E. mæstosa Hulst — May 7, Aug.1.
E. plenoscripta Hulst — July 22.
E. fumata Taylor — July 8.
E. coagulata Gn. — June 11, July 4.
E. multistrigata Hulst — Aug.1.
E. perfusca kootenaiata Dyar — June 29, Aug.1.
E. multiscripta Hulst — May 25.
E. georgii McD. — May 26, Sept.4.
E. subcolorata Hulst — June 16.
E. cretaceata Pack. — June 15, July 22.
E. agnesata Taylor — June 19, Aug.1.
E. nevadata Pack. — Apr.17, July 15.
E. ravocostaliata Pack. — May 15.
E. graefi Hulst — June 30.
Horisme intestinata Gn. — June 6, July 10.
Eustroma semiatrata Hulst — June 16, Aug.26.
E. atrifasciata Hulst — June 12, July 13.
Lygris propulsata Wlk. — June 16, July 24.
L. destinata bowmani C. & S. — Aug.11.
L. xylina Hulst — June 29, Sept.3.
Plemyria georgii Hulst — Aug.25.
Dysstroma walkerata Pears. — July 22.
D. truncata ochrofuscaria Swett — June 15.
D. citrata Linné — May 26, Aug.20.
D. brunneata Pack. — July 4, Aug.5.
D. formosa Hulst — June 24, July 20.
D. formosa f. *gilvifasciata* McD. — July 3, July 23.
D. formosa f. *admiranda* McD. — July 4, July 23.
D. formosa f. *boreata* Taylor — July 14.
Ceratodalia gueneata Pack. — May 26, Aug.5.
Stamnodes topazata Stkr. — July 8.
Stamnoctenis pearsalli Swett — July 8.
Marmopteryx marmorata Pack. — May 2, May 21.
M. animata Pears. — June 15.
Hydriomena furcata Thun. — July 30, Sept.3.
H. nubilofasciata Pack. — June 2.
H. perfracta Swett. — July 1.
H. sierræ B. & McD. — June 10, July 4.
H. columbiata pernigrata B. & McD. — June 2, June 10.
H. ruberata nevadæ B. & McD. — June 14.
H. expurgata franclemonti McD. — May 9.
Xanthorhoe lacustrata Gn. — July 4.
X. designata emendata Pears. — July 11.
X. munitata Hbn. — Aug.3, Aug.21.

X. defensaria Gn. — June 2, Aug.3.
Entephria multivagata Hulst — July 8, Aug.10.
Mesoleuca gratulata Wlk. — June 3.
Epirrhoe plebeculata Gn. — Apr.17, May 5.
E. alternata Mull. — June 13, July 12.
Spargania magnoliata pernotata Hulst — June 10, Aug.20.
Euphyia unangulata intermediata Gn. — July 4, July 13.
Enchoria lacteata Pack. — Apr.24.
Eulype hastata gothicata Gn. — June 3, June 26.
E. subhastata albodecorata Blackmore — May 8, June 8.
Perizoma costiguttata Hulst — June 10, June 16.
Earophila vasiliata Gn. — May 10.
Venusia cambrica Curtis — June 20, July 22.
V. pearsalli Dyar — Apr. 19, June 20.
Babta semiclarata Wlk. — May 30, July 11.
Deilinia erythemaria Gn. — July 4.
Eudrepanulatrix rectifascia Hulst — May 9, July 19.
Drepanulatrix bifilata Hulst — May 9, July 21.
D. secundaria B. & McD. — June 1, July 10.
D. falcataria Pack. — Apr.17, May 16.
D. carnearia columbiaria McD. — June 11, July 26.
D. fœminaria Gn. — Apr. 30, June 4.
Apodrepanulatrix litaria Hulst — May 16, Aug.31.
A. quadraria Grote — May 9, Aug.11.
A. unicalcararia Gn. — May 18, Aug.31.
Sericosema juturnaria Gn. — July 13, Aug.10.
S. wilsonensis macdunnoughi Rindge — Aug.1, Aug.11.
Philobia ulsterata Pears. — June 16, July 13.
Semiothisa adonis B. & McD. — June 2, Aug.4.
S. dispuncta Wlk. — May 18, July 21.
S. sexmaculata incolorata Dyar — May 4, Aug.20.
S. denticulata Grote — May 6, Aug.24.
S. excurvata Pack. — June 2, July 10.
S. nubiculata Pack. — June 2.
S. curvata Grote — May 6, Aug.1.
S. irrorata venosata McD. — July 4.
S. neptaria Gn. — May 26, Aug.24.
Itame ribearia Fitch — Aug.10.
I. occiduaria Pack. — July 30.
I. quadrilinearia Pack. — July 21, Aug.5.
Itame exauspicata Wlk. — July 30.
I. coloradensis Hulst — July 23.
I. plumosata B. & McD. — July 27, Sept.3.
I. bitactata Wlk. — May 25, Aug.20.
Protitame matilda Dyar — June 16, Aug.1.

Elpiste lorquinaria Gn. — July 17, Sept.8.
Hesperumia sulphuraria Pack. — June 16, Aug.10.
Dasyfidonia avuncularia Gn. — Apr.30, May 7.
Hypagyrtis subatomaria Wood. — July 22.
Melanolophia imitata Wlk. — May 16, July 4.
Glena nigricaria B. & McD. — Aug.1.
Stenoporpia excelsaria Stkr. — July 9.
Anavitrinella pampinaria Gn. — July 4.
Anacamptodes emasculata Dyar — May 26, Aug.16.
Æthalura anticaria fumata B. & McD. — Apr.24.
Coniodes plumigeraria Hulst — Mar.20.
Gabriola dyari Taylor — Aug.20.
G. sierræ McD. — July 4.
Euchlæna johnsonaria mollisaria Hulst — June 8, Aug.1.
E. tigrinaria Gn. — July 4.
E. madusaria ochrearia McD. — June 29, July 4.
Epirrhanthis substriataria danbyi Hulst — May 6, June 20.
Campæa perlata Gn. — May 26, Sept.3.
Philedia punctomacularia Hulst — Aug.25.
Plagodis approximaria Dyar — May 26, July 4.
Anagoga occiduaria Wlk. — May 14, July 13.
Hyperetis amicaria H.-S. — May 14.
Nematocampa limbata Haw. — July 30, Aug.24.
Selenia alciphearia Wlk. — June 2, June 11.
Pero behrensarius Pack. — May 20, July 9.
P. occidentalis Pack. — May 30, July 13.
P. morrisonarius Hy. Edw. — June 15, July 13.
P. mizon Rindge — July 31.
Phengommatæa edwardsata Hulst — July 4, Aug.17.
Enypia griseata Grossbeck — July 1, Aug.25.
Platæa trilinearia Pack. — June 2, July 22.
Nepytia umbrosaria nigrovenaria Pack. — Aug.24.
Somatolophia ectrapelaria Grossbeck — July 18.
Caripeta divisata Wlk. — May 26, July 22.
C. æqualiaria Grote — May 26, Aug.5.
Neoterpes trianguliferata Pack. — May 20, July 30.
Sicya macularia crocearia Pack. — July 4, Sept.3.
Deuteronomos magnarius ochreatus Hulst — Sept.1.
Synaxis jubararia Hulst — Sept.12, Oct.1.
S. cervinaria Pack. — June 15, July 13.
S. barnesi Hulst — Sept.12.
Prochœrodes forficaria combinata McD. — June 22, July 8.

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MORE LARVAL FOODPLANTS FROM TEXAS

by Roy O. Kendall

This is a partial list of larval foodplants from Texas which I have found during the past five seasons. Other larval foodplants from this State will be announced when botanical determinations have been completed. Unless otherwise specifically stated, all records herein are from Bexar County, Texas. Descriptions of new life histories resulting from these findings will appear in a later publication. The species of Lepidoptera have been arranged alphabetically under two headings (1) St. Augustine Grass, and (2) Larval Foodplants Other Than Grasses. At the end of this paper will be found a Chart of Larval Foodplants arranged alphabetically by plant family and genus.

1. St. Augustine Grass

St. Augustine Grass, *Stenotaphrum secundatum* Kuntze, may be found in the yards of urbanites throughout the Gulf States. My own yard is no exception. Aside from providing the home-owner with a desireable lawn, this grass is an important larval foodplant for certain species of Lepidoptera. Listed here are ten species whose larvæ I have found will readily eat it. There must be many others.

Amblyscirtes celia Skinner
Amblyscirtes nysa Edwards
Atalopedes campestris Boisduval
Cisseps fulvicollis Hübner
Euptychia rubricata Edwards
Hylephila phyleus Drury
Lerema accius J. E. Smith
Lerodea eufala Edwards
Lerodea julia H. A. Freeman
Wallengrenia otho J. E. Smith

We shall now treat each of these species separately providing more detail. The larval foodplant referred to in each instance is *Stenotaphrum secundatum* unless otherwise named.

Amblyscirtes celia. On 29 April 1956 a female was observed ovipositing in nature; more than 20 additional eggs were deposited after capture. Another gravid female taken 6 September 1958 deposited about 15 eggs. In each instance immature stages were reared to maturity.

Amblyscirtes nysa. On 1 April 1956 a female was seen ovipositing in nature. The west side of my house where the early afternoon sun shown upon the grass was the spot chosen. More than 25 additional eggs were deposited in captivity. Another female taken 18 March 1957 deposited 7 eggs. Still a third female taken 9 June 1958 deposited only 3 eggs. Lastly, a female taken 2 April 1959 laid a quantity of eggs. Adults, *ex ovis,* were obtained in each instance.

Atalopedes campestris. On 5 June 1956 a female was observed ovipositing in nature; this specimen deposited more than 70 additional eggs after capture. On 4 August 1956 another female was seen ovipositing; it laid 23 more eggs in the breeding cage. On 11 August 1956 a third was seen depositing eggs, but this one first deposited a single egg on *Cynodon dactylon* Pers. then moving a few feet away deposited another egg on *Stenotaphrum secundatum.* During the following three summers, 1957, 1958 and 1959 this species was observed depositing eggs on both these grasses without any particular preference. Larvæ were reared to maturity in the first two instances cited.

Cisseps fulvicollis. Eggs were obtained from a female taken *in copula* 12 November 1958, Calcasieu Parish, Louisiana. Larvæ feed readily on *S. secundatum.* Two successive broods were reared through on the same foodplant. Although this little moth is found in my own backyard where it is attracted to fluorescent blacklight, previous attempts to rear it had not been made.

Euptychia rubricata. A gravid female deposited more than 50 eggs in the breeding cage on 7 May 1956. This species does not bond its eggs to the foodplant but simply drops them on the ground near it. Larvæ ate with equal zest both *Stenotaphrum secundatum* and *Cynodon dactylon.* Again on 11 May 1958 a female readily oviposited in captivity. This time the larvæ were fed only *S. secundatum.* Adults were obtained, *ex ovis,* in both instances.

Hylephila phyleus. On 26 June 1955 a female was seen ovipositing in nature; more than 15 additional eggs were laid in the breeding cage. Other females taken 7 July 1956 and 5 August 1956 deposited a quantity of eggs in captivity. Larvæ were reared to maturity in each instance.

Lerema accius. On 3 July 1955 a female was observed depositing eggs in nature; 10 additional eggs were deposited after capture. Other females taken 11 June 1956, 1 October 1956 and 18 August 1958 deposited eggs in captivity. In each instance adults, *ex ovis,* were obtained.

Lerodea eufala. Females have not been observed, in nature, to deposit eggs. On five occasions however, females have readily oviposited for me in captivity and in each instance the larvæ were reared to maturity. Eggs were obtained from different females on the following dates: 7 June 1956 more than 20; 29 June 1956, 18; 14 July 1956, 16; 26 May 1957 a pair taken *in copula,* female deposited a quantity of eggs; 27 September 1958, a few.

Lerodea julia. A female taken 28 September 1958 deposited 4 eggs on grass from the the spot of capture. On 30 September following, this same female deposited 5 more eggs on *S. secundatum.* Ten more eggs were deposited by it on 1 October 1958. Larvæ readily ate *S. secundatum* and matured in due course.

Wallengrenia otho. A female taken 24 May 1958 deposited 15 eggs on grass from the spot of capture in Comal County, Texas. Larvæ feed readily on *S. secudatum* and were reared to maturity. The case-bearing habit of this species is very interesting. I had placed conventional facial tissues in the container to facilitate cleaning. Much to my surprise these larvæ cut circular discs from the paper, folded them over to form cases which they carried until outgrown at which time a larger one was fashioned from the same material. Pupation took place within the paper case, and adults emerged in due course.

2. Larval Foodplants Other Than Grasses

Antigonus pulverulenta Felder. Four larvæ were found 6 May 1957 feeding on *Wissadula holosericea* (Sheele) Garcke. A pupa found 11 May 1957 emerged 15 May. Now I knew where to find this very interesting little skipper. From 19 to 31 May 1957 thirty-two eggs, 135 larvæ, and 27 pupæ were found on this foodplant. Also, 46 eggs were obtained from caged females. During the month of June 1957 three eggs and 157 larvæ were found; 102 eggs were obtained from caged females. Two larvæ were found 12 October 1957. During the month of April 1958 three eggs and 6 larvæ were found. In September 1958 one egg and one pupa were found. By this time I had the larval foodplant growing in my own yard and it has been a pleasure seeing this skipper around my flowers ever since.

The larva lives in a shelter fashioned from the leaf by cutting and folding it over. This is the first task of the newly hatched larva. As it grows the shelter is enlarged accordingly. Finally, the larva pupates inside the shelter. Sometimes pupation takes place between two leaves which have been pulled together and held there by strands of silk. Notwithstanding the care this larva takes in protecting itself, all too often it falls prey to parasitism. More about this and the immature stadiums in a separate article.

Brephidium exilis Boisduval. Although this species has been taken many times during the past four years it wasn't until 4 October 1959 that my wife and I found it swarming at a spot along an old road where it crossed a dry creek. It was late afternoon and skies were cloudy so we didn't remain very long. We noticed that the greatest activity was centered around a very obnoxious weed, the identity of which was not known at the time. Several courting males were observed. Thirty specimens were taken within about 15 minutes. On 10 October 1959 we returned to the spot. It was about noon. Adults were even more abundant than a week earlier. We decided to sit on the ground near the "weed" and carfully observe what was going on. At the point of becoming dizzy watching these little butterflies dance around and through this weed, *Chenopodium album* Linnæus, a female alighted, walked up and down a spike of buds a few times and then very rapidly laid an egg and was off again. I had no sooner announced my observations when my wife said she too had observed the same thing happen at the plant over which she maintained surveillance. Several other females were seen to oviposit, and a number of larvæ were found before we departed an hour later. The larvæ feed primarily on the buds and blossoms of this plant. Larvæ blend perfectly with the mealy buds. We soon discovered the easiest way to find them was to follow ants which were tending the larvæ for the honey-dew. Anyone not familiar with this larval foodplant will recognize it by the odor of stale urine as he walks through or brushes against the plant.

Celotes nessus Edwards. Four larvæ of this species were found on *Abutilion incanum* (Link) Sweet 24 September 1956 in Medina County, Texas. The first adult from these larvæ emerged 25 November 1956. All other records are Bexar County, Texas. On 14 March 1957 a gravid female was placed in a breeding cage containing *A. incanum* and *Malvaviscus drummondii* Torr. & Gray. Eggs were deposited on *A. incanum* only. Eggs were found on this foodplant in nature on 17-19 March 1957. Emergence of adults, *ex ovis,* follows: 16-20 May 1957 (20); 21-28 May 1957 (11); 1-10 June 1957 (9); and 18-21 June 1957 (2). Again on 12 October 1958 larvæ were found in nature. On 28 May 1959 two females were seen ovipositing in nature on this plant; both were taken and placed in breeding cages. Each deposited more than 15 eggs. Immature stages were reared to maturity.

Chlosyne lacinia adjutrix Scudder. My first experience with larvæ of this species was on 2 July 1955. It was found feeding on the Common Sunflower, *Helianthus annuus* L. It wasn't long before I was to learn that it would feed on plants other than *Helianthus*. A single larva was found 4 March 1956 feeding on *Verbesina virginica* L. in Comal County, Texas. It was reared to maturity. The 1957 collecting season brought swarms of this species to south-central Texas. It was 2 June 1957 that I found larvæ feeding on both *H. annuus* and *Ambrosia aptera* DC. in Medina County, Texas. Thousands of larvæ were to be found along the Medina River where the larval foodplants grow. Again on 21 July 1957 larvæ were found feeding on *A. aptera* in Kendall County, Texas. These Giant Ragweeds were growing in sandy loam along the banks of the Guadalupe River. At the foot of these plants were numerous ant-lion (Neuroptera) pits. Caterpillars were so plentiful that not infrequently one would be crowded off the plant only to disappear in one of the burrows where hungry ant-lions awaited. During the 1958 and 1959 collecting seasons adults were relatively scarce. A fairly large number of adults and larvæ were found 17 October 1959 in Atiscosa County, Texas. Here the larvæ were feeding on *Helianthus cucumerifolius* Torr. & Gray growing along the roadside and in uncultivated fields.

Colias (*Zerene*) *cesonia* Stoll. A female was observed ovipositing on *Parosela pogonathera* (A. Gray) Vail. 28 September 1958. For two years I had searched in vain for the local foodplant of this species and now that search was ended. Only one egg was deposited after capture. Another female was observed ovipositing on this plant in Medina County, Texas, 23 February 1959. Two more females were seen ovipositing on this plant 8 March 1959, and a third ovipositing on *Parosela frutescens* (A. Gray) Vail. the same day. Two of these females were taken and on 13 March 1959 obliged by depositing a quantity of eggs. Adults were obtained, *ex ovis,* but not before Microgasters had taken a heavy toll. I made the mistake of leaving the larvæ unprotected for a few days. On 2 May 1959 two larvæ were found in nature;

both proved to be parasitized by Microgasters. This undoubtedly accounts for the relative scarcity of this species in Bexar and surrounding counties. Larvæ were successfully reared to maturity on each of the foodplants named.

Copæodes minima Edwards. A female taken 20 June 1956 deposited a number of eggs on *Cynodon dactylon* Pers. Nine adults emerged, *ex ovis,* between 5-11 August 1956. On 10 March 1957 and 2 September 1958 females were observed ovipositing on *C. dactylon* in nature.

Erynnis funeralis Scudder & Burgess. On 28 March 1959 a female was observed ovipositing in nature on *Vicia texana* (Torr. & Gray) Small. A careful examination of other like plants in a 100-yard area along a road disclosed many eggs. *Medicago hispida* Gaertn. growing with the *V. texana* revealed no eggs. Another female taken 29 March 1959 readily deposited eggs in the breeding cage. On 23 May 1959 two larvæ were found on *Indigofera leptosepala* Nutt. We also found eggs and larvæ on this plant in Kerr County, Texas, 25 May 1959. Larvæ were reared to maturity in each instance.

Hemiargus isola Reakirt. On 23 May 1959 larvæ were found on *Indigofera leptosepala* Nutt. I observed a female ovipositing on the buds of this plant in Kerr County, Texas 25 May 1959. Careful examination of other plants revealed a number of larvæ feeding on the buds and blossoms of this plant. Additional eggs and larvæ were found at this same spot on 3 and 18 July 1959. Eggs were also found on this plant in Kendall County, Texas 19 July 1959. It is interesting to note that the larvæ tend toward canabalism. Adults were obtained from these immature stages.

Lephelisca nemesis Edwards. On 11 August 1956 Mrs. Robert S. Blair Jr. brought me some larvæ which she had found feeding on *Clematis henryi* Rehd. After rearing them through it was a pleasure to find they were *L. nemisis.* A female was placed in a container with *Clematis drummondii* Torr. & Gray on 1 October 1956; more than 50 eggs were deposited. Larvæ readily ate the plant and matured in due course. Adults emerged as follows: 29 between 10-20 November 1956 and 14 between 21-29 November 1956. Again on 8 July 1957 a female deposited 30 eggs on this foodplant. A third female deposited 51 eggs 10 August 1957. In each instance adults were obtained, *ex ovis. C. drummondii* is a native plant found growing on every fence row in this area. It is here the collector should look to find adults and immature stages alike.

Leptotes cassius striatus Edwards. On 2 August 1958 a female was seen flying back and forth over cultivated bean vines, *Phaseolus vulgaris* L. which had been planted to attract *Urbanus proteus L.* females. Its movement and course of flight was a touch-and-go action. After observing this flight pattern for about one minute, I netted the specimen. About four inches of the end of a runner containing blossom buds was held inside the lower end of the net with the captured female. Within a few seconds she very carefully placed an egg between the buds in such manner that it was not perceptible to the naked eye. Two eggs were deposited while confined in this manner. A careful search of the bean vines revealed not only other eggs but small larvæ feeding on the buds and blossoms. The first adult emerged, *ex larva,* 21 August 1958.

Texola elada Hewitson. On 12 July 1959 a female was caged with a sprig of *Siphonoglossa pilosella* (Ness.) Torr. This plant grows in abundance in the area where more than 300 specimens were taken in 1957. This species has been found in the same area on repeated visits since that time. This female deposited six eggs on the twig provided two days after capture. Another female deposited two clusters of eggs on this plant on 26 July 1959. Larvæ fed on this plant without hesitation and matured in due course.

Melitæa theona bolli Edwards. This species has been seen flying in very limited numbers during May, June and July for the past three seasons. It wasn't until this season the larval foodplant was known. On 30 May 1959 WILLIAM A. PLUEMER gave me a number of larvæ which he had found feeding on *Leucophyllum texanum* Benth. The following day four pupæ were formed, and on 8 June 1959 a pair were found *in copula, ex larvis.* Although 75 eggs were deposited, only one egg hatched and this larva died. Embyos failed to develop completely in the other eggs.

Nathalis iole Boisduval. On 30 March 1958 a female was observed depositing eggs on *Thelesperma trifidum* (Poir.) Britton. On 15 March 1959 a female deposited eggs on this plant in captivity. Adults were obtained from eggs in each instance.

Phyciodes texana Edwards. On 24 May 1956 Mrs. ROBERT S. BLAIR, JR. brought me a few larvæ which had been feeding on one of her cultivated flowers, the name of which she could not remember. It wasn't until long after the larvæ had perished that the plant was determined to be *Jacobinia carnea* Nichols. On 9 June 1956 she gave me two pupæ, the larvæ of which had been transformed to *Beloperone guttata* Brandegee; one of them emerged this same day. On 9 August 1959 four females were taken in Comal County, Texas. They were confined in glass jars with *Siphonoglossa pilosella* (Ness) Tor. and *Beloperone guttata.* The following day four clusters of eggs were deposited one of which was on *B. guttata.* Additional eggs were deposited on each of the following four days. Larvæ were fed *S. pilosella, B. guttata, Ruellia occidentalis* A. Gray, and *Ruellia drummondiana* (Ness.) A. Gray which they readily ate without showing preference for any one plant. Eggs from these females were preserved, together with 165 pupæ and an equal number of larvæ, and 479 adults were papered.

Phyciodes vesta Edwards. 25 October 1958 was the day this species was first observed ovipositing on *Siphonoglossa pilosella.* On 21 March 1959 a caeged female deposited a quantity of eggs on this same plant. Eggs are laid side by side in clusters. Again, another female deposited 61 eggs in captivity on 27 March 1959. Three females were observed ovipositing in nature on this plant in Kerr County, Texas, on 18 July 1959. A good number of eggs were found on other like plants in this county. A swarm of adults were seen in Comal County, Texas, on 9 August 1959. They were feeding on the blossoms of and courting over a large patch of this plant. One female taken at the spot deposited a quantity of eggs. Adults were obtained, *ex ovis,* in each instance cited.

CHART OF LARVAL FOODPLANTS

Plant Family	Plant Species	Lepidoptera
Acanthaceæ	*Beloperone guttata*	*Phyciodes texana*
	Jacobinia carnea	*Phyciodes texana*
	Ruellia drummondiana, occidentalis	*Phyciodes texana*
	Siphonoglossa pilosella	*Phyciodes texana*
		Phyciodes vesta
		Texola elada
Asteraceæ	*Helianthus annuus, cucumerifolius*	*Chlosyne l. adjutrix*
	Thelesperma trifidum	*Nathalis iole*
	Verbesina virginica	*Chlosyne l. adjutrix*
Ambrosiaceæ	*Ambrosia aptera*	*Chlosyne l. adjutrix*
Chenopodiaceæ	*Chenopodium album*	*Brephidium exilis*
Gramineæ	*Cynodon dactylon*	*Euptychia rubricata*
		Copæodes minima
	Stenotaphrum secundatum	*Amblyscirtes celia*
		Amblyscirtes nysa
		Atalopedes campestris
		Euptychia rubricata
		Hylephila phyleus
		Lerema accius
		Lerodea eufala
		Lerodea julia
		Wallengrenia otho
		Cisseps fulvicollis
Leguminosæ	*Dolicholus texensis*	*Thorybes pylades*
	Indigofera leptosepala	*Hemiargus isola*
		Erynnis funeralis
	Parosela pogonathera, frutescens	*Colias (Zerene) cesonia*
	Phaseolus vulgaris	*Leptotes c. striatus*
	Vicia texana	*Erynnis funeralis*
Malvaceæ	*Abutilon incanum*	*Celotes nessus*
	Wissadula holosericea	*Antigonus pulverulenta*
Ranunculaceæ	*Clematis henryi, drummondii*	*Lephelisca nemesis*
Scrophulariaceæ	*Antirrhinum antirrhiniflorum*	*Precis lavinia cœnia*
	Leucophyllum texanum	*Melitæa theona bolli*
Zygophyllaceæ	*Porliera angustifolia*	*Kricogonia lyside*

Precis lavinia cœnia Cramer. Five larvæ were found 31 May 1957 feeding on *Antirrhinum antirrhiniflorum* (Poir.) Small. This is the climbing snapdragon that beautifies fence rows and bushes throughout this area. On 7 July 1957 five more larvæ were found on this plant. In each instance adults were obtained, *ex larvis.*

Kricogonia lyside Latreille. While on a field collecting trip with E. M. KINCH of Fort Worth, Texas, 31 March 1957, we stopped at a spot in Atascosa County, Texas, along U. S. Highway 281. Several females were seen ovipositing on *Porliera angustifolia* (Engelm) A. Gray. These egg-laying females had chosen plants well inside fenced property clearly marked "Posted Keep Out". Never having made a practice of climbing or crawling through fences I simply observed what was going on and waited somewhat impatiently until one came within reach of my net. A single egg was recovered. It hatched and was lost before we returned home a week later. At this same spot a larva was found wandering across the road. It pupated the following day and on 7 April 1957 a male *K. lyside* emerged. Up to the date of this writing it hasn't been convenient for me to return to this spot, but I hope to do so during the 1960 collecting season.

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References

Bailey, L. H., 1924. *A Manual of Cultivated Plants.* Macmillan Co., New York.

............, 1939. *The Standard Cyclopedia of Horticulture.* Macmillan Co., New York.

Schulz, Ellen D., 1928. *Texas Wild Flowers.* Laidlaw Brothers, Chicago.

Small, J. K., 1913. *Flora of Southeastern United States.* Published by the Author.

Klots, Alexander B., 1951. *A Field Guide to the Butterflies.* Houghton Mifflin Co., Boston.

Whitehouse, Eula, 1948. *Texas Flowers in Natural Color.* Published by the Author, Dallas 5, Texas.

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ESPECIALLY FOR FIELD COLLECTORS

(Under the supervision of FRED T. THORNE, 1360 Merritt Dr., El Cajon, Calif., U.S.A.)

LEPIDOPTERA COLLECTING IN THE SIERRA SAN PEDRO MARTIR, BAJA CALIFORNIA

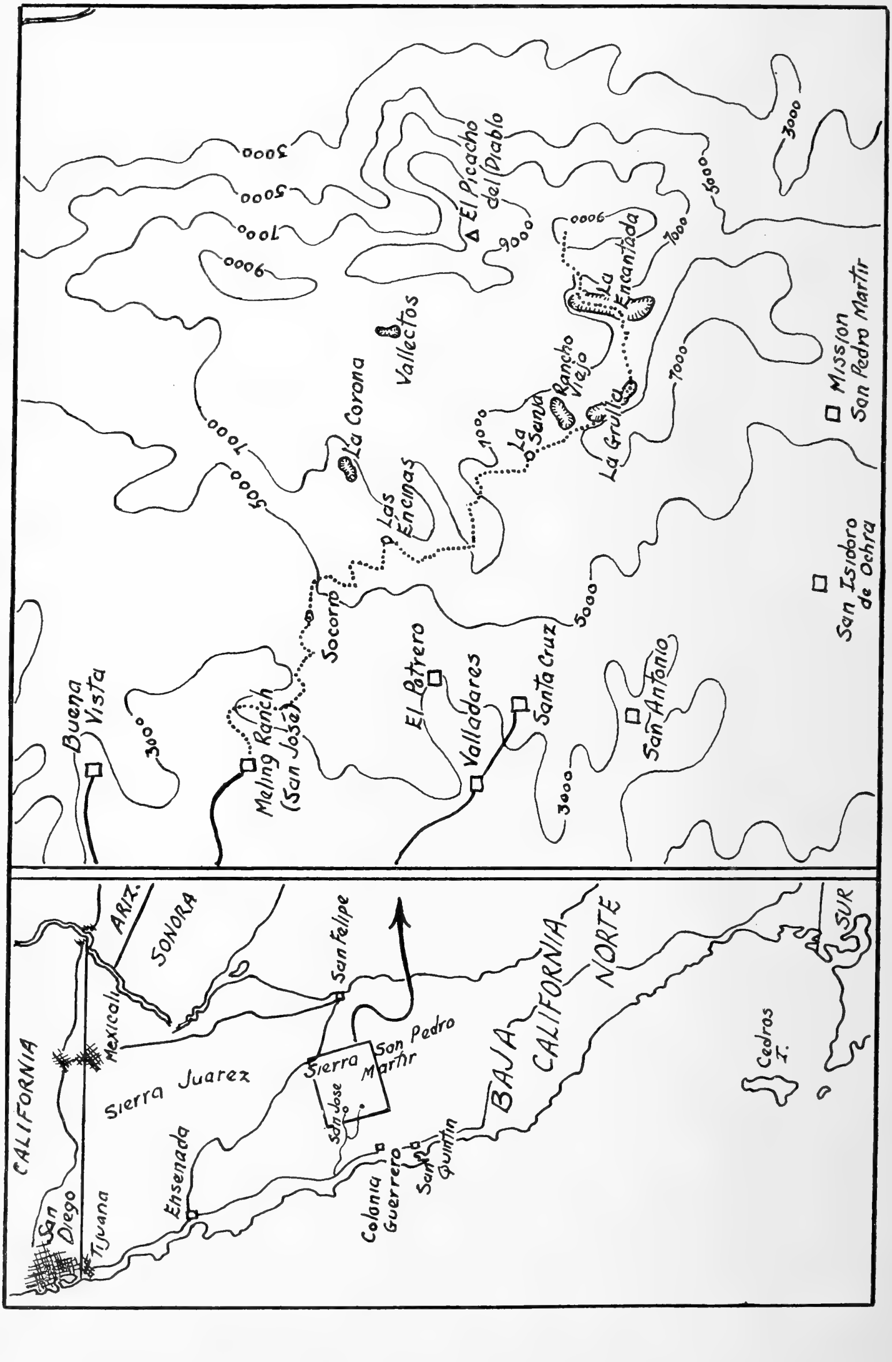
by DONALD PATTERSON and JERRY A. POWELL

The Sierra San Pedro Martir is Baja California's highest mountain range and, together with the Sierra Juarez to the north, forms a 175 mile long direct continuation of the coast range in southern California. The San Pedro Martir, which stands isolated in the form of a high plateau, is separated from the lower Sierra Juarez by San Matias Pass about 100 miles below the international border. These ranges in general fall off in abrupt granite escarpments to the east and descend more gradually in a series of foothills toward the west, thus splitting the semi-desert of the northern part of the peninsula longitudinally.

The high tableland of the San Pedro Martir has a width of 25 to 30 miles, averages about 7000′ to 8000′, and is said to support a half million acres of coniferous forests. The highest peaks of the range reach elevations above 9000′ and 10,000′ and form an east rim to the plateau. With its extensive meadows, deep canyons, permanent streams, canadian zone floral elements, and jutting rocky peaks, the range forms a boreal "island" which is separated by some 175 miles from the nearest comparable mountain areas to the north. An excellent first hand account of the physiography and dominant features of the biota in the area has been given by NELSON (1921).

An aura of remoteness has surrounded the San Pedro Martir from the time of Indian legends, through the missionary period and on into the present century. Mining ventures in the foothills have failed, lumbering has been discouraged by the government and farming is not economical, so that even now, a few hunters and a few *vaqueros* with their cattle are about all who find it profitable to go into this area of no roads, no detailed maps and no permanent inhabitants. Occasional adventurous naturalists have visited the mountains over the past 80 years, and considerable knowledge has accumulated on the plants and the vertebrates of the region, but apparently no lepidopterists had previously found prospects of the trip worth their while.

The two of us, together with BILL PATTERSON, while doing a certain amount of collecting in the lowland areas of Baja California Norte, had become increasingly curious over the past few years as to the composition of the butterfly fauna in the remote uplands of the Martir. There were virtually no butterfly records available from these mountains (Powell, 1958). After contacting various sources, we decided that late May might offer the best cross section of the spring season for a collecting trip. Snowmelt occurs in April


Buena Vista
3000
Meling Ranch (San José)
Socorro
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7000
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El Potrero
Valladares
Santa Cruz
San Antonio
La Corona
Las Encinas
Vallectos
El Picacho del Diablo
La Senja
Rancho Viejo
La Grulla
La Encantada
San Isidoro de Ochra
Mission San Pedro Martir
CALIFORNIA
San Diego
Tijuana
Mexicali
ARIZ.
SONORA
Sierra Juarez
Ensenada
San Felipe
Sierra San Pedro Martir
San Jose
Colonia Guerrero
San Quintin
BAJA CALIFORNIA NORTE
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and the summer rains characteristic of the highlands begin about the first of July. We were indeed fortunate in the selection of this time of year in 1958, which had been an especially wet winter, for we found water everywhere and many plants in bloom at all elevations. We have heard that during many years the area is very dry by the first of June.

The most practical avenue of ascent into the mountains seems to be via the Meling Ranch at San José on the Rio San Telmo, some 30 miles inland from the coastal highway. There the MELING family operates a cattle ranch and a small lodge, and there pack animals can be obtained. So it was that on May 25 we found ourselves overlooking the ranch buildings of San Jose nestling among the cottonwoods in San Telmo Valley, a welcome sight after a dusty day of driving from San Diego capped by a final 30 miles of typically poor Baja California back roads.

We elected to make the trip on foot, with two mules carrying our gear so as to reduce the logistics of packing and handling of animals to a minimum and make collecting possible all along the trail. In addition we decided against taking a guide, and we subsequently found, with the aid of a detailed briefing by the MELINGS, little trouble in following the well-marked cattle trails over the whole of our 90 mile journey.

The lower foothills are traversed by a deteriorating wagon road which had been constructed by a lumbering concern, and it was by means of this road that we hoped to reach Las Encinas and the first permanent stream by the end of the first day. Although the lower slopes were a profusion of blooms (especially *Spæralcea, Diplacus, Encelia,* and *Eriogonum*) due to the exceptional rains, the area was very hot and dry, and we found that the climb from the ranch at 1700′ to Las Encinas at 6000′ was more than we should have attempted considering the amount of collecting we were anxious to do. Sundown found us at 5000′ in the first piñon pines at a small seepage just under the edge of the plateau, some fourteen miles from the ranch. During the first day one man led the mules and two collected; subsequent to that it was necessary to lead each animal separately due to the steep and narrow trails.

As was expected, the Lepidoptera of the foothills were those typical of the dry lowlands of southern California. One interesting catch was that of a single male *Pyrgus scriptura* (Bdv.), an uncommon species in southern California, taken shortly after leaving the ranch. One specimen of *Schinia scarletina* (Sm.) was also taken in this vicinity. Although most of the flowers in bloom at the time were not found to be good collecting for butterflies, *Eriogonum fasciculatum* was frequented by *Philotes battoides bernardino* (Bdv.) and a few individuals of *Incisalia iroides* (Bdv.) and other species. *P. battoides*

EXPLANATION OF MAP

Sketch map of Baja California Norte showing location of the Sierra San Pedro Martir, and inset showing detail of the area discussed in the text. Dotted line indicates route followed on the trip. Scale of inset: one and one-half inches equal to ten miles. Inset adapted primarily from Heald (1957).

bernardino was also encountered in large numbers on a small area of damp earth in an otherwise dry wash at about 3500′. A few other species taken in the chamise-sumac chaparral slopes below 4000′ were *Colias harfordi* Hy. Edw., *Nathalis iole* Bdv., *Leptotes marinus* (Reak.), *Hemiargus gyas gyas* (Edw.), *Erynnis lucilius afranius* (Lint.), and *Stenaspilates apapinaria* Dyar.

One of the better moth collecting nights was encountered the first night, and our coleman lantern attracted several geometrids, *Chlorochlamys hesperia* Sperry, *Nasusina inferior* Hulst, *Platæa ursaria* C. & S., *Neoterpes edwardsata* Pack., and *Drepanulatrix hulsti hulsti* Dyar. In addition a number of micros were taken, including *Argyrotænia niscana* (Kft.), *Phalonia* sp., *Ethmia arctostaphylella* (Wlshm.), *Aroga paulella* (Busck), and *Pleurota albastrigulella* (Kft.).

The following day, May 27, dawned clear and warm; we were extremely fortunate in having near perfect weather for the entire trip. After a short ascent we attained the first ridge of the high country and dropped a short distance to the welcome sight of the cool, clear stream which flows through Las Encinas, a small lush meadow among the oaks which give the camp its name. Many of our common California butterflies frequented this creek. *Papilio rutulus* Lucas, *P. eurymedon* Luc. and *Limenitis lorquini lorquini* Bdv. flew among the willows, and collecting along the stream produced a number of other species we had not seen the previous day such as *Anthocharis sara sara* Bdv., *Zerene eurydice* Bdv., *Hemiargus isola* (Reak.) and *Thorybes pylades* (Scud.). Downstream lupine was in bloom in abundance and a dense population of *Plebius icarioides* (?*evius* Bdv.) was flying, along with occasional examples of *Everes amyntula* (Bdv.) and worn *Glaucopsyche lygdamus australis* Grin. Here we entered the Ponderosa Pine forests, which we were seldom to leave during the remainder of our ten day stay in the high country. The trail followed the creek downstream for about three miles into a steep walled canyon of heavy vegetation before leaving this watershed to climb abruptly back onto the plateau. This canyon looked very interesting and on the return trip proved to be so, as *Staphylos ceos* (Edw.) and *Epargyreus clarus ?huachuca* Dixon were taken there, indicating Arizonan elements in the fauna. However, on the trip in we hurried past, anxious to reach the large meadows to the east.

We reached La Grulla at 6500′ during the third day and found ourselves looking onto the lower end of a beautiful meadow which stretches amongst the conifer forest for some three miles in a sinuate expanse of lush green grass, following up the water course to the east. Each summer the local people bring cattle here from the distant lowlands, but heavy rainfall of the current year delayed their invasion, and they had not arrived. Two days were spent collecting in and around La Grulla, the area proving to be our most profitable stop for non-lepidopterous insects. The butterfly collecting there was disappointing, the abundant *Polites sabuleti tecumseh* Grin., and *Heliopetes ericetorum* Bdv. being the only species not previously encountered. Some interesting micros were taken, however, including a pale *Gyros* which is seemingly distinct from the Sierra Nevadan *G. muiri* Hy. Edw. The elusive flight of this inconspicuous pyralid was confined to the glaring, white decomposed granite slopes bordering the meadow, but a little effort produced a nice series. Dr. E. MUNROE informs us (*in litt.*) that the series represents an undescribed species. MUNROE (1959) is reporting on the Pyraustinæ collected on the trip. Moth collecting in the meadow yielded only some very widespread species, and the night collecting had begun to slacken, for, although we were very fortunate with the season and the weather, full moon occurred on May 31 and was already serving to disperse the moth flight considerably. However a few species were taken including *Eupithecia appendiculata* McD., *Elpiste metanemaria* Hulst, *Lithostege angelicata* Dyar, *Pherne subpunctata* Hulst, *Heterographis morrisonella* Rag., *Sparganothis* sp., and a *Martyrhilda* species near *thoracefasciella* (Chamb.).

On May 30 we set up our last camp before beginning the long journey back, at the largest of the high meadows, La Encantada, which lies at 7000′ just at the base of the rugged east rim peaks. Although higher, La Encantada proved to be drier, and with a few notable exceptions we did not take Lepidoptera there not previously seen. A single worn specimen of *Mitoura spinetorum* (Hew.) was taken on the trail leading into the area. *Polites mystic sonora* (Scud.), which had been encountered in a small swale at about 6000′ on the second day, was found here again. Thus here was another indication of "stepping-stone" distribution from the Sierra Nevadas to the high mountains of southern California to the high country in the Sierra San Pedro Martir. One other interesting species at La Encantada and again the subsequent day on the higher slopes at about 8000′ was a seemingly distinct population of the *Apodemia mormo* complex. Light collecting at this camp was virtually non-existant, with evening temperatures in the low forties and an early morning minimum of about 37° F. However, incidental day collections of moths in the area included *Spælotis havilæ* (Grt.) taken under dead bark, a single specimen of *Cosymbia serrulata* Pack., and three pyraustines, *Nomophila noctuella* D. & S., *Pyrausta futilalis inconcinnalis* Led., and *Mecyna mustelinalis* (Pack.).

The following day, leaving the mules behind, we made the final few miles ascent to the east rim. The coniferous forests of these higher areas are for the most part heavier and take on a more varied aspect, as lodgepole pine becomes a dominant element, along with many examples of the endemic Martir Cypress, *Cupressus montana* Wig. On the rocky slopes between the trees manzanita and ceanothus, the latter in bloom at the time, grow in dense thickets. Although most of the butterflies here were typical lowland species and those which we had been taking each day, several moths not previously seen were encountered. A single specimen of *Pyrausta tatalis* Grt. and a striking aegeriid clearwing moth were netted in small open meadows, and several *Phobus funerellus* Dyar (Phycitinæ) were startled up from around a fallen burned pine. Single males of *Erynnis callidus callidus* (Grin.) and *E. lacustra* (Wgt.) were taken, flying together with numerous *E. lucilius afranius* (Lint.) and *Thorybes pylades* (Scud.), and, interestingly, on a peak well above 9000′ several specimens representing a population of *Hesperia pahaska* nearest to *williamsi* Lindsey whose affinities lie with the fauna of southeastern Arizona rather than to the north.

On this peak we stopped for lunch and contemplated a scene that is not often seen in North America, an area in which there has been almost no change in the natural conditions due to the effects of man. Below us to the west stretched the broad tableland of the Martir, the area we had traversed during the past four days, an area of no human inhabitants, no roads, no power lines marring the horizon, and no tin cans or rubbish lining the trails.

We were impressed by the fact that the elevational sequence we had crossed had shown little effect in general on the species of butterflies around us. *Colias eurytheme* Bdv., a resident of the coast, had been seen all along the way and was taken at the peak; *C. harfordi* Hy. Edw., first encountered below 3000′ on the first day, had been taken at every stop along the way; *Nathalis iole* Bdv. was everywhere and remained one of the commonest species flying at 9000′. *Precis lavinia cœnia* (Hbn.) seemed almost to replace its nymphalid relatives, flying in every habitat which we visited on the trip. Among the Lycænidæ, *Incisalia iroides* (Bdv.), *Leptotes marinus* (Reak.), *Hemiargus gyas gyas* (Edw.), and *Plebeius acmon acmon* (West. & Hew.) seemed not to be affected by the altitudinal differential. *Erynnis lucilius afranius* (Lint.) was first taken on the dry hills at about 3000′, subsequently was seen in almost every area, and was, perhaps, the most abundant butterfly on the slopes above 8500′. Apparently the southern latitude of the Sierra San Pedro Martir serves greatly to reduce the elevational zoning of the biota.

Just before leaving the high peaks to return to our camp at La Encantada, a specimen of *Mitoura loki* (Skin.) was taken on a composite flower. It is difficult to explain its occurrence there at 9000′, since no juniper, the foodplant, was seen in the area. Possibly the specimen had flown up from the juniper belt of the desert slopes to the east.

On the return trip out of the mountains we retraced our steps, stopping to collect at the more promising spots. Our best moth collecting nights were these last three, the first at La Sanja, a stream several miles west of La Grulla, and the final two at Las Encinas again on the western edge of the plateau. At La Sanja (6500′) larvæ were collected on manzanita which subsequently proved to be *Epinotia subplicana* (Wlshm.), a tortricid previously recorded from the foothill areas of coastal central California and thence northward. Some of the more interesting of 30 species taken at light June 2 and 3 at Las Encinas were, *Dasyspoudea lucens* Morr., a noctuid apparently known only as far west as the mountains of southern Arizona, *Aseptis perfumosa* Hamp., *Synedoida scrupulosa* Hy. Edw., *Merochlora graefiaria* Hulst, *Nemoria punctularia* B. & McD., *Protitame pallicolor* Dyar, *Hydriomena nevadæ* B. & McD., *Pero occidentalis canaster* Rindge, *Choristostigma zephyralis* (B. & McD.), three species of pterophorids, and one widespread tortricid, *Endothenia hebesana* (Wlshm.).

As we passed through the foothills on the last day, we were impressed by the extreme dryness of the vegetation which had been in full bloom ten days before. The flowering season is very short and possibly the flight season here for many insects is correspondingly short. Although we considered ourselves fortunate with the number of species of Lepidoptera taken (some 52 butterflies and about 80 moths), four of the butterflies (*Melitæa gabbi* Behr, *Strymon sæpium* (Bdv.), *Lycæna gorgon* (Bdv.), and *Erynnis zarucco funeralis* (Scud. & Burg.)) were taken only on the last day, on the trail below 4000′, and together with the dryness, served to emphasize that our collection was but a small sample from the overall seasonal sequence.

One trip to a relatively unknown place serves only to scratch the surface of the knowledge of the faunal complex of the region, and there is very much yet to be learned about the insects of the Sierra San Pedro Martir. Apparently the butterfly fauna consists primarily of southern California lowland species and to a lesser degree of elements from the high mountains of both California and southern Arizona. Only one season has been sampled; there certainly must be a flight following the summer rains. We hope that the present account may serve to stimulate further collecting in this area.

We wish to acknowledge with thanks the assistance of the following in determining many of the species mentioned above: William R. Bauer, Petaluma, California (Noctuidæ); John M. Burns, University of California, Berkeley (*Erynnis*); C. Don MacNeill, California Academy of Sciences, San Francisco (Hesperiidæ); Dr. Eugene Munroe, Entomology Research Institute, Ottawa, Canada (Pyraustinæ); and Dr. Fred H. Rindge, American Museum of Natural History, New York (Geometridæ). The nomenclature systems followed are essentially those of McDunnough (1938, 1939) and Evans (1953, 1955) emended by the above specialists.

The trip which is the basis for the present report was in part supported by the Associates in Tropical Biogeography, University of California, Berkeley.

Literature Cited

Evans, W. H., 1953. *A catalogue of the American Hesperiidæ in the British Museum (Natural History) Part III. Pyrginæ section 2.* London: British Museum. 246 pp.

----------, 1955. *A catalogue of the American Hesperiidæ in the British Museum (Natural History) Part IV. Hesperiinæ and Megathyminæ.* London: British Museum. 499 pp.

Heald, W. F., 1957. Sierra San Pedro Martir — to Baja California's rooftop. *Pacific Discovery* 10(5): 4-10.

McDunnough, J., 1938. Check list of the Lepidoptera of Canada and the United States of America. Part I. Macrolepidoptera. *Mem. So. Calif. Acad. Sci.* 1: 1-275.

----------, 1939. Check list of the Lepidoptera of Canada and the United States of America. Part II. Microlepidoptera. *Mem. So. Calif Acad. Sci.* 2(1): 1-171.

Munroe, E., 1959. Pyralidæ collected in Lower California by Mr. J. Powell. *Can. Ent.* 91: 725-727.

Nelson, E. W., 1921. Lower California and its natural resources. *Mem. Nat. Acad. Sci.* 16: 1-194.

Powell, J. A., 1958. Additions to the knowledge of the butterfly fauna of Baja California Norte. *Lepid. News* 12: 26-32.

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EXTREME ABUNDANCE OF *ARACHNIS ZUNI* (ARCTIIDÆ) LARVÆ NEAR ALBUQUERQUE, NEW MEXICO

by Noel McFarland

Arachnis zuni (Neum.) is usually considered to be a scarce "Tiger-moth", but many thousands (conservative estimate) of the larvæ were seen in various areas to the south and east of Albuquerque, N. M., in September, 1957. In some spots, they were so abundant as to be easily seen from a car going 50-60 m.p.h.. Most were at an altitude of 6000′-7000′ where Piñon Pine, Juniper, Yellow Pine, and Gambel Oak occur together. They were especially abundant on Pigweed, which was growing under the Junipers and other trees. They were also observed feeding on various weeds along the sides of the roads and upon various native shrubs. Some were seen feeding in Chinese Elms. They were crossing the roads in considerable numbers, although most remained on plants. This was mid-September. By early October, they began climbing up into trees and shrubs where they would sit, exposed on branches and on the trunks. At this time, many hundreds were observed in the ends of large drains, which went under the highway.

Approximately 200 larvæ were taken in mid-September. They were in the last instar, nearly full-sized. They consumed quantities of Sweet Clover (*Melilotus alba* Desr.), Pigweed, and other available plants. In October most had finished feeding and settled down in fixed positions, within the box. No cocoon was made. When cold weather arrived, they remained exactly the same. They were housed in an open garage all winter, near the area where they were captured. All winter they remained motionless. In late April, after several weeks of warm weather, they began spinning sticky, web-like cocoons. The "web" was filled with tiny droplets of a clear, viscous substance. A more perfect cocoon of this material was spun within a larger, outer cocoon. Larval hairs were not used in construction of the cocoon. About a week after spinning, pupation occurred. About three weeks later, most emergences occurred. The greatest number emerged between May 26th and May 30th.

Considering the extreme abundance of the larvæ, parasitism was surprisingly low. Of 191 larvæ, 48 were parasitized by a Tachinid fly and a few by a large Ichneumon wasp. Parasitism was about 25%. Most of the fly maggots came out of the larvæ just before pupation in April, and made their own puparia within the cocoon of the larva. The Ichneumon wasps killed their host before winter and made their cocoon within the larval skin.

A number of the pupæ (about 10) still had not emerged by June 9th. These pupæ looked healthy, but all eventually died without hatching. They may possibly represent what would have been a small, second emergence. I suspected this possibility when collecting the larvæ, because there were quite a few larvæ only half-grown, while the great majority were much larger. These smaller larvæ may have been from eggs laid by moths emerging in July or August, instead of late May.

Without exception, all pupæ emerged between 3:30 and 7:00 p.m., the greatest number between 5:00 and 6:00 p.m. All the pupæ were removed from their cocoons and taped individually to the roughened sides of a cardboard box. Some of the early ones, which were left in their cocoons, damaged themselves in pushing through the very sticky cocoons. All the taped ones emerged in perfect condition.

I now have a fine series of this strikingly beautiful moth. There is considerable variation.

In raising these larvæ, I noted great similarity to *Arachnis picta* (Pack.) larvæ, in general form and pattern of development. *A. p. picta* and *A. picta hampsoni* (Dyar) also make the very same kind of cocoon, and they also have a long dormant period before spinning the cocoon or pupating. In the case of *Arachnis p. picta* in southern California, its period of growth is just the reverse of *A. zuni,* but follows the same pattern. The moths fly in October. The eggs hatch soon after and the young larvæ grow slowly all winter, feeding on annual plants that have started to grow with the early winter rains. In late May and June, *A. picta* larvæ are full-grown. They then spend all summer (which is very hot and dry) in a dormant condition. In September they begin spinning their cocoons, emerging shortly-thereafter (October).

The *A. zuni* larvæ were typical of the other members of this genus. The skin was black; the stiff hairs were glistening black. There was no other color but for the spiracles, which were bright red. In *A. p. picta* the hair is more of a dark brown, the prolegs magenta. In *A. picta hampsoni* the hair is a rich, red brown, or rusty golden brown.

Here are details on areas where the larvæ were extremely abundant:

1) from about 4.6 mi. E. of Tijeras, Bernalillo Co., N. M., to about 7.6 mo. E. of Tijeras, on Hwy. 66 (quite apparent from a moving car).

2) from Tijeras, N. M., south on Hwy. 12 for 4 to 5 miles; the whole strip — both sides of the road.

3) Along the "Torreon Canyon Loop Rd.", west out of Torreon, Torrance Co., N. M. (Manzano Mts.).

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MINUTES OF THE SIXTH ANNUAL MEETING OF THE PACIFIC SLOPE SECTION OF THE LEPIDOPTERISTS' SOCIETY, 29 and 30 AUGUST, 1959

The meeting was opened at the Santa Barbara Museum of Natural History on the morning of August 9 by Program Chairman ROBERT L. LANGSTON and OSCAR E. SETTE was chosen Secretary *pro tempore.*

The Director of the Museum, Dr. V. L. VANDERHOOF, gave a cordial and informal address of welcome, pointing out that extending hospitality for group meetings, such as this, was part of the Museum's policy of serving the community and advancing interest in the natural sciences. He was happy to put the Museum's facilities at the Society's disposal for this meeting and extended a standing invitation for future meetings. DR. J. W. TILDEN responded by expressing the membership's appreciation of this hospitality on this occasion as well as the three previous times of meeting at this Museum.

DR. EUGENE G. MUNROE wired "Congratulations and best wishes for a successful meeting of the Pacific Slope branch." His presidential address entitled "Pyraloid fauna of the western United States" was read by Dr. PAUL R. EHRLICH. It is being published elsewhere in this *Journal.*

Topic I — "Non-variable Species" — was opened by ROBERT L. LANGSTON who pointed out, and illustrated with specimens, that certain species are very constant in size, color, pattern and other characters throughout very wide ranges of latitude, longitude, elevation and distance. This is in contrast to species that exhibit variation associated with latitude, elevation, season and moisture, spearately or in combination; and this is in contrast also to species displaying semi-discontinuous geographical variation, presumably of genetical origin as distant from environmental influences, and recognized by taxonomists as subspeciation. Examples were shown of non-variable and variable species from the same gamut of environments for each of the famililes: Danaidæ, Nymphalidæ, Lycænidæ, Pieridæ, Sphingidæ, and Geometridæ. There arise interesting questions concerning the evolution and "success" of the common non-variable species, some of which have become economic pests.

Under the title, "Variation in *Plebeius acmon* and *Nymphalis antiopa*", PAUL OPLER suggested that the non-variability of *Nymphalis antiopa* could be attributed to the wide ranges of its several food plants, which, coupled with strong flying ability, would lead to free flow of gene variation throughout the gene pool and result in homogeneity over the range of the species. By means of colored slides he illustrated the colors and patterns distinguishing the members of the *Plebeius acmon* complex, including such taxons as *cottlei, monticola, chlorina,* and *lupini.* Having found most of these occuring sympatrically with the widespread "ordinary" *acmon,* he opined that two species might be postulated; one, a non-variable species consisting of ordinary *acmon,* the other, a variaable species consisting of the aggregate of the other named entities, which, according to his experience, seem either to be allopatric, or separated by food plant differences, or a combination of these. Time being available, Mr. OPLER showed and discussed colored slides of a number of members of the *Apodemia mormo* complex.

Under the title, "The distribution of *Lycæna hermes*", FRED THORNE, from the composite records of his many years' collecting graphically showed the rise and fall of numbers caught during this species' flight season, and with colored slides showed the uniformity of this insect despite its occurance in isolated colonies confined to the immediate vicinity of its host, the Red-berry (*Rhamnus crocea*). This low shrub, requiring a certain combination of soil-type, drainage and slope exposure, occurs in small colonies often separated by tens or scores of miles. Peculiarly, although the Red-berry ranges hundreds of miles northward (to Siskiyou County), *L. hermes* has not been recorded north of San Diego County, the northern boundary of which coincides with no obvious topographical or climatological barrier.

An unusual type of apparently cryptic mimicry was illustrated by colored slide. Because the Red-berry is evergreen, its leaves mature singly. During the flight season of *L. hermes* a mature leaf appears, here and there, as a bright yellow spot agaist the background of dark green foliage. At a short distance such a leaf appears to the collector's eye very much like a perched *hermes* in size and color. But the yellow leaves are substantially more abundant than the butterfly and after repeated disappointments they no longer attract the frustrated collector. Thus the perched butterfly is protected against the predation of the collector, if not against that of natural enemies.

At a special session, well attended by members, their wives, and guests, Dr. John A. Comstock portrayed his recent sojourn for "Research and collecting at Puerto Vallarta, Mexico". His illustrated narrative conveyed a vivid impression of the climate, the flora, the physical facilities and the social amenities of this out-of-the-way tropical locale on the west coast of southern Mexico. His many arresting pictures of the often bizarre larvæ of the many Macrolepidoptera that posed for his paintings, consisting of hitherto unknown stages, were of signal interest to the members.

The members enjoyed Saturday's luncheon as guests of the Santa Barbara Museum of Natural History. At the annual banquet held that evening at El Presidio Restaurant, Lloyd Martin entertained with an account of Lepidoptera collecting in southern Arizona, prefaced withe an explanation of the climatological basis for the quasi-tropical character of the fauna. His lecture was profusely illustrated with transparencies of living butterflies, night lighting for moths with "black light" and the apparatus involved. Not the least entertaining were some shots of a contest between a skunk and a heterocerologist, each vying to be first to snatch each visitor to the moth sheet. The audience protested the speaker's refusal to divulge the score.

Topic II — "Hesperioidea" — was opened by the moderator, Dr. J. W. Tilden, who expressed his great pleasure that the two participants were attacking the problems presented by two of the most difficult genera in the group.

John M. Burns's paper, "Distribution and ecology of American *Erynnis*", suggested a coherent and rational arrangement of the members of this genus based on the geographical distribution and host plants in addition to the morphological characters. In this arrangement there are a number of instances where eastern and western counterparts are evident, at either the species or the subspecies level.

C. Don MacNeill's subject, "Oviposition by the genus *Hesperia*", included pictures of feeding, sunning and ovipositing sites of *H. columbia, H. harpalis dodgei* and *H. lindseyi.* The habit of oviposition on arboreal substrate by the last-named introduced many interesting features, including the deposition of a number of eggs on a limited area of substrate, as for instance, in a small patch of lichen on a fence post, even though the eggs are laid singly, at different times (as evident from unequal embryonic development) and presumably by different females.

In the general session, Thomas C. Emmel, by colored slides, narrative, and trays of specimens, shared his experiences as "A lepidopterist in the tropics of southern Mexico". As assistant to L. Irby Davis, a Cornell ornithologist who was recording bird calls and songs, he travelled over five thousand miles through tropical Mexico, principally in Chiapas, Vera Cruz, Tobasco, Campeche, Yucatan and Quintana Roo, visiting many habitats inaccessable to ordinary vehicles. His colored slides of habitats and the seven hundred-odd butterfly species he collected bear testimony to the large accomplishment achieved in four months (March to June, 1959) in an activity that was secondary to the primary mission of the trip.

In reviewing "Butterfly research: past and future" Dr. Paul R. Ehlich discussed problems encountered in working at various systematic levels, from infraspecific taxonomy to systematic studies of higher classification. He pointed out that modern taxonomic work, more and more, requires a broad background in such abstruse fields as population genetics and biometrics, and the use of expensive optical and automatic data processing equipment. This makes it increasingly difficult for most amateurs to work in this field. At the same time he stressed the enormous value of their contributions in supplying much of the basic data and materials used by specialists.

He suggested that collectors might enhance their contributions:

1. Toward advancing ecological studies — by carefully recording and publishing observations on habits, habitats, distribution, abundance, life histories, host plants, etc.;

2. Toward advancing studies of subspeciation and evolution — by collecting long series with detailed data and preserving them intact (choosing which specimens to retain destroys the statistical value of the sample), and where possible, by collecting year-by-year samples of the same population accompanied by data on relative abundance (numbers caught per hour is a handy index);

3. Toward advancing anatomical study essential for higher classification — specimens are needed of all stages, eggs, larvæ, pupæ, and adults, properly killed and preserved in fluid. Collecting these can best be done in consultation with a specialist engaged in such studies to advise on methods. For instance, larvæ may be killed in hot water, and all stages may be preserved in 80% ethyl alcohol, but in certain circumstances there may be other methods equal or superior to these.

At the business session, chaired by Fred Thorne, it was decided:

To thank Dr. Munroe for his presidential address; the Director and staff of the Santa Barbara Natural History Museum for their hospitality; Levi Phillips for donating the programs; Nelson Baker for his excellent local arrangements; and Robert Langston for arranging the interesting program;

To maintain the registration fee at its present level and reserve the small accumulating balance for a future special good cause;

To meet next year in the San Francisco Bay region on August 27 and 28, 1960; and that Dr. J. W. Tilden be Program Chairman and C. Don McNeill be Chairman for Local Arrangements for the 1960 meeting.

A number of members brought interesting exhibits. Among them was one by Charles L. Hogue on the rearing and the curating of life history specimens of the Noctuidæ, largely with simple, inexpensive, make-it-yourself equipment; and another by Dr. W. H. Lange on the life history of some members of the families Eriocraniidæ and Incurvariidæ. From Texas, Everard M. Kinch sent a series of colored slides showing variation in the larva and adult of *Phœbis sennæ,* which were projected during the exhibit period.

The fallowing 26 members registered: Nelson Baker, Peter F. Bellinger, John M. Burns, Paul R. Ehrlich, Thomas Emmel, Al Habegger, M. C. Habegger, Chas. F. Harbin, Richard Hart, Charles L. Hogue, William Hovanitz, W. H. Lange, Robert L. Langston, Don MacNeill, Lloyd M. Martin, P. McHenry, Joe McKenney, S. S. Nicolay, Paul Opler, Jerry A. Powell, Allen Ruppert, Elton Sette, Fred Thorne, and J. W. Tilden.

Respectfully,

Oscar E. Sette

Secretary *pro tempore*

PRESIDENTIAL ADDRESS TO THE SIXTH PACIFIC SLOPE MEETING OF THE LEPIDOPTERISTS' SOCIETY, AUGUST, 1959

THE PYRALID FAUNA OF THE WESTERN UNITED STATES

Introduction

The western United States is one of the most interesting and complex natural environments in the temperate zone. The north-and-south trending mountains cause not only long southward extensions of cool zones in warm surroundings, but also, because of the rain-shadow effect, sharp contrasts of moisture and precipitation. No less important is the barrier effect of the mountains and valleys, permitting the differentiation of faunas even though their environments may be similar.

These conditions are reflected in the complexity and interest of the pyralid fauna, still imperfectly known. What I shall do in this paper is to discuss certain types of ranges, with exampes, and then to try to give a general picture of the fauna, with hints as to promising fields of investigation.

Typical Ranges

1. ARCTIC-ALPINE PYRALIDS. The arctic-alpine region can be defined very roughly as that lying above or north of the limit of trees. In practice it is usually found that the non-arctic or non-alpine fauna penetrates to a certain distance beyond this limit. Typical members of this group have a wide range in the arctic and alpine zones. For historical reasons these were often first described from their relict habitat in Colorado, rather than from their main range in the Arctic. Examples are *Orenaia coloradalis* B. & McD., which proves to have a wide range in the Canadian Arctic, and *Crambus browerellus* Klots, originally described from Colorado in the west and Mt. Katahdin in the east, but now known from Alaska to Baffin Island. In general the alpine ranges of these insects have been poorly studied. They are usually known from isolated collections in Colorado or Wyoming, much less often from British Columbia; usually there is a wide gap in the known range from Colorado or Wyoming to the Arctic. Systematic investigation of the alpine moth fauna in the western U. S. and British Columbia is something that is badly needed. If plants are any guide, interesting and complex distribution patterns will be found.

In addition to the arctic-alpine pyralids already discussed, there are other alpine species that are purely Cordilleran. The ranges of these are usually incompletely known; often they are known only from single collections, as, for instance, my *Orenaia pallidivittalis* from Mt. Stephen, B. C., and *Metaxmeste nubicola* from Colorado. Further discoveries in this group must be expected, with more mountain investigations.

In general, typical arctic-alpine pyralid species have not been found south of Colorado, and they tend to occur in the Rockies rather than in the coastal ranges and Sierras, where heavy snowfall tends to squeeze out their zone.

2. SUBARCTIC-SUBALPINE AND BOREAL-MONTANE PYRALIDS. This large group consists partly of widely ranging species, sometimes associated with conifers, *e.g., Dioryctria reniculelella* Grt., but often less obviously limited, *e.g., Pyrausta fodinalis* Led. These species tend to range across Canada and the northern U. S. and to extend southward along the mountains, often to the San Bernardino Mts. and to the Arizona ranges, sometimes — perhaps oftener than we think — far into Mexico and even Central America. Sometimes the wide-ranging northern forms show complex specific or subspecific differentiation in the western mountain region, as in the *Udea itysalis* and *Loxostege commixtalis* groups. Then, too, there is a strong group of purely Cordilleran species or groups, *e.g., Pyrausta tuolumnalis* B. & McD., which ranges from high altitudes in the Sierras to low altitudes in the Yukon, cutting across the transcontinental range of the closely related *P. ochosalis Dyar.* A good example of a Cordilleran group is the large development of the metallic-black group of the phycitine genus *Pyla.* Differentiation, both specific and subspecific, within the Cordillera is important, but is too complex to discuss here.

3. VANCOUVERIAN PYRALIDS. The special group of linear Pacific-coast ranges is less important in Lepidoptera than in beetles or plants, but there are some good examples in Pyralidæ. A striking one is *Udea washingtonalis* (Grt.), which ranges from northern California to the Aleutians and Pribilofs; it is always strictly coastal except for the typical limited reappearance in the wet interior zone of British Columbia. Another type of linear Pacific-coast range is shown by *Pyrausta perrubralis* Pack., which is widely distributed to Arizona and Mexico in the south, but which has a ribbon-like range along the Pacific coast as fas as Vancouver Island.

4. PLAINS PYRALIDS. A large group of pyralids is characteristic of the grassy plains; these include many Crambinæ, such Pyraustinæ as *Loxostege albertalis* B. & McD., and Phycitinæ of several genera, *e.g., Sarata, Pyla,* and *Pima.* The plains fauna extends to the foot of the Rockies, and is represented in considerably modified form in the grasslands of the Great Basin and the interior valleys of Washington and British Columbia.

5. CALIFORNIA VALLEY PYRALIDS. A small but special element appears to exist in the interior valley of California; the species of this area may be of eremic affinity, *e.g., Noctuelia atascaderalis* Munroe, or, on the other hand, even aquatic, *e.g., Synclita occidentalis* Lange. *N. atascaderalis* reappears in the valley country of Oregon, but does not extend south to the Mojave desert.

6. SOUTHWESTERN EREMIC PYRALIDS. The desert and subdesert areas of the southwest form an enormous and complex habitat, characterized by many widespread species, *e.g., Palpita gracilalis* Hulst, *Diastictis sperryorum* Munroe, and a large number of others. A considerable number of species are shared with the dry grasslands and extend northward into Canada on the Prairies or in the interior valleys of British Columbia, *e.g., Noctuelia rufofascialis* Steph. and *Microtheoris ophionalis* Zell.

Although the eremic areas are tied together by a common fauna of widespread forms, every lepidopterist knows that they are extremely varied both as to habitats and as to details of the fauna. Perhaps the richest area is Arizona, where plateau and coastal Mexican forms abut on those of the Colorado Plateau and the Mojave and Imperial deserts. This assemblage is liberally studded with high mountain ranges and presents a startling mixture of faunas, which, as the recent work of LLOYD MARTIN and his associates shows, is only beginning to be explored. Lepidoptera-wise, what we badly need is thorough collecting in the plateau and mountain regions of Mexico, which will shed tremendous light on our North American problems. To the east, in the mountainous areas of western Texas and southeastern New Mexico, a considerably different desert fauna occurs. This contains a number of endemic species, mostly as yet undescribed. Still farther east, in the Brownsville-Pharr area of Texas is the locality *par excellence* for tropical invaders; here a mixture of "moist" and "dry" forms is found. On the west, in California, the low-level Imperial Desert and the higher Mojave Desert have much in common. Many species, for instance several species of *Noctuelia,* seem confined to this area. Farther north, the Great Basin and the Colorado Plateau are among the least-collected areas in North America, perhaps because they are flanked by more obviously interesting regions. What we know of them suggests that remarkable discoveries await us.

The most general characteristic of the eremic fauna is close adaptation to the harsh environment. Extreme food-plant specialization and elaborate water-conserving and diapause arrangements are the rule. A large group of Phycitinæ is associated with cactus, boring in the fleshy stems. The *Noctuelia* group of Odontiinæ has developed in a manner closely similar to *Schinia* in the Heliothidinæ, being closely tied to flowers, especially of Compositæ, in which the larvæ probably feed, and having developed a number of brightly coloured, diurnal species, with reduced eyes.

NATURE OF THE WESTERN FAUNA

The western fauna consists of a mixture of Holarctic, purely North American, and Neotropical elements. The last, of course, predominate in the south, the first in the north and at high altitudes.

Considering the Pyralidæ group by group, the Glaphyrinæ are well represented, mainly by eremic forms. The species are mostly different from those in the east; they run very close in external apparance, but have striking characters in the male and female genitalia. This is an entirely New-World group. The Nymphulinæ, recently monographed by LANGE, are characterized by a predominance of stream forms, as opposed to the greater importance of pond species in the east. Species extend throughout the west; they are mainly of Neotropical affinity. In the Scopariinæ there are both Holarctic and Central American components. The genus *Scoparia,* s.str., is less well represented than in the east, but this is compensated for by other genera. In all three of these subfamilies there are numerous cryptic species and careful collecting in a variety of localities is desirable.

The Pyraustinæ are well represented, by genera and species of varied origins. Among the important genera are *Pyrausta, Evergestis,* and *Loxostege,* all of which contain numerous extremely close species.

The Odontiinæ are very well represented, especially in the drier regions, in contrast to their poor representation in eastern North America. The strong development of *Noctuelia* and allies parallels the similar development in the eremic regions of temperate Asia. The North American forms have little direct affinity with Palæarctic ones, and even less with the Neotropicals.

The Crambinæ are well represented, again with important Holarctic and Neotropical components, but also with a large native North American development of the genus *Crambus,* s.l. The water-loving Schœnobiinæ, on the other hand, are poorly represented.

Of the pyraline series, the Pyralinæ themselves have a moderate representation, but with a number of purely western species, well distributed among the different regions. The Epipaschiinæ have a few genera but numerous species. The widely distributed western group centering on *Jocara trabalis* Grt. presents interesting problems, as does the difficult genus *Tetralopha.* The western Epipaschiinæ have considerable affinity with the Neotropical fauna, but little with Old World forms. The mainly American subfamily Chrysauginæ is represented by a scattering of species and genera, most numerous in the southwest. The general affinities are tropical.

The Galleriinæ are poorly represented, but the related Macrothecinæ reach their best development in the Southwest, where there are many undescribed species.

The Phycitinæ are represented by a rich array of genera and species; they are well developed in both arid and moist areas, and have a good mixture of Holarctic, native and Neotropical elements. Some of the groups have been mentioned above. HEINRICH'S recent monograph has opened the door to the study of this fascinating group. The related subfamily Anerastiinæ remains the most poorly known pyralid subfamily in North America. It is well represented in the arid southwest and will certainly repay the efforts of an energetic specialist.

CONCLUSION

It should be obvious that our knowledge of the western Pyralidæ is far from satisfactory. Even in the better-known groups such as Pyraustinæ and Crambinæ, a number of species remain to be discovered. However our distributional and biological knowledge lags far behind that of the taxonomy. What we need is careful and intensive collecting in a wide variety of habitats, to reveal species and establish distributional patterns. Even more do we need life-history studies and careful observations of habits and ecological correlation.

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REVIEWS

GEOGRAPHIC VARIABILITY IN SPEYERIA. COMMENTS, RECORDS AND DESCRIPTION OF A NEW SUBSPECIES. By Arthur H. Moeck. 1957. 48 pp., 2 pls., 7 maps. Paper presented to and sponsored by the Milwaukee Entomological Society. [Privately printed in limited edition. A few copies remain available through the Secretary to the Society, Miss Florence Schiller, 2915 North Bartlett Avenue, Milwaukee 11, Wisc., U. S. A. Price $1.00.]

This is a rambling essay, of a sort rapidly vanishing from the literature, a frankly "unscientific" discourse on the travels, adventures and discoveries made by the author during many summer vacations spent in quest of *Speyeria.*

Oldsters recall when such papers were commonplace. Nowadays, lepidopterology is becoming an aseptic science with a technical jargon having few words to spare for the sweat, toil and excitement of the chase in the field where the material originates. The pace has stepped up; rising costs of publication and the taking over by professionals of what once equally was a domain of amateurs has brought tighter organization and higher scientific caliber to the contents of our journals.

But something has gone that was intrinsically worthwhile. Those who remember HENRY BIRD's delightfully written accounts of *Papaipema,* to cite a classic example, can attest that basic values were not wholly neglected in the earlier luxuriances. Occasionally, even now, a breath of sweet air manages to waft between the rows of statistics, as when the STALLINGS clan write of a hegira into the Southwest for *Megathymus,* but such literary interludes are becoming rare pleasures.

The values which are to be discerned in MOECK's article are largely of this sort. At the same time, hitherto unpublished records and descriptions are included, of subspeciation probably new to most students.

There are some minor annoyances: the print job is atrociously poor; the proof-reading somehow got bungled; the composition is somewhat uneven. The author nevertheless has written a paper which fills a definite need, giving a summary of the genus which is reasonably up-to-date and quite comprehensive; the freedom from any provincialism is noteworthy but is to be expected from a collector who takes the continent for his playground.

In truth, more than any other student, this man has slain his thousands of argynnids. From Maine to California, from Mexico to Manitoba, it is all one to MOECK — if a question arises of variation in an isolated desert range, or of where a cline ends, or of where distinctive subspecies may be intergrading, off he goes, the uncanny thing about it all being his knack of blundering into precisely the right spots. His many friends who know of his physical handicaps and his lackadaisical collecting pace would not wager a chipped nickel on his chances of success. But back he comes, with rarities overflowing, from places which more stalwart and supposedly more capable collectors will not, cannot, or at least do not explore to full potentiality. It may be stretching the legend a bit to say that this one person discovers annually more new facets of *Speyeria* than do all of the remaining fraternity of *Speyeria* buffs, but it is not too far from the mark, at that. We can but shake our heads and wonder —.

Those procuring this summary of MOECK's field work expecting, from the title, help in classifying a difficult genus may be disappointed. Still, his remarks do add up to an indispensable approach philosophy, which, along with the many little-known variations described, will repay careful reading. The tyro, especially, will be put on the right track. The size of the geographical canvas and the enormity of the problems are given in faithful and rare perspective. Additionally, the beginner will be disabused of the feeling of inferiority to the "experts", for MOECK clearly puts the case as it really is, namely, that the main source of knowledge lies in the geographically representative series, in fields and woods which are open to all.

The new subspecies described is *S. zerene gloriosa,* from the vicinity of Selma, Josephine County, southern Oregon toward the coastal slope. Almost equal in interest are descriptions of some other Oregon varients unnamed and not mentioned in the standard literature. However, the Oregon data are not singled out for special commendation; there are many of these highly important references, for almost all of the regions where speyerians occur; the breadth of view is the most appealing feature.

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MOTYLE SLOVENSKA. OBLAST SLOVENSKÉHO RAJA. [Lepidoptera of Slovakia. The region of the Slovak Paradise.] By Andrej Reiprich. 1960. 553 pp., 137 figs., 68 pls. Published by the Slovak Academy of Sciences, Klemensova Street 27, Bratislava, Czechoslovakia; price 50.-Kčs.

In the general part of this work the author introduces a short survey of the studied area, which is shown in two maps (pp. 373-374). The Slovak Paradise is situated in the eastern part of Central Slovakia. The author worked mainly in the neighbourhood of the town Spisská Nová Ves.

In the systematic part of the book (pp. 64-365) the author gives information about all 859 recorded species. In this part there are a number of interesting biological observations. The majority of all observed species is figured in the 68 plates. Very nice are the photos of the living butterflies, caterpillars, and their localities. The book is in Czech, with Russian and German summaries (pp. 405-416).

The book is of importance to the knowledge of the Lepidoptera in Slovakia.

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RECENT LITERATURE ON LEPIDOPTERA

(Under the supervision of PETER F. BELLINGER)

Under this heading are included abstracts of papers and books of interest to Lepidopterists. The world's literature is searched systematically, and it is intended that every work on Lepidoptera published after 1946 will be noticed here; omissions of papers more than 3 or 4 years old should be called to Dr. BELLINGER's attention. New genera and higher categories are shown in CAPITALS, new species and subspecies are noted, with type localities if given in print. Larval foodplants are usually listed. Critical comments by abstractors may be made. Papers of only local interest and papers from *The Lepidopterists' News* and the *Journal* are listed without abstract. Readers, not in North America, interested in assisting with this very large task, are invited to write Dr. BELLINGER (Dept. of Natural Sciences, San Fernando Valley State College, Northridge, Calif., U. S. A.). Abstractors' initials are as follows: [P.B.] — P. F. BELLINGER; [I.C.] I. F. B. COMMON; [W.C.] — W. C. COOK; [A.D.] — A. DIAKONOFF; [W.H.] — W. HACKMAN; [T.I.] — T. IWASE; [J.M.] — J. MOUCHA; [E.M.] — E. G. MUNROE; [N.O.] — N. S. OBRAZTSOV; [C.R.] — C. L. REMINGTON; [J.T.] — J. W. TILDEN; [P.V.] — P. E. L. VIETTE.

F. BIOLOGY AND IMMATURE STAGES

Burmann, Karl, "Aus dem Leben von *Crambus luctiferellus* Hb. (Lepidoptera, Pyralidæ)" [in German]. *Zeitschr. wiener ent. Ges.,* vol.39: pp.209-218. 1954. Describes egg, larva (reared on *Racomitrum canescens*) & mating flight. [P. B.]

Burmann, Karl, "Ein kleiner Beitrag zur Kenntnis der Lebensweise der Raupen von *Acasis* (*Lobophora*) *appensata* Ev. (Lepidoptera, Geometridæ)" [in German]. *Nachrichtenbl. bayer. Ent.,* vol.4: pp.23-26. 1955. Details of larval habits; feeds on leaves & berries of *Actæa spicata.* [P. B.]

Burmann, Karl, "*Nyssia alpina* Sulz (Lepid., Geometridæ). Einige lebenskundliche Beobachtungen aus Nordtirol" [in German]. *Zeitschr. wiener ent. Ges.,* vol.41: pp.251-257. 1956. Detailed notes on biology. [P. B.]

Burmann, Karl, "*Swammerdamia zimmermani* Now. (Lepidoptera, Yponomeutidæ)" [in German]. *Zeitschr. wiener ent. Ges.,* vol.41: pp.187-190, 1 fig. 1956. Describes larva, pupa, & biology; foodplant *Saxifraga cæsia.* [P. B.]

Burmann, Karl, "Etwas aus dem Leben der Endrosen (Lepidoptera, Endrosidæ)" [in German]. *Zeitschr. wiener ent. Ges.,* vol.42: pp.65-72. 1957. General account of biology & habits of *Endrosa* spp. in Tyrol. [P. B.]

Burns, A. N., "Moisture sucking habit among Australian butterflies." *Victorian Nat.,* vol.70: pp.228-229. 1954. Notes on butterfly spp. observed inbibing moisture from damp surfaces in various localities in Australia. [I. C.]

Burns, A. N., & F. Angel, "The Small Brown Azure (*Ogyris atanes* Feld.)" *Victorian Nat.,* vol.68: pp.183-186, 1 pl. 1952. Descriptions and figures of adults and immature stages of a lycænid taken on Kangaroo Island and in other localities in South Australia. Larvæ feed in the bark and shoots of *Choretrum glomeratum* (Santalaceæ) and are attended by the ant *Myrmophyma ferruginipes.* [I. C.]

Busbridge, William E., "Moths attacked by birds." *Entomologist,* vol.85: p.215. 1952. Stonechats eating *Saturnia pavonia.* [P. B.]

Busch, Theo, "Beobachtungen über die Anlockungswirkung des Duftstoffes der ♀♀ auf die ♂♂ von *Lasiocampa quercus* L. in der Hocheifel" [in German]. *Zeitschr. Lepid.,* vol.3: pp.169-170. 1955. Observations on reactions of wild ♂♂ to ♀ scent. [P. B.]

Callahan, Philip S., "Oviposition response of the imago of the Corn Earworm, *Heliothis zea* (Boddie)." *Bull. ent. Soc. Amer.,* vol.2, no.3: p.19. 1956. Abstract.

Callahan, Philip S., "Reproductive behaviour and oviposition of the Corn Earworm, *Heliothis zea* (Boddie)." *Bull. ent. Soc. Amer.,* vol2, no.3: p.19. 1956. Abstract.

Callan, E. McC., "Observations on the species of *Pachyzancla* Meyrick (Lep., Pyraustidæ) in Trinidad." *Ent. mo. Mag.,* vol.89: pp.160-161. 1953. *P. bipunctalis, P. periusalis, P. phæopteralis*; records foodplants & discusses economic importance; lists parasites & predators. [P. B.]

Camping, M. W., "Enkele kweekervaringen" [in Dutch]. *Ent Berichten,* vol.14: pp.359-360. 1953. Rearing notes on *Macrothylacia rubi, Aglia tau, Orgyia antiqua,* & *Diataraxia splendens.* [P. B.]

Camping, M. W., "De cocon van *Orgyia recens* Hb." [in Dutch]. *Ent. Berichten,* vol. 15: p.300. 1955.

Capek, Milan, "Einige Bemerkungen über die Parasiten der Raupen der Motte *Tachyptilia disquei* Meess" [in Czech; Russian & German summaries]. *Folia zool. ent.,* vol.4: pp 29-32, 2 figs. 1955. 3 spp. of hymenopterous parasites of the caterpillars are recorded: *Lycorina triangulifera, Apanteles čapeki,* and *Perisierola gallicola.* [J. M.]

Capek, M., & H. Zwolfer, "*Apanteles murinanæ* nov. spec. (Braconidæ, Hym.), ein neuer Parasit des Tannentriebwicklers" [in German; English summary]. *Mitt. schweiz. ent. Ges.,* vol.30: pp.119-126, 5 figs. 1957. Parasite of *Choristoneura murinana.* [P. B.]

Carlier, S. E., "Some leguminous plants and the lepidopterous insects which feed on them." *Proc. Birmingham nat. Hist. Soc.,* vol.18: pp.75-79, 113-118, 6 pls. 1954; 1955. Figures of plants, with associated Lepidoptera: *Lathyrus* spp., *Vicia cracca, Lotus corniculatus, Hippocrepis comosa, Ornithopus perpusillus;* Lepidoptera listed. [P. B.]

Carpenter, G. D. Hale, "Homochromie et moyens de défense chez les insectes" [in English]. *C. R. XIIIe Congr. intern. Zool.*: pp.466-467. 1949. Abstract; natural selection as an explanation for cryptic, aposematic, & mimetic patterns. [P. B.]

Carter, W. A. C., "Stridulation of Hairstreak pupæ." *Ent. Rec. & Journ. Var.,* vol.64: pp 254-255. 1952. Mechanism not discovered. [P. B.]

Carter, W. A. C., "Parasites of *Limenitis camilla* L." *Ent. Rec. & Journ. Var.,* vol.66: pp.85-86. 1954. *Apanteles* spp.

Cayrol, René, "Influence de l'alimentation et de l'effet de groupe sur la pigmentation des chenilles de *Plusia gamma* L." [in French]. *C. R. Acad. Sci., Paris,* vol.243: pp.601-602. 1956. Larval coloration varies with foodplant, but differences are slight except under crowded conditions, when dark larvæ are produced. [P. B.]

Cepelák, Jiří, "Beitrag zur Kenntnis der Raupenfliegen des Ringelspinners *Malacosoma neustrium* L." [in Czech; Russian & German summaries]. *Folia zool. ent.,* vol.4: pp.167-174, 3 figs. 1955. Describes a number of dipterous parasites (Larvævoridæ) from *M. neustrium* in S. Slovakia. [J. M.]

Cepelák, Jiří, "Beitrag zur Kenntnis der schlesischen Raupenfliegen (Dipt. Larvævoridæ)" [in Czech; Russian & German summaries]. *Acta Rer. nat. Dist. Ostraviensis,* vol.16: pp.222-223, 8 figs. 1955. Lists a number of parasite spp. from Silesia with remarks on their hosts among lepidopterous larvæ. [J. M.]

Cermak, Květon, "Insect pests which attack the seeds of our main forest trees" [in Czech; Russian & English summaries]. *Prace vyzk. ustavů lesnických CSR,* vol.1: pp.5-87, 32 figs. 1952. Lists a number of insect spp. whose larvæ attack seeds of forest trees in Czechoslovakia. Lepidoptera are represented by many spp., namely Tortricidæ. Interesting paper in applied forest entomology. [J. M.]

Chalmers-Hunt, J. M., "Observations on *Thalera fimbrialis* Scopoli in Kent in 1951, with some notes on its early stages." *Ent. Rec. & Journ. Var.,* vol.64: pp.10-11. 1952. Fed on *Achillea millefolium.* Description of egg. [P. B.]

Chandy, K. C., "A note on *Apanteles flavipes* Cam., a braconid parasite of the Chelam Stem Borer, *Chilo zonellus* Swinh." *Journ. Bombay nat. Hist. Soc.,* vol.53: pp.6-9, 5 figs. 1955. Records other pyralid hosts; describes biology. [P. B.]

Charpentier, L. J., "1954 studies of parasites for sugarcane borer control in Louisiana." *Journ. econ. Ent.,* vol.49: pp.267-268. 1956. Laboratory and field studies on parasitic control of *Diatræa saccharalis.* [W. C.]

Chaudhry, Gulam-Ullah, "The development and fecundity of the Oriental Fruit Moth, *Grapholitha* (*Cydia*) *molesta* (Busck) under controlled temperatures and humidities." *Bull. ent. Res.,* vol.46: pp.869-898, 13 figs. 1956.

Cheema, D. S., "Studies on the bionomics of the Case-bearing Clothes Moth, *Tinea pellionella* (L.)" *Bull. ent. Res.,* vol.47: pp.167-182, 1 pl., 2 figs. 1956. Data on biology of all stages and duration of instars, and on effects of temperature, humidity, & light on various activities. [P. B.]

Cherian, M. C., & V. Margabandhu, "*Trichogrammatoidea nana* Zehnt. (Hym. Chalcidoidea) — an egg parasite of the sugarcane borer *Argyria sticticraspis* Hampson: a new record for South India." *Journ. Bombay nat. Hist. Soc.,* vol.48: pp.157-158.

1948. Lists recorded hosts; apparently attacks any available lepidopterous egg. [P.B.]
Cherian, M. C., & V. Margahandhu, "Identity of *Microbracon brevicornis* Wesm and *Micrtobracon hebetor* Say." *Journ. Bombay nat. Hist. Soc.,* vol.48: pp.334-337. 1949. Lists numerous lepidopterous hosts of these Hymenoptera. [P. B.]
Chevallier, L., "*Lampides bœticus* Linn. in Surrey." *Ent. Rec. & Journ. Var.,* vol.64: pp 274-277. 1952. Describes rearing.
Chopard, Lucien, *Le mimétisme.* 335 pp., 100 figs. Paris: Payot. 1949. See notice in *Lepid. News,* vol.5: p.61.
Christie, L., "Notes on rearing *Lampides bœticus* Linn." *Ent. Gaz.,* vol.4: pp.202-204. 1953. Careful description of larval habits; larvæ fed on buds, pollen, and seeds of *Lathyrus latifolius.* [P. B.]
Church, H. F., "Sex ratios in the Pierinæ." *Entomologist,* vol.90: pp.19-20. 1957. Some data from captures of *P. napi, P. brassicæ,* & *P. rapæ* in Britain, showing excess of ♂♂. [P. B.]
Ciaccio, G., "Essai d'inoculation de *Rickettsia prowazeki* et *Rickettsia mooseri* chez les insectes. Étude des anticorps specifiques" [in French]. *C. R. XIII^e Congr. intern. Zool.*: pp.496-498. 1949. *Bombyx mori,* etc., may be infected with *Rickettsia,* & are incapable of forming antibodies. [P. B.]
Clark, Edwin C., "Survival and transmission of a virus causing polyhedrosis in *Malacosoma fragile.*" *Ecology,* vol.38: pp.728-732. 1956. Shows that virus can survive winter on trees & infect larvæ of this univoltine sp. in spring. [P. B.]
Clark, Edwin C., "The Great Basin Tent Caterpillar in relation to Bitterbush in California." *Calif. Fish & Game,* vol.42: pp.132-142, 4 figs. 1956. Describes biology of *Malacosoma fragile* on *Purshia tridentata;* figures early stages; records other foodplants. [P. B.]
Clark, Gowan, "The life history of *Crudaria leroma.*" *Journ. ent. Soc. southern Africa,* vol.14: pp.127-132, 1 pl. 1951. Detailed description; foodplant *Mimosa.* [P. B.]
Clark, Gowan C., "Some pecularities in the early stages of some butterflies." *Journ. ent. Soc. southern Africa,* vol.15: pp.96-98. 1952. Variations in number of instars and length of pupal period in South African spp. [P. B.]
Clark, Gowan C., & C. G. C. Dickson, "The honey gland and tubercles of larvæ of the Lycænidæ." *Lepid. News,* vol.10: pp.37-43, 3 pls. 1956.
Clark, Gowan C., & C. G. C. Dickson, "The life history of *Lepidochrysops patricia* (Trim.) (Lepidoptera: Lycænidæ)." *Journ. ent. Soc. southern Afr.,* vol.20: pp.114-116, 1 pl. 1957. Describes all stages & figures them in color; larva feeds on *Lantana camara* when young & lives in nests of *Camponotus maculatus* in last 2 instars. [P.B.]
Clarke, C. A., "A note on the larva of *Maculinea alcon* (Lep. Lycænidæ)." *Entomologist,* vol.88: pp.49-50, 1 pl. 1955. Young larvæ fed on *Gentiana pneumonanthe;* older larvæ reared by ants. [P. B.]
Clarke, J. F., Gates, "Grant no.1259 (1950). To secure larvæ and rear moths of the genus *Depressaria* (Œcophoridæ) attached to plants of the family Umbelliferæ and to determine the degree of host specificity of these moths and their evolutionary relationship to the host plants." *Yearb. Amer. philos. Soc., 1950*: p.136. 1951. Progress report.

G. PHYSIOLOGY

Lichtenstein, N., "Proteolytic enzymes of insects. I. Proteases of the Silkworm (*Bombyx mori* L.)" [in English; French summary]. *Enzymologia,* vol. 12: pp. 156-165. 1947. Survey of glycerol-soluble proteolytic enzymes in all stages (not found in eggs). [P. B.]
Limpel, L. E., & J. E. Casida, "Iodine metabolism in insects. I. *In vivo* metabolism of radioiodide." *Journ. exper. Zool.,* vol.135: pp.19-27. 1957. Study of retention of ingested radioiodide & its chemical form in larvæ of *Galleria mellonella, Euchætias egle,* & other insects. [P. B.]
Magnus, D., "Wie sieht der Kaisermantel sein Weibchen?" [in German]. *Umschau,* vol. 54: pp. 262-263, 5 figs. 1954. Appearance and disappearance of orange-brown wing color attracts ♂ of *Argynnis paphia,* even in absence of normal markings, shape, or movement. [P. B.]
Manunta, C., "Sul metabolismo dell' azoto in *Bombyx mori.* — III. L'acido allantoinico durante lo sviluppo larvale nella razza bivoltina Awojiku" [in Italian]. *Rend.*

Cl. Sci. fis. mat. nat. Accad. naz. Lincei, ser. 8, vol. 4: pp. 117-121. 1948: Records changes in allantoinic acid content of larva during development, and relates these to problem of nitrogen metabolism. [P. B.]

Manunta, C., "Sul metabolismo dell' azoto in *Bombyx mori.* — IV. Ricerca degli enzimi allantoicasi et allantoinasi nei bachi da seta durante lo sviluppo larvale" [in Italian]. *Rend. Cl. Sci. fis. mat. nat. Accad. naz. Lincei,* ser. 8, vol. 4: pp. 211-214, 1948. Presence of enzyme converting allantoin to allantoic acid in larval tissues. [P. B.]

Miyao, Takeo, "Wing-dimension of butterflies in relation to copulation flight" [in Japanese]. *Shin Konchu,* vol. 6, no. 11: pp. 18-19, 1 table. 1953. ♂♂ have more capacity to flight than ♀♀ do in *Pieris rapæ crucivora.* [T. I.]

Morita, Hiromichi, Satoru Doira, Kimihisa Takeda, & Mastaro Kuwabara, "Electrical response of contact chamoreceptor on tarsus of the butterfly, *Vanessa indica.*" *Mem. Fac. Sci. Kyushu Univ., Ser. E., Biol.,* vol. 2: pp. 119-139, 9 figs. 1957. Describes method of stimulation (direct application of solutions to tarsal sensory hair) and recording of impulses. Shows existence of specific receptors for several different substances (sucrose, NaCl, etc.); also nervous response to stimulation of tarsal spines & integumentary proprioceptors. [P. B.]

Moulinier, Claude, "Le glycogène de l'œuf embryonné de *Bombyx mori* et ses variations dans les conditions habituelles de conservation" [in French]. *C. R. Soc. Biol.,* vol. 150: pp. 1402-1403. 1956. Records changes in glycogen content of silkworm egg during diapause. [P. B.]

Müller, Hans Joachim, "Die Bedeutung der Tageslänge für die Saisonformenbildung der Insekten, insbesondere bei den Zikaden" [in German]. *Ber. 7. Wanderversammlung deutscher Ent.*: pp. 102-120, 14 figs. 1955. Larvæ of *Araschnia levana* (offspring of summer generation), reared in artificial day length of 16 hours, developed without diapause into summer form "prorsa"; larvæ reared in 8-hour day entered diapause (and had not emerged when paper was written). [P. B.]

Mutchmor, J. A., & W. E. Beckel, "Importance of photoperiod and temperature in inducing diapause in the European Corn Borer, *Pyrausta nubilalis* (Hon.)." *Nature,* vol. 181: p. 204. 1958. Larvæ of multivoltine stock will enter diapause if reared at 65° F. during last instar. Percent entering diapause increases with increasing day length from 4 to 9 5 hours, but remains low at greater day lengths or in total darkness. [P. B.]

Nawa, Saburo, & Toshifumi Taira, "Pterins found in Silkworm and *Drosophila.*" *Proc. Japan Acad.,* vol.30: pp.632-635, 2 figs. 1954. Shows chemical difference in pterin pigment between normal *Bombyx mori* larvæ and larvæ of mutant *lem.* [P.B.]

Niemierko, Stella, "Studies in the biochemistry of the Waxmoth (*Galleria mellonella*). 4. Metabolism of total phosphorus during feeding and during starvation of the larvæ." *Acta Biol. exper.,* vol.15: pp.91-99, 1 fig. 1950.

Niemierko, Stella, "Studies in the biochemistry of the Waxmoth (*Galleria mellonella*). 5. Acid soluble phosphorus in the starving larvæ." *Acta Biol. exper.,* vol.15: pp.101-109, 1 fig. 1950.

Niemierko, Stella & W., "Studies in the biochemistry of Waxmoth (*Galleria mellonella*). 6. Metaphosphate in the excreta of *Galleria mellonella.*" *Acta Biol. exper.,* vol. 15: pp.111-123. 1950.

Niemierko, W., & S. Cepelewicz, "Studies in the biochemistry of the Waxmoth (*Galleria mellonella*). 1. Growth of the larvæ and their chemical composition." *Acta Biol. exper.,* vol.15: pp. 57-68, 2 figs. 1950. Mainly on fat accumulation in developing larvæ. Notes great variation in number of instars, etc. [P.B.]

Niemierko, W., & P. Wlodawer, "Studies in the biochemistry of the Waxmoth (*Galleria mellonella*). 2. Utilization of wax constituents by the larvæ." *Acta Biol. exper.,* vol.15: pp.69-78. 1950. Larvæ use about 50% of ingested wax. [P.B.]

Niemierko, W., & L. Wojtczak, "Studies in the biochemistry of the Waxmoth (*Galleria mellonella*). 3. Oxygen consumption of the larvæ during starvation." *Acta Biol. exper.,* vol.15: pp.79-90, 1 fig. 1950.

Palm, Nils-Bertil, "Storage and excretion of vital dyes in insects. With special regard to trypan blue." *Ark. Zool.,* n.s., vol.3: pp. 195-272, figs. 1952. Survey of dye reactions in some 125 spp., including many Lepidoptera. [P.B.]

Petersen, B., O. Törnblom, & N.-O. Bodin, "Verhaltensstudien am Rapsweissling und Bergweissling (*Pieris napi* L. und *Pieris bryoniæ* Ochs.)" [in German; English summary]. *Behaviour,* vol.4: pp.67-84, 1 fig. 1952. Study of effectiveness of different colors in releasing sexual behaviour in ♂. White ♀♀ are more attractive than yellow ♀♀ to ♂♂ of these spp., *P. rapæ, Anthocaris cardamines,* & *Leptidea sinapis.* Evidence from painted models suggests that ♂♂ perceive ultraviolet reflection from paint & are attracted to whites with such reflectance (though ♀ has little). [P.B.]

Piepho, Hans, "Das Jugendhormon der Schmetterlinge" [in German]. *Umschau,* vol. 53: pp. 9-11, 8 figs. 1953. Review of action of hormone produced by corpus allatum, in *Galleria mellonella.* [P.B.]

Pierantoni, Umberto, "Influenza delle varie luci sullo sviluppo del *Bombyx mori*" [in Italian; French & English summaries]. *Arch. zool. ital.,* vol.31: pp. 321-326. 1947. Reports differences in sizes of pupæ from larvæ reared under monochromatic light of various wavelengths. Violet light gave largest pupæ; yellow light, smallest. [P.B.]

Pierpont, W. S., "Polyphosphates excreted by Wax-moth larvæ (*Galleria mellonella* L. and *Achroia grisella* Fabr.)." *Biochem. Journ.,* vol.67: pp.624-627, 1 fig. 1957.

Possompès, Bernard, "Les données expérimentales sur le determinisme endocrine de la croissance des insectes" [in French]. *Bull. Soc. zool. France,* vol.78: pp.240-275, 16 figs. 1953. Review of hormonal control of insect growth & metamorphosis. [P.B.]

Potter, C., K. A. Lord, J. Kenton, E. H. Salkeld, & D. V. Holbrook, "Embryonic development and esterase activity of eggs of *Pieris brassicæ* in relation to TEPP poisoning." *Ann. appl. Biol.,* vol.45: pp.361-375, 8 figs. 1957.

Powning, R. F., M. F. Day, & H. Irzykiewicz, "Studies on the digestion of wool by insects. II. The properties of some insect proteases." *Austral. Journ. Sci. Res. B.,* vol. 4: pp.49-63, 6 figs. 1951. Including *Tineola,* whose ability to digest wool is not dependent on proteases. [P.B.]

Prat, Henri, "Analyse micro-calorimétrique des variations de la thermogenèse chez divers insectes" [in French; English summary]. *Canad. Journ. Zool.,* vol.32: pp.172-197, 32 figs. 1954. Records of heat production by individual insects under various conditions; records of *Galleria mellonella* show notable deviations of output at time of eclosion, during egg-laying, & during flight. Some records also for *Tineola bisselliella.* [P.B.]

Punt, A., "The respiration of insects during hibernation." *Acta brevia neerland. Physiol.,* vol.16: p.30. 1948. Reports discontinuous respiration (CO_2 production) by hibernating larvæ (*Arctia*), pupæ (*Papilio, Sphinx, Agrotis*), & adults (*Vanessa*). [P.B.]

Punt, A. W., J. Parser, & J. Kuchlein, "Oxygen uptake in insects with cyclic CO_2 release." *Biol. Bull.,* vol.112: pp.108-119, 10 figs. 1957. Includes measurements on pupæ of *Hyalophora cecropia* & *Sphinx ligustri.* [P.B.]

Purmann, Robert, & Fritz Eulitz, "Zur Kenntnis des Erythropterins. Über die Flügelpigment der Schmetterlinge XVI" [in German]. *Liebigs Ann. Chem.,* vol. 559: pp. 169-174. 1948. On this and related pigments from wings of pierids (*Catopsilia argante*). [P.B.]

Ramsay, J. A., "Active transport of potassium by the Malpighian tubules of insects." *Journ. exptl. Biol.,* vol.30: pp.358-369, 1 fig. 1953. Including *Pieris brassicæ.*

Razet, Pierre, "Recherches sur la localisation des enzymes uricolytiques chez les insectes" [in French]. *Comptes rendus Acad. Sci.,* Paris, vol.236: pp. 1304-1306. 1953. Localized in fat body in *Bombyx mori* & *Antheræa pernyi.* [P.B.]

Reali, G., "Effet parasympathycolitique de l'atropine sur les muscles locomoteurs de chenilles de lépidoptères" [in French]. *Trans. 9th intern. Congr. Ent.,* vol.1: pp.303-304. 1953. Describes experiments on effects of alkaloids atropin, pilocarpin, & eserin on larvæ of *Galleria mellonella.* [A.D.]

Rehm, Marianne, "Die zeitliche Folge der Tätigkeitsrhythmen inkretorischer Organe von *Ephestia kühniella* während der Metamorphose" [in German]. *Roux' Archiv Entwicklungsmech.,* vol.145: pp.205-208, 17 figs. 1951. Describes secretory cycle in neurosecretory cells of brain, prothoracic glands, corpora allata, corpora cardiaca, & pericardial cells, throughout life, mainly from histological changes. [P. B.]

de Ruiter, L., & IJ. van der Horn, "Short-term oscillations in sign of phototaxis in the Eyed Hawk caterpillar (*Smerinthus ocellata* L.)" [in English; German summary]. *Experientia,* vol.13: pp.374-375, 2 figs. 1957. Demonstrates alteration between positive and negative phototaxis in individual larvæ. [P. B.]

Salt, R. W., "Influence of moisture content and temperature on cold-hardiness of hibernating insects." *Canad. Journ. Zool.,* vol.34: pp.283-299, 2 figs. 1955. Study of effects of dessication & exposure to low temperature on cold-hardiness of *Loxostege sticticalis* & other insects. [P. B.]

Salt, R. W., "Natural occurrence of glycerol in insects and its relation to their ability to survive freezing." *Canad. Ent.,* vol.89: pp.491-494. 1957. Glycerol present in *Antheræa polyphemus* pupæ (resistant) & *Loxostege sticticalis* larvæ (susceptible); absent in *Anagasta kühniella* (susceptible). Other insects also tested. [P. B.]

Sanborn, Richard C., "Experiments on the permeability of the testicular envelope of *Samia walkeri.*" *Anat. Rec.,* vol.128: p.617. 1957. Abstract.

Schadewald, Gerhard, "Lichtfang" [in German]. *Nachrichtenbl. bayer. Ent.,* vol.4: pp.75-80; vol.5: pp.59-62. 1955, 1956. Observations on reactions of moths to light, and related subjects. [P. B.]

Schneider, Dietrich, "Elektrophysiologische Untersuchungen von Chemo- und Mechanorezeptoren der Antenne des Seidenspinner *Bombyx mori* L." [in German]. *Zeitschr. vergl. Physiol.,* vol.40: pp.8-41, 22 figs. 1957. Study of electrical potentials recorded in isolated antennæ exposed to various stimuli, notably the ♀ sex attractant scent; ♂ antennæ have a distinctive response to this substance. [P. B.]

Schneiderman, Howard A., & Lawrence I. Gilbert, "The distribution and chemical properties of the juvenile hormone of insects." *Anat. Rec.,* vol.128: p.618. 1957. Abstract; Saturniidæ, etc.

Seiler, J., & O. Puchta, "Neue Ergebnisse aus den Intersexualitäts-Untersuchungen an *Solenobia*" [in German]. *Zool. Anz.,* suppl. no.20 (*Verhandl. deutschen Zool. in Hamburg*): pp.142-143. 1957. In development of reproductive organs in intersexes, both ♂ and ♀ elements are present from the beginning; this contradicts Goldschmidt's theory of intersex development. [P. B.]

Shappirio, D. G., & C. M. Williams, "The cytochrome system of the Cecropia Silkworm. I. Spectroscopic studies of individual tissues." *Proc. Roy. Soc. London (B),* vol.147: pp.218-232, 5 figs. 1957. Demonstrates disappearance of cytochromes *b* and *c* from pupal tissues at onset of diapause, and their reappearance at its termination; their resynthesis is presumably linked to action of prothoracic gland hormone. [P. B.]

Shappirio, D. G., & C. M. Williams, "The cytochrome system of the Cecropia Silkworm. II. Spectrophotometric studies of oxidative enzyme systems in the wing epithelium." *Proc Roy. Soc. London (B),* vol.147: pp.233-246, 1 figs. 1957. Confirmation of results of paper above, in detailed study of a single tissue. [P. B.]

Singh, K. R. P., "Studies on nutrition of *Corcyra cephalonica* Staint. (Galleriidæ, Lepidoptera) with special reference to carbohydrate requirements." *Science & Culture,* vol.20: pp.339-340. 1955.

Stephen, W. P., & A. L. Steinhaus, "Sexual and developmental differences in insect blood proteins." *Physiol. Zool.,* vol.30: pp.114-120, 1 pl., 2 figs. 1957. Includes data for egg & adult of *Smerinthus cerisyi.* [P. B.]

Stride, George O., "Investigations into the courtship behaviour of the male of *Hypolimnas misippus* L. (Lepidoptera, Nymphalidæ), with special reference to the role of visual stimuli." *British Journ. Animal Behav.,* vol.4: pp.153-167, 14 figs. 1957. Models with bright colors, especially if like color of ♀, stimulated ♂, while white areas on model had an inhibiting effect. It is suggested that this effect of white is general in Nymphalidæ, which therefore do not waste time pursuing the common Pieridæ (though many other moving objects are pursued). This also may explain the failure of *H. misippus* to develop a form which mimics the local race of *Danaus chrysippus* at Achimota, which has white hind wings. [P. B.]

Tassoni, Joseph Paul, "Studies on the nitrogen and phosphorus content of insect protein." *Physiol. Zool.,* vol.30: pp.128-132. 1957. In *Samia walkeri.*

Teruyama, Kengo, "On the oviposition of *Neozephyrus taxila japonicus* Murray (Lycænidæ) in nature and in the confined condition" [in Japanese]. *New Entomologist,* vol.1, nos.3/4: pp.14-17, 2 figs., 2 tables. 1952. 3 ♀♀ produced 149 eggs under 'electric light and flower pot system' (Richard technique). Foodplants *Alnus* spp. [T. I.]

Tolman, Rinke, "Ontmoelingen met Atalanta's" [in Dutch; English summary]. *Ent. Berichten,* vol.16: pp.75-76. 1956. Reports *Vanessa atalanta,* migrating along coast, following shoreline & avoiding shorter overwater flight. [P. B.]

Umeya, Yoshichiro, "Studies on embryonic development and diapause in insects." *Proc. Japan Acad.,* vol.20, no.6: pp.1-9. 1950. Classifies diapausing insect eggs, by stage at which diapause occurs, into 5 types, with examples of each type among Lepidoptera. Notes changes in water content of *Bombyx mori* eggs during development; suggests that diapause is associated with dehydration (which would protect egg against low temperatures). [P.B.]

Urbahn, Ernst, "Probleme bei Lichtfang" [in German]. *Bericht über die Hundertjahrfeier der deutschen Entomologischen Gesellschaft,* Berlin: pp.204-207. Berlin: Akademie-Verlag. 1957. Notes on some problems in the behaviour of moths in response to light trapping. [P.B.]

Vielmetter, Walter, "Ein auf Ultrastrahlung ansprechender Orientierungsmechanismus bei Tagfaltern" [in German]. *Zool. Anz.,* Suppl. no.20 (*Verhandl. deutschen Zool. in Hamburg*): pp.102-106, 4 figs. 1957. Demonstrates that *Argynnis paphia,* when "sunning" itself (wings spread), orients to visible light; but in position assumed at high temperatures (wings folded and directed toward light source) insect orients to infrared radiation. Probably orientation results from perception of temperature differences on different parts of body and wings. [P.B.]

Waku, Yoshio, "Seasonal change of the pupal respiratory metabolism in the Chinese Oak Silkworm, *Antheræa pernyi* Guerin, with special regard to its hibernation and diapause." *Sci. Rep. Tohoku Univ.,* 4th ser., vol. 23: pp. 101-118, 8 figs. 1957. Comparative study on diapausing and non-diapausing pupæ. In winter the former showed an increase in O_2 uptake as winter progressed, but only if measurements were made at an artificially high temperature. [P. B.]

Williams, Carroll M., "Physiology of insect diapause. X. An endocrine mechanism for the influence of temperature on the diapausing pupa of the Cecropia Silkworm." *Biol. Bull.,* vol.110: pp.201-218, 5 figs. 1956. Temperatures from 6° to 15° C. (especially) effect some chemical change in brain of diapausing pupæ of *Hyalophora cecropia* which restores brain's ability to secrete brain hormone. [P. B.]

Williams, Carroll M., "The juvenile hormone of insects." *Anat. Rec.,* vol.128: pp.640-641. 1957. Abstract.

Wyatt, G. R., & G. F. Kalf, "The chemistry of insect hemolymph. II. Trehalose and other carbohydrates." *Journ. gen. Physiol.,* vol.40: pp.833-847. 1957. This disaccharide made up most of the blood sugar in the insects examined, including *Telea polyphemus* & other Lepidoptera. [P. B.]

Yagi, Nobumasa, "On the effect of parabiosis upon the scale content of wings of each sex in *Pieris rapæ crucivola* [sic!] Boisduval." *Proc. Japan Acad.,* vol.30: pp.498-503. 1954. Wing scales contain leucopterin macromolecules (♂) or urea crystals (♀) (because of sexual differences in protein metabolism). If pupæ are joined, scales of resulting adults are intermediate in ultrastructure. [P. B.]

Yamafuji, K., F. Yoshihara, & H. Wada, "Formation of oxime in Silkworms after feeding with inorganic nitrogenous salts" [in English; German summary]. *Enzymologia,* vol.14: pp.170-176. 1950. Larvæ of *Bombyx mori,* fed nitrates or ammonium compounds, had higher oxime content than control larvæ. Larvæ, tissues, or extracts could apparently reduce or oxidize inorganic nitrogen compounds. Conversion of nitrogen salts to amino acids by larvæ is suggested. [P. B.]

Yamafuji, K., T. Kawakami, & K. Shinohara, "On an enzyme in Silkworm which catalyzes the transformation of oximes into amino compounds" [in English; German summary]. *Enzymologia,* vol.15: pp.199-203. 1952.

Yamafuji, K., H. Omura, & T. Sakamoto, "Variation of the activity of some enzymes in Silkworm by chemical feeding" [in English; German summary]. *Enzymologia,* vol.15: pp.210-214. 1952.

Yamafuji, Kazuo, & Hirohisa Omura, "On the oximase." *Enzymologia,* vol.15: pp.296-302. 1952. Enzyme from *Bombyx mori.* [P. B.]

ERRATA in Vol.12: nos.3-4 — page 137, 2nd line of Ae reference should be: *Lepid. News,* vol.10: pp.9-14. 1956.

Same issue, page 141, volume number for Clench reference should be 9 (not "8").

CORRECTION

On p.188 of vol.13, no.3, of the *Journal,* the abstract of the second paper by B. C. S. Warren concludes with the remark, "Misstates facts about differences in chromosome number." This is completely incorrect, and the sentence should be deleted. My apologies are due to Mr. Warren for this error.

Peter F. Bellinger

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INDEX TO SUBJECTS IN VOLUME 13

CORRIGENDA AND *ADDENDA*

Vol.13: no.3 — page 128: the list of mimics should have included the symbol for female [♀] after *Euryphene rubrocostata, E. wilwerthi, E. sophus sophus, E. congolensis, E. phranza phranza, E. lætitia,* and the notation "♂ & ♀" after *E. cutteri* and *E. "sp. nov.?"*; all these are clearly shown by the color plates but were omitted from the list.

Same paper, page 145: the caption to Plate 8 shows *Iolaus* as the genus of all the forms figured; in the text above, the new generic assignments from the Stempffer & Bennett revision are shown, and the plate caption should have had the same genera.

Vol.12: nos.3-4 — page 94: the dates for *Stallingsia, Turnerina* (misspelled *"Ternerina"*), and *Agathymus* should be 1959 (not "1958"), since FREEMAN's paper was published 26 January 1959.

Vol.10: no.6 — page 207, text line 17: "SCHINDLER" should have been SCHILDER.

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Contributions to the *Journal of the Lepidopterists' Society* may be on any aspect of the study and collection of Lepidoptera in any part of the world. Particularly appropriate are: 1) review papers on subjects of general interest to lepidopterists (such as heredity, migration, light traps, etc.); 2) papers on such subjects as behavior, hybridization, larvæ, and comparative taxonomy (papers naming new higher taxa, genera, species, and sub-species—NOT individual variants—will be accepted); 3) field notes of more than a very local nature; 4) notes on well-tested techniques. Papers of more than twenty pages will not normally be accepted, but if they are, authors may pay for overage.

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9 November 1961

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The Lepidopterists' Society is a non-profit, scientific organization. The office of publication is New Haven, Connecticut (see address inside back cover). Application for Second-class mail privileges is pending at Colorado Springs, Colorado.

Journal of The Lepidopterists' Society

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PRESIDENT'S ANNUAL ADDRESS, 1959

PROFESSIONAL AND AMATEUR RESEARCH IN LEPIDOPTERA

by Eugene Munroe

Dear Fellow Members —The subject I have chosen is one I cannot pretend to have thought through in all its ramifications, though it is an important one and one that has received less study and discussion than it merits. However, as a lepidopterist who was an amateur for many years, and who has been a professional for the last ten, I feel I have a foot in both camps. I accordingly venture to express some rather tentative opinions, in the hope that at least they may stimulate other persons to constructive thought.

I suppose most of us originally become lepidopterists for the fun of it, whether to satisfy the collector's or hunter's instinct, or from a more studious interest in nature. But I am sure that a deeper satisfaction is found when we realize how easy it is to find out something really new, perhaps a new species or some new fact of classification, life history, behaviour or distribution. This is the beginning of research or scientific investigation; it is here that our particular specialty begins to influence other branches of knowledge, and it is here that the amateur and the professional research worker begin to find common ground. There are, however, obvious differences in the conditions under which amateurs and professionals work, and these differences necessarily influence the selection of projects and the way they are carried out.

The amateur has both advantages and disadvantages as compared to his professional colleague. His advantages come mainly from his freedom to choose fields and objectives. His disadvantages arise from the necessity of financing his work. This often imposes limitations of time, of resources, of training and preparation, and of facilities for publication. Wisely planned research, whether by professional or amateur, will be chosen and arranged to exploit the advantages and to minimize the disadvantages of the investigator's situation.

I will not discuss at length the proper course of professional research. My professional colleagues are well equipped to determine their own lines of work, and specific suggestions from me would be presumptuous. I think, however, you will agree that professionals should take the lead in large and expensive projects, and especially those requiring complex laboratory facilities, costly instrumentation, extensive technical assistance, or other major investments of plant and funds. Major entomological studies may conveniently be regional, but they should rarely be based primarily on political boundaries, unless purely economic projects are concerned. Even government research should in my opinion include a generous share of studies with a broad geographic basis and on a fundamental scientific plane, for it is only from such broad perspectives that stable classifications and sound theoretical interpretations of general applicability can be derived. This is particularly important nowadays, when an increasing share of research is government-conducted or government-supported, and when private capital to support individual lines of interest is not quite as freely available as it once was. The professional and his employing organization also have a responsibility to encourage, assist and coordinate the activities of serious amateurs. We have, for instance, in North America an acute lack of identification manuals, and particularly of up-to-date manuals suitable for use by the amateur or by the general or economic entomologist. Our professional lepitopterists should certainly be taking a leading part in the preparation of such manuals. This, and indeed the whole field of professional encouragement of amateur observation and research, is much better developed in Europe than in America, and we could learn much from the highly developed and co-ordinated body of amateurs that exists there. Recent progress in Japan has also been exemplary. One has only to glance at the superbly produced and highly scientific and accurate handbooks now being produced there and the large volume of entomological periodicals, both professional and amateur, to realize the great strides being made in that country, and the excellent cooperation between professionals and amateurs.

Turning now to the amateur lepidopterist, I think one of his most difficult problems is often to decide what he can do usefully. It is easy to fall into the rut of making the same old collection of common butterflies and partly identified larger moths that has been made by dozens or hundreds of collectors before. With a little thought and care much more interesting and useful activities are possible. I do not, of course, mean that collecting is useless or overdone. But for collecting to be useful its results should be communicated; this means first of all accurate identification, and secondly publication of lists of captures. The second step, without the first, is worse than useless. In the present state of literature accurate identification is possible for many butterflies, especially the eastern ones, thanks to KLOTS' excellent handbook, and for a number of the more distinctive species of moths, by a judicious use of old pictures and new manuals and lists. For a few special groups of moths, such as the Phycitinæ and several groups of tortricoids, accurate identification is within the reach of those willing to take the trouble to make genitalic preparations. By and large, however, the moths are not fully identifiable from literature. This means that the help of specialists must be sought, and that, if possible, the amateur should personally make comparisons with the material of one or another of the large museum or university collections, which fortunately are fairly well distributed through the continent. Regional lists, based on accurate identifications, and preferably with annotations on habitats, seasons, relative abundance and other biological data, will certainly be welcome contributions to knowlegde for a long time to come.

Accurate observation, in conjunction with literature and in consultation with specialists, will certainly bring the collector in contact with taxonomic puzzles, of which very many still remain unsolved, even among seemingly well-known groups such as butterflies. Often the critical aspects of such problems are best studied by the field collector on the spot, who can investigate life-histories, habits, seasonal occurrence and behaviour, and who can often detect biological differences in the living insect that are inaccessible to the museum taxonomist.

However, pure systematics is only the beginning of entomology. Other aspects of the subject are equally important and often much more poorly understood. We know relatively little about the biology of most species, yet this can be investigated by direct methods and often with little special equipment. Time, industry and the willingness to make accurate observations are all that is required. Life-histories, for instance, are unknown for a very large proportion of our North American Lepidoptera, in spite of the dense population and high educational standards of our continent. Even superficial color descriptions of early stages are greatly to be desired, though of course technical anatomical descriptions are much better. Where insects are reared, some specimens should always be preserved, if the material permits, in some suitable liquid preservative. This will permit later technical description and comparative study, even if these are not possible at the time. Foodplant records are of the greatest importance, and should in general be published, even where they confirm previous findings. It is desirable that plant identifications should be checked by a competent authority, and of course evidence of actual successful feeding is necessary before a host-plant association is worthy of acceptance.

Rearing may also yield most valuable information as to parasites. The parasitic Hymenoptera and Diptera, in spite of intensive study, are still far from being thoroughly known. Their host-relationships are even less adequately known. A parasitized egg, larva, or pupa, which we are apt to think of as "spoiled", may yield a scientific result far more interesting than a perfect adult specimen would have done. We should, therefore, try to resist the impulse to "throw away the nasty fly" and instead preserve it carefully, with an accurate host association. Specialists are available at, or through, most of the major entomological organizations who will be only too happy to study parasites of Lepidoptera and to put the identifications to use. Even butterfly parasites are, as a group, poorly known, and for many groups of moths our knowledge is little more than fragmentary.

A tremendous field lies open in the study of lepidopteran behaviour. Butterflies are, on the whole, the most easily observed because of their diurnal habits, but even the daytime habits of night-flying moths are full of interest, and ingenious students will easily find it possible to investigate nocturnal habits as well. Various forms of protective behaviour are well known in a general way, but we have little detailed information on particular species—photographs of resting positions, for instance, have not been published in any systematic manner. Courtship and mating behaviour is interesting both intrinsically and because of its ecological implications. The problem of "assembling" in different species needs detailed experimental study. Activity of butterflies and moths in general is poorly known. We do not know how far individuals normally travel, how much they move around, or how much they are attached to particular places or territories. These are all things that could easily be investigated for particular species by alert amateurs.

Reactions to various stimuli—to light, to odors, to colors, to vegetation, etc., provide a rich field for study. Experiments with marked individuals offer possibilities here. We all know that local differences in temperature and humidity have a strong influence on the activities and distribution of Lepidoptera, and that different parts of a sugar line, for instance, may be good or bad on different nights because of local variations in atmosphere conditions. However, we sadly lack documented evidence on phenomena of this kind. Careful and systematic observation would go a long way towards supplying the lack.

A further area of critical knowledge within reach of the amateur is the study of numbers and mass movements of Lepidoptera. We have little comparative information on the actual numbers or densities of lepidopterous populations in different areas or in the same area at different times, though fairly simple sampling methods are available for observing and calculating such data. We do not know with much accuracy where and how given populations originate, whether they are sedentary and conservative, or whether they are dissipative, and maintained or reconstituted by colonists from other sources. Population studies of this sort can, of course, tie in closely with individual behaviour and activity studies such as were mentioned previously.

There are many other fields in which intelligently directed curiosity can yield valuable information. How much do caterpillars eat? How does this vary with conditions promoting slow or fast growth? What is the weight of living Lepidoptera at different stages? How does feeding by Lepidoptera affect the growth of the host plants? How effective are Lepidoptera as pollinators, and do they have specific relationships with certain plants? One could go on almost indefinitely, but I promised not to give an exhaustive list. If I have suggested a few ideas for learning interesting things without elaborate equipment, I shall have fulfilled my intention.

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A STUDY OF HYBRIDS BETWEEN *PAPILIO XUTHUS* AND THE *P. POLYXENES-MACHAON* GROUP

by Shigeru Albert Ae

Papilio xuthus Linné (pl.1: fig.2) is found commonly but only in East Asia. It is distributed in Japan, Korea, Manchuria, Amur, China, North Burma, Formosa, Luzon, Guam, etc. It is very common in most parts of Japan, but becomes rare toward the northern part of Hokkaido. It seems also uncommon in hot regions, as in Formosa. In Japan, it is usually not found in the high mountains, unlike *P. hippocrates* Felder & Felder (Fig. 1), which is found in the high mountains as well as the lower places. The adult of *P. xuthus* resembles the adult of the *P. machaon* group, and *P. xuthus* is usually placed in the *P. polyxenes-machaon* group. However, the pupa and larva of *P. xuthus* do not resemble the pupæ and larvæ of species of that group. They rather resemble the pupæ and larvæ of *P. protenor demetrius* Cramer, *P. memnon thunbergii* von Siebold, *P. helenus nicconicolens* Butler, and *P. macilentus* Janson in Japan. The pupæ and larvæ of these four Japanese black swallowtails resemble each other closely. The larval and pupal resemblances between *P. xuthus* and *P. helenus* Linné were pointed out by Remington (1960). These four black swallowtails are Rutaceæ feeders as is *P. xuthus*. Therefore, the phylogenetic position of *P. xuthus* in the genus *Papilio* is interesting and a study of it may help in analyzing the evolutionary process of species in the genus.

Dr. C. L. Remington obtained very important data in this problem by interspecific crossings between *P. xuthus* and the *polyxenes-machaon* group (1960). Namely, he succeeded in obtaining one male hybrid between *P. hippocrates* and *P. xuthus* and two male hybrids between *P. polyxenes* Linné and *P. xuthus*. Since *P. hippocrates* is very common in Japan as well as *P. xuthus*, it is very easy to work on hybridization of these two species in Japan. Therefore, the writer obtained many hybrids of this kind in 1958 and 1959 at Nanzan University, Nagoya, Japan, following Dr. Remington's work in 1957. The writer also obtained some hybrids between *P. xuthus* and *P. polyxenes* (Fig.3) and between *P. xuthus* and *P. "brucei* Edwards" (Fig.4). The data are not sufficient to give a final conclusion on the relation between *P. xuthus* and *P. machaon* relatives, and crossing experiments are still in progress in the writer's laboratory, along with hybridization tests between *P. xuthus* and the four above-mentioned Japanese black swallowtails. However, it takes years to complete this kind of work. Therefore, the writer presents here the data mainly in genetics of interspecific characters on the hybrids between *P. xuthus* and *P. machaon* relatives obtained in 1958 and 1959, so that they are available for the workers in the same field.

Pupæ of *P. polyxenes* and *P. "brucei"* were reared by the writer in 1957 at Yale University and the Rocky Mountain Biological Laboratory respectively and sent to the writer at Nanzan University in winter by the kindness of Dr. REMINGTON. The so-called *"brucei"* is the high mountain *Papilio* of Colorado and is considered by REMINGTON not to be true *brucei* (Maeki & Remington 1960: p.196). A permit to import these pupæ to Japan was given to Nanzan University by the Agricultural Ministry of Japan. *P. hippocrates* pupæ were obtained by the rearings of local wild larvæ and eggs from local wild females in the fall of 1957 and 1958, and wild *P. xuthus* pupæ were collected from Karatachi (*Poncitrus trifoliata* Rafin., Rutaceæ) fences in Nagoya and Osaka in the winters of 1957-1958 and 1958-1959. Wild adults of *P. hippocrates* and *P. xuthus* in the vicinity were also used in 1958 and 1959, especially males.

The prefix of individual designation used for *P. "brucei", P. hippocrates, P. polyxenes*, and *P. xuthus* are respectively B, H, P, and X. The individual designation of a female was also used as the designation of its brood. When a female mated twice or more, this brood was separated; *e.g.* H-3a and H-3b.

All the matings were obtained by hand-pairing (Clarke & Sheppard, 1956). Eggs were obtained from females in glass cylinders on potted food plants. The containers were placed under incandescent and fluorescent lights. For the rearing of larvæ, insect cages about 30 cm. cubed were used. These experiments were carried on exclusively in a double screened rearing room to prevent any accidental release of American butterflies in 1958. This room was windowless and lighted by fluorescent and incandescent lights usually during the day time but with no definite period. The rearing of the larvæ of the hybrids between *P. hippocrates* and *P. xuthus* in 1959 was carried on at the windowside of the laboratory. There was no control of temperature or humidity, and no heater was used in either room.

REMINGTON (1960) pointed out that *P. hippocrates* should be placed as a species separate from *P. machaon*, and the writer has no objection on it.

HYBRIDS BETWEEN *Papilio xuthus* AND *P. hippocrates*

Nine *P. hippocrates* females were hand-paired with *P. xuthus* males in 1958. Only two of the females, H-3 and H-11, laid fertile eggs. Broods H-3a and H-11 were obtained from them. One more female laid a few eggs but they were all infertile. H-3 was remated with another *P. xuthus* male and later again with a *P. hippocrates* male, and Broods H-3b and H-3c were obtained. Seven *P. xuthus* females were hand-paired with *P. hippocrates* males in 1958. Four females laid eggs, but only one, X-26, laid fertile eggs. The fertility of matings is shown in Table 1. An egg is yellowish white when laid, and if it starts a development, a brown mottling or ring appears (Remington, 1960). This phenomenon was used as an indication of fertilization. When a larva is well formed in an egg shell, the egg color turns black.

All larvæ which hatched in Brood X-26 were put into plastic containers with Seri (*Œnanthe stolonifera* DC., Umbelliferæ) and Karatachi. The larvæ which chose Karatachi were reared on Karatachi. The number of larvæ which started to feed on Seri was larger than the number which started to feed on Karatachi. Fifteen larvæ of Brood H-3a were reared on Seri, 14 on Natsumikan (*Citrus natsudaidai* Hayata) and 4 on Karatachi, respectively. The larvæ which were reared on Natsumikan were moved to Seri at their 4th instar, because of the shortage of fresh Natsumikan leaves. The larvæ of H-3b were reared on Mitsuba (*Crytotænia japonica* Hassk., Umbelliferæ), and the larvæ of H-3c were reared on Seri. The number of pupæ which were obtained from these rearings and the pupal lengths are shown in Table 3. Although the eggs of Brood H-3c were laid after the female mated with a wild *P. hippocrates* male for more than one hour, the larvæ from them were identified as hybrids. Broods H-3a, X-26, and X-27 (from eggs laid by a wild *P. xuthus*) were reared at the same time (April to May), and the pupæ of X-27 were larger than the pupæ of the hybrids. Therefore, the small size of the hybrid pupæ are not seasonal. Since three pupæ of *P. xuthus*, which were obtained from the larvæ reared on Seri, were as large as the other *P. xuthus* reared on Karatachi, effects of food plant on hybrid larvæ do not seem to be the cause of the small size. [*P. hippocrates* larvæ feed on Umbelliferæ and occasionally on Rutaceæ, and *P. xuthus* feeds on Rutaceæ in nature in Japan (Esaki & Shirozu, 1951)]. No difference in developmental rates was observed in these rearings. The *P. hippocrates* larvæ were not reared at the same time, but their summer form, which comes from spring larvæ, is usually larger than the summer form of *P. xuthus.* The hybrid butterflies which emerged from these small pupæ were consequently very small. Loss during the larval stage in hybrids was noticeable. Some definitely died of diseases, but some deaths could have been due to hereditary causes from hybridization. Some pupæ were malformed to some extent. The larvæ of Brood H-11 were reared outdoors under a net and fed on Natsumikan branches. Some of them reached the 4th instar, but all died without having another molt.

Some additional data were obtained in 1959. Ten *P. hippocrates* females were hand-paired with *P. xuthus* males. Seven of the females laid eggs, and the eggs laid by five of them contained some fertile ones. Twelve *P. xuthus* females were hand-paired with *P. hippocrates* males. Nine of the females laid eggs, and the eggs laid by four of them contained some fertile eggs. Table 2 shows the fertility of these matings. Only one larva, which hatched from the eggs laid by female H-29-13, was reared on Seri and reached the pupal stage. This was sent to Mr. K. Maeki for chromosomal study. The two larvæ which hatched from the eggs laid by female H-29-16 were killed accidentally. Fifteen larvæ which hatched from the eggs laid by female H-34-5 were reared on Seri, and 6 pupæ were obtained; four of them emerged. Forty of the larvæ from female X-70 were reared on Seri and 14 pupæ were obtained. A few were sent to Mr. Maeki for chromosomal study, and 5 adults were obtained from the remaining pupæ. Seven and eight larvæ from the same female were reared respectively on Inuzansho (*Fagara schinifolia* Engl., Rutaceæ) and cultivated carrot (*Daucus carota* L.). All of them died during their larval stages. Four larvæ from female X-97 were reared on *Citrus,* but died during their larval stages. Seven larvæ from female X-103 were reared on cultivated carrot; one reached its pupal stage but did not emerge. Eleven larvæ from female X-107 were given a choice among cultivated carrot, Seri, and Inuzansho. Four, four, and three started to feed on cultivated carrot, Seri, and Inuzansho respectively. However, all of them died during the larval stages. The main cause of larval loss during the above rearings seems to be virus diseases. These hybrid pupæ were as small as the hybrid pupæ in 1958.

The larvæ of *P. xuthus* and *P. hippocrates* are completely different in color pattern, and the hybrid larvæ share some characters with one parent and show intermediate expression in other characters. The writer's observations essentially coincide with REMINGTON'S (1960). In general, the hybrid larvæ resemble *P. xuthus* in the first 2 instars and show somewhat intermediate (rather close to *hippocrates*) appearance in the last instar (Plate 2: figs. 1-3; Remington 1960: plates 2, 3). The mature larva of *P. hippocrates* is extensively variable in the width of the black area. Sometimes the black area covers almost all the green area and sometimes the green area is predominant. This variation seems environmental and the same tendency appears in the hybrid larvæ.

The pupæ of *P. xuthus* and *P. hippocrates* are also quite different. The hybrid pupæ show somewhat intermediate appearance. The ground color of *P. hippocrates* pupæ is brown or green and that of *P. xuthus* is variable, but able to be classified as green, brown, or orange. The ground color of the hybrid pupæ is as variable as *P. xuthus,* but they are either green or brown and no orange appears, although the numbers of the pupæ examined are not enough to conclude that orange pupæ are absent in hybrids. Otherwise, the writer's observations coincide with REMINGTON'S (1960) in the detailed characters (Remington 1960: plate 3).

The twenty-nine adults which emerged were all males (Table 1). REMINGTON (1960) pointed out that this hybrid closely resembles summer *P. xuthus* in general appearance, but the writer's hybrids more resemble summer *P. hippocrates* females than either sex of summer *P. xuthus.* Summer *P. hippocrates* females are darker in melanin pigmentation and paler in the ground color than summer *P. hippocrates* males. The ground color of summer *P. hippocrates* female is indistinguishable from that of the present hybrids. REMINGTON (1960) also made character-by-character comparisons among the male parental species and the hybrid. The writer's hybrids coincide with REMINGTON'S in 8 detailed characters (2nd pale wedge from forewing apex in postmedian row, 2 transverse pale spots in forewing discal cell, hindwing anterior cell, and hindwing submarginal lunules resemble *P. hippocrates;* length of pale zone of hindwing anal eyespot, hair along anal margin of hindwing, and basal ½ antennal club resemble *P. xuthus;* and hindwing anal eyespot is intermediate). Four points of difference from REMINGTON'S analysis are as follows: 1) ground colors are somewhat variable in the hybrids and in general they are intermediate between the parental species; 2) four pale streaks in forewing discal cell, which are present in *P. xuthus* and absent in *P. hippocrates,* are always present in the hybrids but they are not so clear as in *P. xuthus;* 3) black-striping along veins of forewing and hindwing, which is broad in *P. xuthus* and narrow in *P. hippocrates* are rather intermediate than most like *xuthus;* 4) outer tail fringe, which is pale in *P. xuthus* and is dark in *P. hippocrates,* is variable in the hybrids — in some it is *hippocrates*-like, in some it is *xuthus*-like, and in others it is intermediate (Figs. 5, 6; Remington 1960: plates 2, 3).

One prominent reciprocal difference was found in the pre-pupal stage. Many hybrids between *P. hippocrates* female and *P. xuthus* male succeeded in making a silk girdle passed around the thorax in their prepupal stage and consequently normal pupation took place. However, no hybrid between *P. xuthus* female and *P. hippocrates* male succeeded in making a girdle in the prepupal stage and the pupæ hung only by the tip of the abdomen or often dropped. Consequently almost all pupæ were malformed to some extent and most of the hybrid butterflies failed to extend their wings fully.

Hybrids between *P. polyxenes* Female and *P. xuthus* Male

Five hand-pairings of this kind were obtained and eggs were also obtained from all the matings. However, only two matings were fertile, and from these Broods P-1-70 and P-1-73a were obtained. The second female was remated with another male *P. xuthus* and again it laid fertile eggs (Brood P-1-73b). The fertility of matings is shown in Table 1. All larvæ of Brood P-1-70 were put into a plastic container with Seri and Karatachi when they hatched. The number of larvæ which started to feed on Seri was larger than the number which started to feed on Karatachi. Larvæ were reared on either food plant as selected by the larvæ themselves. This rearing was carried on at the same time as the rearings of 1958 reported in the previous section. Their developmental rates showed no difference in comparison with the rearings in the previous section. Twelve pupæ were obtained from Brood P-1-70. Only one pupa was obtained from Brood P-1-73a and none from Brood P-1-73b. The hybrid pupæ were very small, and consequently the butterflies were too (Table 2).

The larvæ of *P. polyxenes* and *P. hippocrates* are very similar except in the color of the larval spots. These are always orange to red in *P. hippocrates* and orange or yellow in *P. polyxenes.* This color was always yellow in the *P. polyxenes* which the writer used. Consequently, in the hybrid larvæ, these larval spots were always yellow. In the other characters, they were exactly the same as with the hybrids between *P. hippocrates* and *P. xuthus* (Pl. 2: figs. 4a, 4b).

The pupæ of *P. polyxenes* and *P. hippocrates* are indistinguishable and both of them have green or brown ground color. The pupal color of the hybrids is brown or green, and the other characters are the same as with the

Table 1. *PAPILIO XUTHUS* HYBRIDIZATION

Mother	Father	Kind of matings[1]	Brood	Eggs laid	Eggs fertile	Eggs blackened	Eggs hatched	Imagines[6]
H-3	X-18	H × X	H-3a	62	58	58	33	8 ♂♂
H-3	X-18 &/or X-25	H × X	H-3b	18	9	9	3	0
H-3	X-18 &/or X-25 &/or H-5	H × X or H	H-3c	81	8	7	3	0
H-29-13	X-85	H × X	H-29-13	4	3	2	1[2]	0
H-29-16	X-96	H × X	H-29-16	14	9	9	2[3]	0
H-29-15	X-94	H × X	H-29-15	2	1	1	0	
H-34-2	X-127	H × X	H-34-2	2	2	2	0	
H-34-5	X-129	H × X	H-34-5	45	39	38	15	4 ♂♂
X-26	H-5	X × H	X-26	199	189	189	179	12 ♂♂
X-70	H-30	X × H	X-70	167	163	163	55[4]	5 ♂♂
X-97	H-33	X × H	X-97	4	4	4	4	0
X-103	H-36	X × H	X-103	12	10	10	7	0
X-107	H-36	X × H	X-107	23	11	11	11	0
P-1-70	X-17	P × X	P-1-70	58	46	46	34	9 ♂♂
P-1-73	X-36	P × X	P-1-73a	55	31	17	10	1 ♂
P-1-73	X-38	P × X	P-1-73b	42	21	18	9	0
B-3-9	X-24	B × X	B-3-9	109	98	97	30	5 ♂♂
X-16	B-3-6	X × B	X-16	64	60	52	4	0
			CONTROLS					
X-27	wild	X × X	X-27	43	43	43	43	5[5]
X-72	X-73	X × X	X-72	36	33	33	31	16[5]
X-62-6	X-62-2	X × X	X-62-6	31	30	30	15	4
X-100	wild	X × X	X-100	18	18	18	18	15
X-123	wild	X × X	X-123	234	231	229	228	4[5]
X-124	wild	X × X	X-124	113	112	112	112	5[5]
X-126	wild	X × X	X-126	249	248	248	248	1[5]
H-29	wild	H × H	H-29	225	224	223	223	16[5]
H-34	wild	H × H	H-34	33	32	32	32	13
H-40	wild	H × H	H-40	84	69	56	40	4[5]
H-44	wild	H × H	H-44	161	160	160	149	—
P-1-61	P-1-58	P × P	P-1-69	99	98	83	69	0
P-1-74	P-1-76	P × P	P-1-74	132	119	115	96	0
P-1-77	P-1-75	P × P	P-1-77	87	83	81	79	0
P-1-80	P-1-78	P × P	P-1-80	31	29	26	16	0
P-1-84	P-1-81	P × P	P-1-84	42	41	41	29	0
B-3-7	B-3-5	B × B	B-3-7	160	154	153	110	0
B-1-19	B-2b-27	B × B	B-1-19	113	112	111	80	0
B-1-18	B-1-20	B × B	B-1-18	26	25	—	—	0

[1]H = *P. hippocrates*; X = *P. xuthus*; P = *P. polyxenes*; B = *P. "brucei"*.
[2]Used for chromosomal study at its pupal stage.
[3]Both larvæ killed accidentally.
[4]A few were used for chromosomal study at their pupal stage.
[5]Many larvæ died because of the inadequate food plants used for these tests.
[6]No female hybrids were obtained from any of the crosses.

Table 2. PUPAL LENGTHS OF *PAPILIO* SPECIES AND THEIR HYBRIDS

Kind of matings	Food plants	Pupæ obtained	Average pupal length (mm)
X-27 × X	Karatachi	9	30.31±2.01
	Seri	3	30.00±3.12
H × H	Seri[1]	5	36.52±1.94
H-3 × X-18	Seri	14	22.92±1.92
X-26 × H-5	Seri	22	20.61±1.84
	Karatachi	10	19.20±1.21
P-1-70 × X-17 & P-1-73 × X-36	Seri	13	21.62±0.07
B-3-9 × X-24	Seri	7	19.79±0.91

[1]Collected from the field at their 4th instar.

hybrid pupæ between *P. hippocrates* and *P. xuthus* (Remington 1960: plate 3).

The adults (10 males) are almost identical to normal *P. polyxenes* males except in size, and the writer's observations coincide with REMINGTON'S (1960) in character-by-character comparisons, in which the hybrids resemble *P. polyxenes* in 11 detailed characters, *P. xuthus* in 1, and are intermediate in 2. One more character is added here. This character is transverse pale spots in the forewing discal cell. *P. xuthus* has two clear spots and *P. polyxenes* has one slight spot. The hybrids have one or two spots, which are not clear.

Twelve sib matings were obtained from *P. polyxenes* Brood P-1 by hand-pairings. Eggs were obtained from 11 pairs of them, and 5 laid fertile eggs. The fertility of these matings is shown in Table 1. Unfortunately diseases killed all of the offspring in their larval or pupal stages.

HYBRIDS BETWEEN *P. "brucei"* AND *P. xuthus*

Ten *P. "brucei"* females were hand-paired with *P. xuthus* males. Five of them laid eggs but fertile eggs were obtained from only 1 female, B-3-9. Five *P. xuthus* females were hand-paired with *P. "brucei"* males. Although two of them laid eggs, eggs from only one of them, X-16, were fertile. The fertility of the matings is shown in Table 1. Larval foods were as follows: X-16, two by Natsumikan, two by Mitsuba; B-3-9, 27 by Seri, 3 by cultivated carrot. Losses during the larval stages were many. Table 2 shows the number of pupæ obtained and their lengths. They were again very small. These rearings were carried on at the same time as the rearings in 1958, reported in previous sections. Their developmental rates showed no difference in comparisons with other rearings in the previous sections. Five male hybrids were obtained (Table 1, Fig. 8).

Table 3. INTERSPECIFIC DIFFERENCES BETWEEN ♂ *PAPILIO XUTHUS* AND ♂ *P. "BRUCEI"* AND THEIR EXPRESSION IN THE HYBRID*

Character	*xuthus*	*brucei*	Hybrid
1. Ground color:	creamy white	yellow	*int*
2. Basal 2/3 of FW discal cell:	4 pale streaks	dark with peppering of yellow	dark with 4 pale streaks in some indi. (int)
3. Basal ½ of cell Cu_2 of FW:	1 pale streak	dark with peppering of yellow	dark with slight peppering of yellow (*bru-*)
4. Marginal ½ of cell Cu_2 of FW:	J-shape spot	rectangular spot	*xu-*
5. FW cell 2nd A:	1 pale streak	dark with peppering of yellow in base and marginal spot	peppering and spot (int)
6. 2nd pale wedge from FW apex in p.m. row (cell R_5):	with black median spot	spotless	*bru*
7. FW submarginal lunules:	most much longer than broad	about as long as broad	int
8. Blackstriping along veins of FW & HW:	broad	narrow	*xu*
9. HW anterior cell (cell Sc + R_1):	bisected by broad median black patch	no black patch on basal 2/3	*bru*
10. Submarginal lunules of HW:	slender	fat	*bru*

*Symbols are: *xu* = exactly like *xuthus*, *bru* = exactly like *"brucei"*, int = intermediate, *xu-* = most like *xuthus*, *bru-* = most like *"brucei"*, FW = forewing, HW = hindwing, p.m. = postmedian. Names of cells follow "Comstock-Needham" system.

The larvæ of *P. "brucei"* and *P. polyxenes* are similar, and the larval spots were all yellow in the *P. "brucei"* which the writer used. The hybrid larvæ were exactly the same as the hybrid larvæ between *P. polyxenes* and *P. xuthus*. The pupal ground color of *P. "brucei"* is brown or green, and that of the hybrids was also brown or green. The hybrid pupæ were indistinguishable from the hybrid pupæ between *P. polyxenes* and *P. xuthus*. The general appearance of the hybrid butterflies is intermediate between the parental species. Table 3 shows the character-by-character comparisons in the male parental species and the hybrids in adult stage. The same system was used with REMINGTON's Tables 2 and 3 (1960) and the "Comstock-Needham" system was used for the names of wing cells. The hybrid butterflies were intermediate in 4 detailed characters, resemble *P. xuthus* in 2, and resemble

P. "brucei" in 4. The ground color was intermediate, but it was variable in some extent, therefore it is close to *P. xuthus* in some and close to *P. "brucei"* in other.

Twelve hand-pairings were obtained between *P. "brucei"* females and males. Eggs were obtained from 8 pairs, and the eggs from 3 pairs included fertile eggs. Unfortunately diseases killed all of the larvæ.

Backcrosses of Hybrids to *P. xuthus* Females

One male each of Broods H-3a and P-1-70 was hand-paired with *P. xuthus* females which emerged in the laboratory in 1958. One male of Brood B-3-9 was hand-paired with two females of *P. xuthus,* also in 1958. However, only one female which mated with H-3a-5 laid any eggs (3), which were all infertile. Two males of Brood H-34-5 were hand-paired with *P. xuthus* females in 1959; one of the females laid one egg but it was infertile.

Discussion

There is no definite information for a minimum duration of a successful copulation. In about 150 inter- and intra-specific hand-pairings in *Papilio,* which the writer has obtained, fertile eggs were obtained only from the matings which lasted about or more than one hour. Therefore, all matings which lasted less than about one hour were omitted from the present data temporarily. However, there is another problem concerning spermatophore formation in mating. A *P. hippocrates* female, H-3, was hand-paired three times, the first and the second time with *P. xuthus* and the third with *P. hippocrates.* All lasted more than one hour. It laid some fertile eggs after each mating. After the third mating, it laid 81 eggs, but only 8 were fertile and 3 hatched. These larvæ, however, proved to be a hybrid between *P. hippocrates* and *P. xuthus.* Therefore, it is quite possible that the third mating was not effective, probably by improper or no formation of a spermatophore. The writer has a few more exampes of the same kind in other *Papilio* matings. However, the writer is still unable to separate spermatophores which were produced by different males in a female body in *Papilio,* although it is easy in *Colias.* Therefore, more studies should be done concerning the failure to lay fertile eggs after a mating of sufficient duration.

The absence of females, namely the heterogametic sex, from the three kinds of hybrids, is a clear example of Haldane' Rule. There is some possibility of the appearance of female sex if a large enough number of hybrids is obtained. However, male predominancy seems to be fairly definite.

Although a few backcrosses were tried, more experiments are necessary to find out if these hybrids are sterile.

More larvæ chose to feed on Seri (Umbelliferæ) than Karatachi (Rutaceæ) in hybrids between *P. xuthus* and *P. hippocrates* or *P. polyxenes.* These phenomena may tell the food plant preference of hybrid larvæ. However, the softness of Seri leaves in comparison with Karatachi which was not so fresh could also be the reason for it.

The conditions of the rearing room were not controlled. However, since the three kinds of hybrids and their controls were reared at the same time in 1958, the small sizes of the hybrids were not environmental. *P. polyxenes* and *P. "brucei"* which were used for the controls were not reared by the adult stage, but the size of their mature larvae, which were obtained in large numbers was as great as for *P. xuthus* and *P. hippocrates* mature larvæ. The developmental rates of the hybrids and the pure parental species were apparently identical, although a minor difference in the rates may be found when they are checked more precisely.

The high inviability of the F_1 hybrids between *P. xuthus* and the three species of the *P. polyxenes-machaon* group in the writer's experiments, in comparison with the viability of the hybrids within the *P. polyxenes-machaon* group (Clarke & Sheppard 1953, 1955; Remington 1958; Ae in press), indicates that *P. xuthus* is not so closely related to the *P. machaon* group as many taxonomists have presumed. These data support REMINGTON's data and discussion in his 1960 paper. The egg fertility was rather high in some crosses such as 98% in Brood X-70, 95% in Brood X-26, 94% in Brood H-3a (all *xuthus* × *hippocrates*) and 94% in Brood X-16 (*xuthus* × *brucei*). When the eggs started to develop, the larva seems to be fully formed inside of the egg shell in a high percentage in many broods. However, the actual hatch of the larvæ dropped extensively except in one case, 90% hatching in Brood X-26. This phenomenon may indicate weakness of the hybrid larvæ or some differences in egg shell or in the mechanism of emerging from the egg shell between the parental species. More studies are necessary in this point. Many hybrid larvæ were apparently lost by virus diseases. However, they seemed more resistant to virus disease than the larvæ of pure species of the *P. polyxenes-machaon* group. Some of the larvæ of *P. xuthus* were also killed by virus diseases. But *P. xuthus* seemed not to be affected by the same virus which kills the *P. polyxenes-machaon* group, although this is very difficult to prove. If it is really so, this is another negative datum on the relationship between *P. xuthus* and the *P. polyxenes-machaon* group. Egg fertility and hatchability of the controls were rather low in some crosses (Table 1). These phenomena are probably the effect of inbreeding or of shortage of spermatozoa. But the effect of laboratory rearing or virus diseases in developing eggs may not be denied and these could have a similar effect on hybrids.

P. hippocrates larvæ are occasionally found feeding on Rutaceæ in Japan, but it is very difficult to rear the larvæ on Rutaceæ. The writer had no success in getting an adult reared on Rutaceæ thus far, although more species of Rutaceæ should be checked. *P. xuthus* can be reared on Seri (Umbelliferæ), but the results are not so good. Therefore, although the hybrid can be reared on either Rutaceæ or Umbelliferæ, if Rutaceæ-feeding species of the *P. poly-*

xenes-machaon group are used for hybridization with *P. xuthus,* better results may be obtained.

Most probably one could conclude that *P. xuthus* does not belong to the *P. polyxenes-machaon* group from the data of REMINGTON (1960) and the writer in this paper. However, it is possibly more closely related to the *P. polyxenes-machaon* group than the present data indicate.

P. hippocrates and *P. xuthus* are sympatric in Japan. The writer has observed in Nagoya many *P. hippocrates* males flying about at the place where *P. xuthus* females were emerging. Yet, there is no report on natural hybridization. This was confirmed by Dr. T. SHIROZU, T. IWASE and other Japanese butterfly specialists seeing the writer's hybrid. This may indicate the importance of mating behavior, because hand-pairing bypasses these behavior differences.

SUMMARY

1. Of nineteen *Papilio hippocrates* females which were hand-paired with *P. xuthus* males, 7 laid fertile eggs. Twelve male butterflies were reared from these eggs.

2. Of 19 *P. xuthus* females which were hand-paired with *P. hippocrates* males, 5 laid fertile eggs. Seventeen male butterflies were reared from these eggs.

3. The characters of the larvæ, pupæ, and adults of the above F_1 hybrids between *P. hippocrates* and *P. xuthus* were compared to those of the similar hybrids which were obtained by REMINGTON (1960) and to their parental species. The hybrid larvæ and pupæ have intermediate appearances in general between the parental species. The ground color of the pupæ is brown or green. The above hybrid adults are also intermediate in the general appearance and differ in 4 detailed characters from REMINGTON's hybrid. The writer's hybrids resemble *xuthus* in 4 detailed characters, *hippocrates* in 4, and are intermediate in 4.

4. Of five *P. polyxenes* females which were hand-paired with *P. xuthus* males, two laid fertile eggs. Ten male butterflies were obtained from these eggs.

5. The characters of the larvæ, pupæ, and adults of the above F_1 hybrids were compared to those of the similar hybrids which were obtained by REMINGTON and to their parental species. The larvæ and pupæ are generally intermediate of the parental species as in REMINGTON's hybrids. The hybrid males are almost identical to normal *P. polyxenes* males, and detailed characters coincide with REMINGTON's similar hybrids. In addition, transverse pale spots in the forewing discal cell have an intermediate expression between the parental species and are variable.

6. Of 10 *P. "brucei"* females which were hand-paired with *P. xuthus* males, one laid fertile eggs. Five male butterflies were reared from these eggs.

7. Of 5 *P. xuthus* females which were hand-paired with *P. "brucei"* males, one laid fertile eggs but no adult was reared from them.

8. The larvæ and pupæ of *P. "brucei"* are indistinguishable from those of *P. polyxenes;* the larvæ and pupæ of their hybrids with *P. xuthus* are also like those of *P. polyxenes* × *P. xuthus.* The general appearance of the male hybrids between *P. "brucei"* and *P. xuthus* is intermediate between that of the parental species. In detailed characters, they resemble *"brucei"* in 4, *xuthus* in 2, and are intermediate in 4.

9. The inviability of the above three kinds of hybrid is high in general. Egg fertility is rather high in some crosses of all three kinds, but the drop in hatchability is very large. The few backcross attempts were not successful.

10. The larvæ of these hybrids feed on both Rutaceæ and Umbelliferæ. The developmental rates of these hybrids and their parental species are the same. The sizes of these hybrids are very small in comparison with the parental species.

11. The adults of these hybrids are all males and Haldane's Rule applies here.

12. *P. xuthus* seems not to belong to the *P. polyxenes-machaon* group, since they are not closely related with the three species of the *P. polyxenes-machaon* group used in these hybridization experiments. But it may be somewhat more closely related with other species of the *P. machaon* group.

13. There is no record of a natural hybrid between *P. hippocrates* and *P. xuthus* in Japan, although the two species are extensively sympatric in Japan.

Acknowledgements

The writer wishes to express his sincere gratitude to Dr. CHARLES L. REMINGTON, Department of Zoology, Yale University, for his advice and reading this paper in manuscript. He also kindly sent the writer a manuscript copy of his 1960 paper, so that the writer could revise a part of this paper. The writer is grateful to the Agricultural Ministry of Japan for a permission to import American *Papilio* pupæ for experiments reported here, to Rev. FRANCIS BURES, S. V. D., for help in writing this paper, and to the Rocky Mountain Biological Laboratory for facilities given. A fund was supplied from the Ministry of Education in Japan in 1959.

Literature Cited

Ae, S. A., in press. A study of hybrids in the *Papilio machaon* group.

Clarke, C. A., & P. M. Sheppard, 1953. Further observations on hybrid swallowtails. *Supplement to the Entomologist's Record* 65: No. 9.

............, 1955. A preliminary report on the genetics of the *machaon* group of swallowtail butterflies. *Evolution* 9: 182-201.

............, 1956. Hand-pairing of butterflies. *Lepid. News* 10: 47-53.

Esaki, T., & T. Shirozu, 1951. *Shin Konchu* 4: no. 9.

Maeki, K., & C. L. Remington, 1960. Studies of the chromosomes of North American Rhopalocera. 1. Papilionidæ. *Journ. lepid. soc.* 13: 193-203.

Remington, C. L., 1958. Genetics of populations of Lepidoptera. *Proc. X. int. congress ent.* 2: 787-805.

............, 1960. Wide experimental crosses between *Papilio xuthus* and other species. *Journ. lepid. soc.* 13: 151-164.

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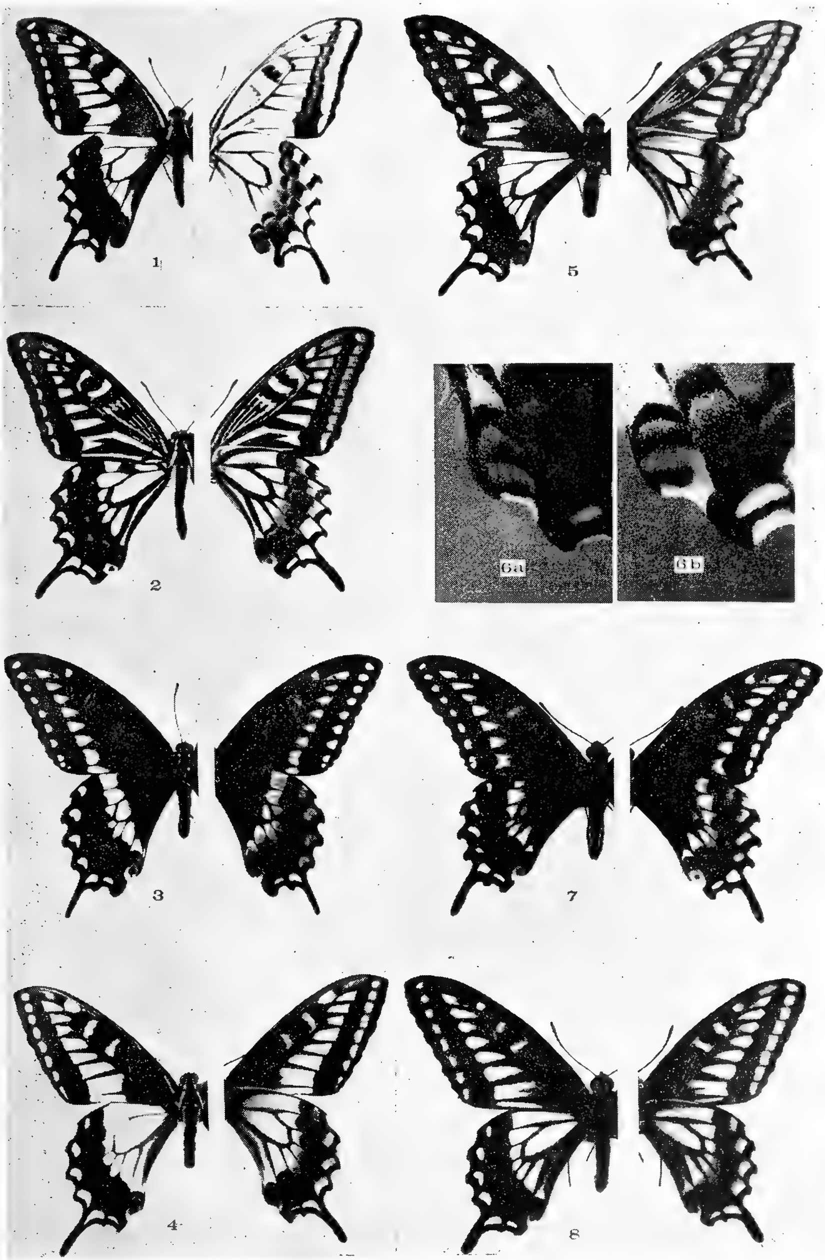
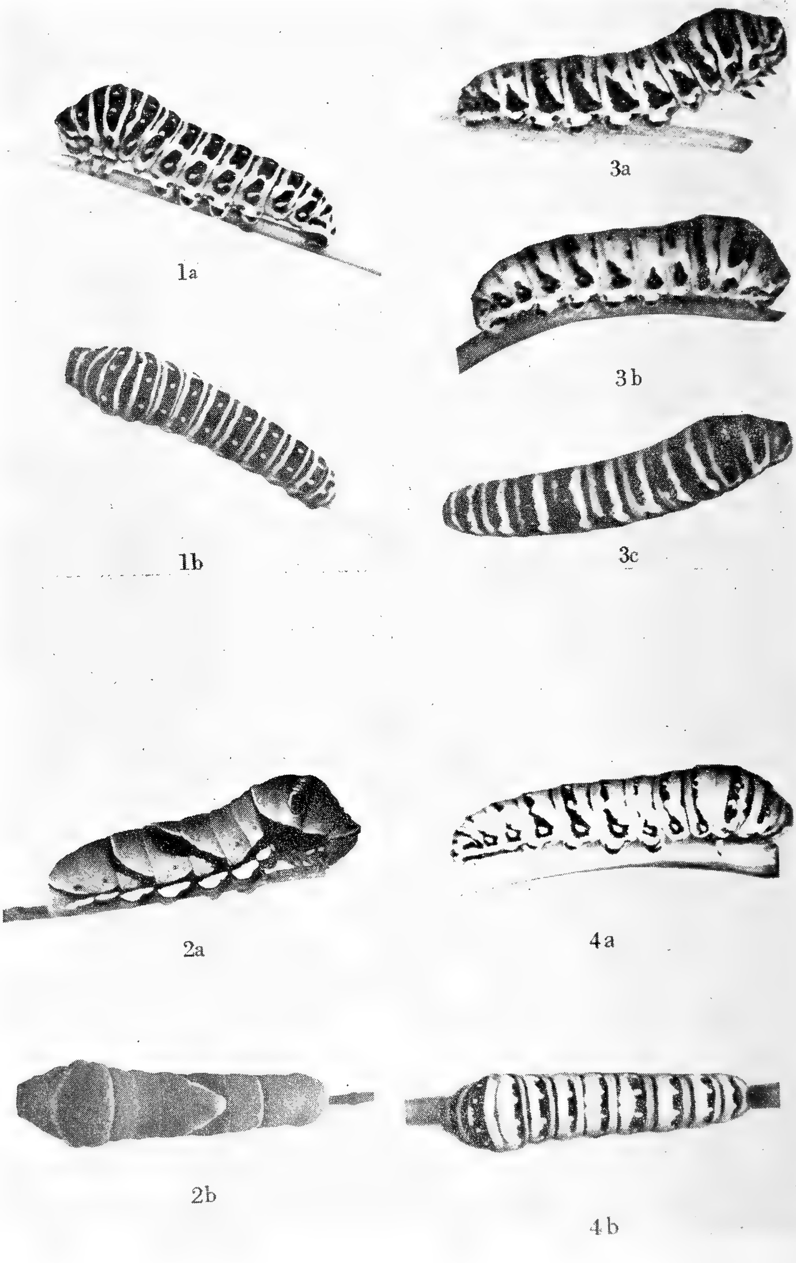


Fig.1 — ***Papilio hippocrates*** ♂ (summer form); fig.2 — ***P. xuthus*** ♂ (summer form); fig.3 — ***P. polyxenes*** ♂; fig.4 — ***P. "brucei"*** ♂; fig.5 — ♂ F_1 hybrid ***hippocrates*** × ***xuthus*** (H–3–3); fig.6 — anal eyespot of same F_1 hybrid (H–3–3), enlarged; fig.7 — ♂ F_1 hybrid ***polyxenes*** × ***xuthus*** (P–1–70–1); fig.8 — ♂ F_1 hybrid ***"brucei"*** × ***xuthus*** (B–3–9–2). Upperside at left of each figure, underside at right.



PAPILIO 5th INSTAR LARVÆ: Fig.1a, 1b — *P. hippocrates*; fig. 2a, 2b — *P. xuthus*; fig.3a, 3b, 3c — F_1 hybrid *hippocrates* × *xuthus*; fig.4a, 4b — F_1 hybrid *polyxenes* × *xuthus*. Each figure shows lateral view above, dorsal view below.

PRELIMINARY CONTRIBUTION TO A REDEFINITION OF THE GENERA OF NORTH AMERICAN HAIRSTREAKS (LYCÆNIDÆ) NORTH OF MEXICO

by J. BENJAMIN ZIEGLER

It is well known that the generic arrangement of the North American hairstreaks (Theclinæ auct.) is unsatisfactory (cf. A. B. KLOTS, 1951: p. 126). The current classification is exemplified for the eastern part of the continent north of Mexico by that of KLOTS (1951: pp.314-316), and for the continent as a whole north of Mexico by that of J. MCDUNNOUGH (1938).

For some time the author has been working on this problem, and has arrived at a revised classification based in large part on a survey of the male *and female* genitalia of practically all of the hairstreaks known to be permanent residents of North America north of Mexico. Although a definitive manuscript giving full details of this work is in process of preparation, increasing current interest in this area has prompted the presentation of the major results at this time. They may be summarized as follows:

(1) The species contained in the monotypic genera *Habrodais* Scudder, *Hypaurotis* Scudder, *Eumæus* Hübner, *Atlides* Hübner, and *Erora* Scudder are quite distinct and these genera may be retained, at least provisionally.

(2) The genus *Strymon* Hübner with *S. melinus* Hübner as type species is restricted to a few of the species currently included therein.

(3) The type species of the monotypic genera *Callipsyche* Scudder and *Satyrium* Scudder are found to be congeneric with each other and with a large group of species hitherto included in the heterogeneous "genus" *Strymon* (*s. l.*). The name *Satyrium* Scudder is selected for this new grouping.

(4) The remaining species from the old *Strymon* (*s.l.*), apparently mostly tropical in their affinities, were for the most part not studied and are relegated for the time being to the non-committal, quasi-generic grouping "Strymon." It is emphasized that this is purely a device of nomenclatorial convenience, and it is not intended that the term "Strymon" should have any formal status in nomenclature. Much more study of the Neotropical fauna will be required to enable proper placement of these species.

(5) The genera *Mitoura* Scudder, *Incisalia* Scudder, and *Callophrys* Billberg are combined under the latter name.*

(6) The two genera *Satyrium* (*s.l.*) and *Callophrys* (*s.l.*), as herein redefined, are subdivided into sections and species groups. No new infrageneric names are coined, but existing names are indicated where applicable in a subgeneric sense.

Changes made in the existing classification are given below in check-list form, expanded to indicate the infrageneric groupings adopted; no attempt has been made to re-assess the taxonomic validity of the specific names listed.

* This combination was first suggested by Mr. HARRY K. CLENCH, based on other than genitalic characters.

This is followed by keys defining the generic and infrageneric groupings as listed. The genitalic terms used are taken from KLOTS (in S. L. Tuxen, 1956). Male genitalia were mounted for study to show the ventro-caudal aspect, with the valvæ and penis removed and mounted separately to display the ventro-caudal and lateral aspects, respectively. Female genitalia were mounted to show the ventral aspect.

Several individuals and institutions have generously given assistance of various sorts during the conduct of this research. Proper acknowledgment of this indebtedness will be deferred for the most part until the appearance of the amplified version of this paper. However, it is desired to express thanks at this time to Dr. PAUL R. EHRLICH and Mr. HARRY K. CLENCH for kindly permitting the examination before publication of their manuscript describing the new species (and subgenus) *Callophrys* (*Sandia*) *macfarlandi* Ehrlich & Clench.

CHECK LIST OF SPECIES FORMERLY INCLUDED IN THE GENERA *Strymon, Callipsyche, Satyrium, Mitoura, Incisalia,* AND *Callophrys*

Strymon Hübner

1. *melinus* Hübner
2. *avalona* Wright
3. *martialis* Herrich-Schäffer
4. *acis* Drury
5. *columella* Fabricius

Satyrium Scudder (*s.l.*)

Section A

Group I

1. *liparops* Boisduval & Leconte
2. *kingi* Klots & Clench
3. *titus* Fabricius
4. *behrii* Edwards
5. *sæpium* Boisduval

Group II

6. *fuliginosa* Edwards
7. *adenostomatis* Henry Edwards
8. *auretorum* Boisduval

Section B

Group III

9. *falacer* Godart
10. *calanus* Hübner
11. *caryævorus* McDunnough
12. *edwardsii* Grote & Robinson
13. *californica* Edwards
14. *acadica* Edwards
15. *sylvinus* Boisduval
16. *dryope* Edwards

Group IV

17. *ontario* Edwards
18. *favonius* J. E. Smith

Group V

19. *alcestis* Edwards
20. *oslari* Dyar

Callophrys Billberg

Section A

Group I (subgenus *Mitoura* Scudder)

1. *gryneus* Hübner
2. *siva* Edwards
3. *loki* Skinner
4. *hesseli* Rawson & Ziegler
5. *nelsoni* Boisduval

Section B

Group II (subgenus *Sandia* Clench & Ehrlich)

6. *xami* Reakirt
7. *macfarlandi* Ehrlich & Clench

Group III (subgenus *Incisalia* Scudder)

8. *augustinus* Westwood
9. *iroides* Boisduval
10. *irus* Godart
11. *henrici* Grote & Robinson
12. *mossii* Henry Edwards
13. *fotis* Strecker
14. *doudoroffi* dos Passos
15. *polios* Cook & Watson
16. *lanoraieensis* Sheppard
17. *niphon* Hübner
18. *eryphon* Boisduval

Section C

Group IV

19. *spinetorum* Hewitson
20. *johnsoni* Skinner

Group V (subgenus *Callophrys* Billberg)

21. *dumetorum* Boisduval
22. *affinis* Edwards
23. *sheridani* Edwards
24. *apama* Edwards

"Strymon"

1. *m-album* Boisduval & Leconte
2. *cecrops* Fabricius
3. *beon* Cramer

4. *buchholzi* H. A. Freeman
5. *simæthis* Drury
6. *pastor* Butler & Druce
7. *facuna* Hewitson
8. *mæsites* Herrich-Schäffer
9. *bazochii* Godart
10. *clytie* Edwards
11. *azia* Hewitson
12. *endymion* Fabricius
13. *cestri* Reakirt
14. *yojoa* Reakirt
15. *spurina* Hewitson
16. *laceyi* Barnes & Mc Dunnough
17. *zebina* Hewitson
18. *rufofusca* Hewitson
19. *echion* Linnæus
20. *jada* Hewitson
21. *critola* Hewitson
22. *leda* Edwards
23. *polingi* Barnes & Benjamin

KEYS TO THE GENERA

STRYMON s. s., *CALLOPHRYS*, AND *SATYRIUM*

A. Based on Male Genitalia.

1. Orifice of ædœagus unornamented, the ædœagus being simply and abruptly truncated distally .... *Strymon*
1. Orifice of ædœagus with a prominent rostellum and one or two cornuti, usually serrate, directed dorso-caudally 2
2. Ædœagus rather more than twice as long as long axis of ring, more or less strongly curved ventrally, rostellum rather less conspicuous, flattened or spatulate dorso-ventrally .... *Callophrys*
2. Ædœagus considerably less than twice as long as long axis of ring, slightly curved dorsally, rostellum more conspicuous, heavily sclerotized and keel-shaped, flattened laterally .... *Satyrium*

B. Based on Female Genitalia.

1. Ductus bursæ with a more or less tightly-convoluted spiral near corpus bursæ; latter with paired, elongated, "feather-shaped" signa .... *Stymon*
1. Ductus bursæ straight, without convolution near corpus bursæ, paired signa of the latter, when present, not "feather-shaped" 2
2. Corpus bursæ without a sclerotized cervix at juncture with ductus bursæ .... *Callophrys*
2. Corpus bursæ with a narrow, more or less heavily sclerotized cervix at juncture with ductus bursæ .... *Satyrium*

KEY TO SECTIONS AND SPECIES GROUPS OF THE GENUS *SATYRIUM* BASED ON FEMALE GENITALIA

1. Genital plate with a bilateral pair of more or less conspicuous, more or less heavily-sclerotized, lobe-like pockets or invaginations, their bottoms directed cephalad (SECTION A) 2
1. Genital plate without such a pair of pockets (SECTION B) 3
2. Ductus bursæ relatively short, flaring widely at or near antrum, outline ovate or roughly triangular .... I. *LIPAROPS* GROUP
2. Ductus bursæ relatively longer and without marked flare at or near antrum .... II. *FULIGINOSA* GROUP
3. Ductus bursæ with shallowly sinuate outline, doubly or triply-inflected and narrowing between ostium bursæ and corpus bursæ .... III. *FALACER* GROUP
3. Ductus bursæ without definitely sinuate outline 4
4. Ductus bursæ relatively short and lightly sclerotized with rather fragile wrinkled appearance .... IV. *ONTARIO* GROUP
4. Ductus bursæ relatively longer and more heavily sclerotized, with more robust, smoother appearance .... V. *ALCESTIS* GROUP

KEY TO SECTIONS AND SPECIES GROUPS OF *CALLOPHRYS* BASED ON ♀ GENITALIA AND WINGS

1. Corpus bursæ with signum vestigial or absent (SECTION A) .... I. *GRYNEUS* GROUP (Subgenus *Mitoura*)
1. Corpus bursæ with paired signa present 2
2. Ductus bursæ weakly sclerotized or membranous at juncture with corpus bursæ and/or antrum of ductus (SECTION B) 3
2. Ductus bursæ entirely sclerotized (SECTION C) 4
3. Wings beneath a shade of green .... II. *MACFARLANDI GROUP* (Subgenus *Sandia*)
3. Wings beneath a shade of brown or gray, not green .... III. *NIPHON GROUP* (Subgenus *Incisalia*)
4. Hind wings with tail, color beneath a shade of brown .... IV. *SPINETORUM* GROUP
4. Hind wings without tail, color beneath a shade of green .... V. *RUBI* GROUP (Subgenus *Callophrys*)

References

Klots, Alexander B., 1951. *A field guide to the butterflies of North America, east of the Great Plains.* Houghton Mifflin Company, Boston.

----------, 1956. 20 Lepidoptera, *in*: S. L. Tuxen, *Taxonomist's glossary of genitalia in Insects*: 97-111. Ejnar Munksgaard, Copenhagen.

McDunnough, J., 1938. Check list of the Lepidoptera of Canada and the United States of America. *Mem. So. Calif. Acad. Sci.* 1: 23-25.

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TAXONOMIC NOTES ON SOME NEARCTIC RHOPALOCERA 1. HESPERIOIDEA

by Cyril F. dos Passos

Introduction

The object of the present paper is to explain briefly the systematic changes that will be incorporated in the forthcoming Check List of Nearctic Rhopalocera and to give the reasons therefor.

Contrary to the present practice, the Check List will proceed from the lower butterflies, the Hesperioidea, to the higher, the Papilionoidea, and the same system will be followed within those super-families in the arrangement of the families, subfamilies, and genera. This is believed to be the most scientific approach to the problem.

In the Hesperioidea the result is the complete reversal of the order of subfamilies as well as the genera used by Evans (1951-1955). As a result the List will commence with Megathymidæ to be followed by Hesperiidæ, with Hesperiinæ, Pyrginæ, and Pyrrhopyginæ in that order. The genera throughout will be those employed by Evans with the exception of one name (*Urbanus*), that has been invalidated by the International Commission on Zoological Nomenclature (Opinion 278) since the publication of his work.

There will be a number of changes in the systematic arrangement of the species followed by Evans, because it is quite evident from an examination of his Catalogue that the British Museum (Natural History) does not have an extensive collection of Nearctic hesperiids and among those that it does have there are unfortunately some mislabeled specimens. This has at times led Evans astray.

A number of typographical errors in Evans' work will be corrected in these notes. Many such errors have been corrected already in the "Addenda and Corrigenda to Parts I and II" of his work (1953, pt.3, pp.233-234) and in Appendix II "Addenda and Corrigenda to Parts I, II and III," (1955, pt.4, pp.475-478), and in a four-page "Addenda and Corrigenda to the 'Catalogue of American Hesperiidæ' " published by the Trustees of the British Museum (Natural History), my copy thereof having been received on 10 September 1956, but there are still other errors which will be corrected herein. The attention of students is called to these important corrections.

There is an abstract of Evans' work by Bellinger (*Lepid. News* 10: 60-65; 1956) listing all new names proposed by Evans and giving the type species of the generic names. This is most useful for quick reference.

The arrangement of the Papilionoidea will follow the same system as above outlined, but in this case in accordance more or less with Warren's (1947) plan, *i.e.,* it will start with the Papilionidæ and end with the Satyridæ, those being considered respectively the lowest and highest families. It must be confessed that there is much more room for differences of opinion respecting the proper arrangement of the intervening families, their subfamilies and genera. However, since these are subjective matters on which it is impossible to please everyone, it has been considered best to follow WARREN especially since the latest important work on this subject by EHRLICH (1959) agrees in most respects with his conclusions. Within the genera MCDUNNOUGH'S (1938) listing of the species has been followed except where it has been possible to make some slight improvement or genera have since been revised.

It is hoped that the above fundamental changes, which may seem somewhat radical at first, will establish the Nearctic list of Butterflies on a firm basis from which there should be no necessity for any substantial changes in the future. No new names are proposed in these notes, but some names are elevated or reduced in rank or sunk in the synonymy.

In recent years there has been a strong tendency among some authors, mostly European, to erect many new or revise some old generic names, usually for a very small number of species. Insofar as the Holarctic species are concerned, this splitting of genera has been done mostly by NABOKOV in the Plebejinæ, REUSS in the Argynninæ, and WARREN in the Pyrginæ and Argynninæ. While the practice of splitting genera has merit in pointing out differences between heretofore considered closely related species, it has been considered best in the Check List to give most of these new or resurrected names subgeneric standing only, thus following the practice adopted by KLOTS (1951). Such a procedure gives recognition to these names and permits any student to use them as full genera, if so desired.

A few words must be added concerning the Règles Internationales de Nomenclature Zoologique. These Règles, originally adopted at Berlin in 1901, were comparatively simple until amended at Paris in 1948. Their text until then will be found in 1958 *Bulletin Zoological Nomenclature* 14: pp.IX-XXVIII. At Paris an effort was made to amend the Règles so as to cover almost every conceivable contingency by a rule or a recommendation. The Règles adopted at that Congress (1948) were never published in final form although the Secretary of the Commission was directed to do so, (*Bulletin Zoological Nomenclature* 4: 78, 342; 1950).

At the next Congress held at Copenhagen in 1953 more or less under the same influences, the Règles were amended again and considerably amplified in a still more determined effort to cover every possible contingency. Again the Secretary of the Commission was directed (CDZN. 98-103) to publish the draft text of the Règles, which was assigned to Professor BRADLEY for reduction. This excellent "draft" was published prior to the Zoological Congress held in London in 1958 (*Bulletin Zoological Nomenclature* 14: 1-286; 1957). Another Colloquium was held a week ahead of that Congress at which the Règles were again substantially and radically revised. When the results of that Congress will be published has not been announced but it has not yet been done.

As a result of this brief history of the Règles, it can be seen that they are in a somewhat chaotic condition. No one knows the exact text. Decisions taken by the Commission prior to 1948 as well as at that time have been revised and some even reversed; decisions taken in 1953 will presumably be again revised and some reversed. In addition the Règles have become so long, complicated and involved that even the proverbial "Philadelphia lawyer" cannot understand them in all their detail and much valuable time is wasted in trying to solve the most simple problems.

In this paper and in the Check List an effort will be made to comply with the Règles. The principle of priority will be adhered to strictly. The orginal spelling of a name will be used unless obviously a *lapsus calami*.

In this country for nearly half a century entomologists have enjoyed the benefit of an excellent Entomological Code of Nomenclature published by Banks and Caudell (1912). This Code is clear and simple. In the writer's opinion it has worked well in practice and is preferable to the International Règles in their present state of complexity and flux. It will be followed in these notes and the Check List, except in those cases where it has been modified by the Règles.

I am indebted to my colleague, Mr. Ernest L. Bell, Sr., of Flushing, New York, for much valuable advice and assistance in the Hesperioidea and for permission to use his complete card index of the genera and species of the new world hesperiids. Also to Professor Alexander B. Klots, of Pelham, New York, for help in the Pieridæ and *Boloria*. Their interest and encouragement in this work have been of great aid to me. I am greatly obliged also to Mr. Paddy B. McHenry, of Burbank, California, who, in the course of preparing a compilation of the original descriptions of Nearctic Rhopalocera, has run across many perplexing problems of spellings, authorships, dates of publication, etc. He has most kindly placed his notes on these matters at my disposal with permission to use the same. I must also express my thanks to Dr. Paul R. Ehrlich of Stanford, California, for advice on the arrangement of families and genera and for going over my *ms.* and pointing out some errors therein. He has been most kind and generous in his help. Many others, too numerous to mention here, have had the kindness to answer questions about various matters that arose from time to time. To them my thanks are expressed also.

These notes do not include all changes in dates and authorships, of which quite a few will appear in the Check List, mainly as a result of five papers published recently by the author in *The Lepidopterists' News*. Such changes would not seem to require any special documentation since the results generally follow a careful check of the names in the literature and are explained in these five papers.

We proceed now to the discussion of all systematic changes which are not already explained in the literature or conveniently found by those who do not have the entire literature at their command, first promising that the author would be pleased to hear from all those having differences of opinion respecting these notes, especially if their inquiries are documented.

Taxonomic Notes

MEGATHYMIDÆ

Evans (1955, p.464), followed by J. A. Comstock (1956), has reduced this name to a subfamily name (Megathyminæ). In this the present work Barnes and McDunnough (1912) and McDunnough (1938) and Klots (1951) have been followed. There appears to be sufficient reason to consider these insects as constituting a family as explained by the last two authors.

Megathymus yuccæ Boisduval & LeConte, "1833" [1834]. This name was mentioned first by Boisduval and LeConte, as *Eudamus? yuccæ*. If that was not a valid publication because of the question mark after the generic name, the author is Walker (1856, p.1583), who placed the species in *Castnia*. However, the publication by Boisduval and LeConte is considered valid.

Megathymus alabamæ H. A. Freeman, 1943. In giving this name subspecific rank under *yuccæ*, Evans (1955, p.467) overlooked the fact that Freeman had sunk it as a synonym (1952, p.30). Freeman has been followed, and Evans (*in litt.*) later corrected this error.

Megathymus ursus violæ Stallings & Turner, 1956. During the past several years the descriptions of a number of new species of *Megathymus* have been published by Stallings and Turner as well as by other authors. These are based upon differences in pattern, genitalia, and especially the food plants upon which the larvæ were found or reared. Having examined the genitalia of several species of *Megathymus* E. L. Bell and the writer found that they differ considerably from specimen to specimen in the same species and the conclusion has been reached that some of the new species may in fact be subspecies. In this case the authors themselves have suggested that *violæ* may be a subspecies of *ursus* and that suggestion has been adopted in giving it subspecific rank.

Megathymus aryxna Dyar, 1905. The correct taxonomic position of this name has been the subject of differences of opinion (Stallings & Turner 1954, p.77; Bell & dos Passos 1954, pp.1-5; and dos Passos & Bell 1955, pp. 289-294). This problem has been decided by the International Commission on Zoological Nomenclature. That decision fixes the lectotype of this name as the species figured by Druce in Godman & Salvin (vol.3, p.69, f.4) and not one of the specimens in the United States National Museum.

HESPERIIDÆ

HESPERIINÆ

Panoquina wimico (Plötz), 1883. Evans (1955, p.403) ascribes this name to Godman, (1907) "(Plötz MS)" but its publication earlier by Plötz in the synonymy of *P. panoquin* is valid. It is therefore ascribed to that author.

Amblyscirtes hegon (Scudder), 1863. This name has been sunk by Evans (1955, p.389) for *A. samoset* (Scudder), 1863 on the theory that as the first reviser SCUDDER (1872) took that action, thus upsetting well-established usage but in accordance with the present Règles.

Atrytonopsis hianna turneri H. A. Freeman, 1948. There is sufficient difference between specimens from Massachusetts and Kansas, the respective type localities of these insects, to justify giving subspecific standing to *turneri*.

Atrytonopsis cestus (Edwards), 1884. This name is given specific standing. EVANS may not have had anything before him but *A. python*. Both are rare in collections, especially *cestus*. The hyaline spots are not the same color in these insects.

Atrytonopsis ovinia edwardsi Barnes & McDunnough, 1916. EVANS (1955, p.386) places *zaovinia* Dyar, 1913 described from Mexico as a subspecies of *A. ovinia* with *edwardsi* as a synonym. Examination of specimens in the American Museum of Natural History collection shows that *edwardsi* is entitled to subspecific rank, and *zaovinia* is omitted from the List as not being a Nearctic insect.

Euphyes conspicua buchholzi (Ehrlich & Gillham), 1951. This name, sunk by EVANS (1955, p.363), warrants subspecific standing as a large, well-marked population occurring in Nebraska and other western states from which EVANS appears to have had no material.

Euphyes vestris (Boisduval), 1852 and *E. v. metacomet* (Harris), 1862. These names were proposed for specimens from California and Massachusetts respectively, ends of an east-west cline, and appear sufficiently distinct to warrant subspecific standing. This fact was recognized by KLOTS (1951, p.259), who removed *metacomet* from the synonomy.

Poanes massasoit hughi Clark, 1931 and *P. m. suffusa* (Laurent), 1892. EVANS (1955, p.345) appears to have had no specimen from Maryland, the type locality of *hughi*. These specimens differ sufficiently to warrent subspecific standing. Also form *suffusa* (Laurent), 1892 is recognized as a distinct form occurring in isolated colonies in the southern range of the species.

Poanes hobomok f. ♀ pocahontas (Scudder), 1863. While EVANS does not recognize form names, in the present author's opinion they are of value when clearly distinct, consequently, the dark female of *hobomok* is recognized as form ♀ *pocahantas*.

Poanes aaroni howardi Skinner, 1896. This insect is recognized as the subspecies of *aaroni* occurring in Florida. EVANS (1955, p.346) appears to have had only two females from Florida and therefore may not have been in a position to judge the validity of the name.

Poanes baiva (Evans), 1955. This name, ascribed to "(Boisduval MS)" by EVANS (1955, p. 346) was included by BUTLER (1870) among species of *Pamphila*, but without any description or being placed in any particular synonomy. It appears therefore to have been a *nomen nudum* until published by EVANS in the synonomy of *P. yehl* Skinner, 1893.

Ochlodes yuma (Edwards), "1872-3" (1873). This insect placed by EVANS (1955, p.343) as a subspecies of *O. sylvanoides* (Boisduval), 1852 has been given specific standing. EVANS appears to have had one specimen only from Olancha, California, whereas the type was described from Arizona.

Atrytone logan lagus (Edwards), 1881. Evans (1955, p.340) mistook the type locality of *logan* as "Philadelphia", whereas it is Lansing, Michigan. *A. l. lagus* was described from Texas and is sufficiently distinct to warrant subspecific standing.

Pompeius verna sequoyah (H. A. Freeman), 1942. This insect is considered sufficently different from the nominate subspecies to warrant subspecific rank. It is accordingly removed from the synonomy of *P. verna*, where Evans (1955, p.336) places it.

Wallengrenia otho Smith, 1797. This species has caused considerable difficulty. It is not correctly listed by McDunnough (1938, p.34) or by Evans (1955, pp.332, 333). In the first place *drury* (=*drurii* and *druryi*) (Latreille), "1819" [1824] is not the correct specific name, as conceded by Evans ("1955" [1956], p.218). The correct name is *otho* and *drury* does not occur in the Nearctic region but occurs as a subspecies in Hispaniola, St. Thomas, and Porto Rico. In the second place, *pustula* Geyer, 1832 is not a subspecies but a synonym of *otho otho*. While we are not concerned with *curassavica* (Snellen), 1886 because probably it does not occur in our faunal region it should be pointed out that its two synonyms, *lacordairii* Godman, 1900 and *jobrea* Dyar, 1919, should be omitted also from the List. The underside of the secondaries of Mexican specimens are yellowish and not reddish as are specimens from the southern United States. *W. curassavica* was recorded by H. A. Freeman (1950, p.78) from Texas, but the record is omitted by Evans (1955). According to Bell (1946, p.140) it is a subspecies of *W. otho*. It is not included in the List with its synonym *winslowi* Weeks, 1906.

Wallengrenia ætna (Boisduval), 1870. This name listed by McDunnough (1938, p.34) as a synonym of *Catia otho egeremet* is omitted from the List. It appears to have been a misidentification by Scudder (1889, p.1696). The insect was described from Sicily and is included by Evans (1949, p.431) in his catalogue of the Hesperioidea from Europe etc.

Polites enys Scudder, 1889. Evans (1955, p.332) calls attention to the fact that *Pamphila enys* Butler (1870) is a *nomen nudum* and ascribes the name to Lindsey, Bell and Williams (1931). However, the next valid use of this name was by Scudder (1889, p.1683) when he placed it in the synonymy of *P. peckius* Kirby (1837).

Polites sabuleti chusca (Edwards), "1872-3" (1873). This name, placed in the synonomy of *P. s. sabuleti* (Boisduval), 1852 by Evans (1955, p.331) is given subspecific standing as the result of an examination of a long series of specimens from the type locality in the American Museum of Natural History. Evans appears to have seen no specimens from Arizona, the type locality.

Polites sabuleti tecumseh (Grinnell), 1903. This name, given subspecific standing by Evans (1955, p.331) has been placed in the synonomy of *P. sabuleti* (Boisduval), 1852.

Polites sabuleti mardon (Edwards), 1881 and *P. s. draco* (Edwards), "1870-1" (1871). These names have been given specific standing. Evans appears to have seen no specimen of the former.

Polites manataaqua Scudder, 1863. This name, usually ascribed to Harris, 1862, has been credited to Scudder by Evans (1955, p.328), which is correct.

Polites siris (Edwards), 1881. This name has been removed by the author as a subspecies of *P. mystic* (Scudder), (1863) and given specific standing. It does not appear to be related to *mystic*.

Polites combinata Plötz, 1883. The author of this name is Plotz, 1883 and not Godman, 1907 as given by Evans (1955, p.326). It is a synonym of *P. v. præceps* (Scudder) (1872, p.79) and does not occur in North America.

Hesperia comma ochracea Lindsey, 1941. This name, proposed for a form of *colorado*, is given subspecific standing as a subspecies of *comma* (Linnæus), 1758.

Hesperia comma ruricola Boisduval, 1852. This name has been transferred to *H. comma* (Linnæus), 1758 as a subspecies, replacing *H. harpalus* (Edwards), 1881 in accordance with the advice of Bell and Evans (*in litt.*).

Hesperia comma yosemite (Leussler), 1933. This name, sunk by Evans (1955, p.319) as a synonym of *harpalus* (Edwards), 1881 is given subspecific standing as a race of *comma* and removed from the synonomy of *harpalus*.

Hesperia colorado f. leussleri Lindsey, 1940. This name, sunk by Evans (1955, p.319) as a synonym of *harpalus*, is given subspecific standing as a race of *H. comma* (Linnæus), 1758.

Hesperia pahaska williamsi Lindsey, 1940. This name, proposed as a form of *pahaska Leussler*, 1938 and sunk by Evans (1955, p.321) as clinal, is removed from the synonomy and placed as a subspecies. The author sees nothing wrong with clinal names, especially when they come from the center or the ends of a cline.

Hesperia pawnee montana (Skinner), 1911. This name, sunk by Evans (1955, p.322) as a synonym of *H. pawnee* Dodge, 1874 is given subspecific standing. It represents a very dark population occurring in Colorado. (See *Ent. news* 32: 206; 1921).

Hesperia sassacus manitoboides (Fletcher), 1889. This name, sunk by Evans (1955, p.323) apparently without an examination of any specimen, is restored to subspecific standing.

Hesperia attalus seminole (Scudder), 1872. This name proposed for Floridian specimens was sunk by Evans (1955, p.323) as a synonym of *attalus* but that species was described from Waco, Texas, and Evans appears to have had no typical material before him. Specimens from Florida being somewhat different, the name is restored to the List as a subspecies.

Hesperia liberia Plötz, 1883. It is somewhat doubtful where this name should be placed. The type is lost or destroyed and the description is unsatisfactory. Not even a type locality is given. Probably it is a synonym of *H. leonardus* Harris, 1862, where it appears best to place it for the time being.

Hylephila phyleus (Drury), "1770" [1773]. This name has been written usually *"phylæus"*, but that was not the original spelling and there is no apparent reason for changing it. Phyleus was the son of Augeas whose stable Hercules cleansed.

Hylephila phyleus f. pallida Hayward, 1944. This name is recognized as a valid form name for a nearly white aberration. While the type was collected in Argentina, such a form could occur in North America.

Thymelicus lineola f. pallida Tutt, 1896. EVANS overlooked the occurrence of this form in the Nearctic region. The name was proposed for a specimen from Europe, but the form has been reported from Michigan by CLENCH (1948, p.105).

Copæodes Edwards, 1877. EVANS (1955, p.307) ascribes this name to SPEYER. It may be that SPEYER is responsible for the description but it is not clear from EDWARDS' paper that SPEYER is responsible also for the name. If so it should be cited "Speyer *in* Edwards, 1877." In the meanwhile, it seems best to retain EDWARDS as the author.

Perichares philetes adela (Hewitson), 1867. This subspecies, incorrectly dated by EVANS (1955, p.254) as "1871" has priority over *dolores* Reakirt, 1868. Consequently *dolores* is placed in the synonmy.

Eutychide complana (Herrich-Schäffer), 1869. EVANS (1955, p.198) records a specimen from "Texas." This locality is highly improbable and requires verification before the name is added to the Nearctic List.

Cymænes tripunctus theogenis (Capronnier), 1874. EVANS (1955, p.129) lists five specimens, one from "Idaho" and four from "Colorado" under this name, but it is believed that they are mislabeled. For that reason *C. t. theogenis* is omitted from the List.

Cymænes odilia trebius Mabille, 1891. This appears to be the insect determined by H. A. FREEMAN (1945, p.103) as *"Lerodea edata* (Plötz)", 1883. The name *edata* is now applied to a subspecies of *odilia* occurring in South America.

Pyrrhocalles utha Hewitson, 1868. This name, placed by EVANS (1955, p.81) as a synonym of *P. antiqua,* is omitted from the List with that name as explained below.

Pyrrhocalles antiqua (Herrich-Schäffer), 1863. MCDUNNOUGH (1938), lists *Phemiades antiqua* with *P. jamaicensis* Schaus, 1902 as a synonym. According to BELL (*in litt.*) these are distinct species now transferred to *Pyrrhocalles.* The former was described from "Cuba", later claimed to be from Haiti (Evans, 1955, p.81), and the latter from Jamaica. It is very doubtful whether either species occurs in the Nearctic region. The Nearctic records of *antiqua* and *jamaicensis* are believed to be false. Until further light is thrown on this problem *P. jamaicensis* will be retained in the List but preceded by an asterisk and *P. antique Auctorum* placed as a synonym.

Phemiades jamaicensis Barnes & Benjamin, 1926 *nec* Schaus, 1902. As explained above, this record for the United States is from a mislabelled specimen of *P. jamaicensis* Schaus which was described from Jamaica and not from the Nearctic region. See Bell, 1938, p.H-32 and Evans, 1955, p.81.

Synapte malitiosa pecta Evans, 1955. H. A. Freeman's record (1945, p.103) of "*Godmania malitiosa* (Herrich-Schäffer)", 1865, from Texas should be referred to this subspecies.

Carterocephalus palæmon mesapano (Scudder), 1868. This name is given subspecific standing. It was described from Maine, whereas *C. mandan* (Edwards), "1863-4" (1863), was described from Lake Winnipeg, and the two populations differ sufficiently to justify recognition of each.

PYRGINÆ

Pholisora libya (Scudder), 1878. Evans (1953, p.232) states erroneously that the type locality of this insect is "Utah." In fact, it is Beaver Dam, Arizona. He places *P. lena* (Edwards), 1882, in the synonymy. This population, described from Minta, Montana, is sufficiently distinct to warrant subspecific standing.

Heliopetes laviana leca Butler, 1870. This name is omitted because it is a subspecies of *H. laviana,* which does not occur in the Nearctic region.

Heliopetes nivella (Mabille), 1883. This name, listed by McDunnough (1938, p.31) as a subspecies of *H. macaira* (Reakirt), 1866, was described from Bogota, Colombia. It, together with its synonym *nivea* Scudder, 1872, is omitted from the Check List as not Nearctic.

Heliopetes sublinea Schaus, 1902. This name, listed by Evans (1953, p.225) as a questionable synonym of *H. macaira* Reakirt, was described from Mexico. According to Bell (*in litt.*) it is a species closely allied to *H. domicella* (Erichson), 1848 but has not been recorded from the Nearctic region. It is accordingly omitted from the Check List.

Pyrgus cæspitatis (Boisduval), 1852. This is the original spelling of the specific name. In 1869 Boisduval published the name *Syrichtus cæspitalis* both in the text and in the index of his paper. It is not known whether this was intended as an emendation of *cæspitatis* or was a *lapsus calami.* The word does not appear to be derived from the Latin or Greek languages. Either spelling would appear to form a proper Latin word. While the second spelling has been employed by most authors, since no reason for an emendation is apparent the original spelling will be used in the Check List in accordance with the usual practice followed therein.

Pyrgus xanthus Edwards, 1878. Although Evans (1953, p.218) has placed this insect as a subspecies of *P. ruralis* (Boisduval), 1852, F. Martin Brown of Colorado Springs, Colorado, advises (*in litt.*) that they fly together at that place, and both he and Mr. Bell consider them specifically distinct. Hence they are so treated in the List. Evans' date of publication "1873" is erroneous.

Pyrgus ruralis macdunnoughi (Oberthür), 1913. Evans (1953, p. 218) has given this name subspecific standing. Bell (*in litt.*) believes that it is a form of *xanthus* as it has been treated usually. In the List it is relegated to that position as a form of *xanthus.*

Erynnis rutilius Evans, 1953. This name is ascribed to MEAD (1875, p.787) by EVANS (1953, p.208), but lacking an indication etc., it was a *nomen nudum.* It is next mentioned by LINTNER (1878, p.176) but not in a way to constitute a valid publication. EVANS' mention of the name in the synonomy of *persius* constitutes a publication, since the Règles changing the practice of recognizing as valid names published in synonomies, adopted at Copenhagen in 1953, had not become effective at that time.

Erynnis persius fredericki H. A. Freeman, 1943. This subspecies of *persius* has been placed in the synonomy by EVANS (1953, p.208) with an interrogation mark. It would seem better to retain it as a subspecies. The western population of *persius* is quite distinct from that occurring in the East.

Erynnis baptisiæ (Forbes), 1936. This insect has been placed by EVANS (1953, p.208) as a subspecies of *lucilius* (Scudder & Burgess), 1870. It would appear better to retain it as a closely related species.

Erynnis propertius (Scudder & Burgess), 1870. This name is treated as a species and not as a subspecies of *E. juvenalis* (Fabricius), 1793, in accordance with the advice of BELL and EVANS (*in litt.*).

Erynnis callidus Grinnell, 1904. EVANS (1953, p.207) treats this as a subspecies of *brizo.* Here it is placed as a subspecies of *pacuvius* (Lintner), 1878. (See dos Passos, 1947, p. 1.)

Ephyriades zephodes (Hübner), "1806" [1825]. This name is listed by McDUNNOUGH (1938, p.31) but omitted from the Check List because the insect is not found in the Nearctic region.

Achlyodes thraso (Hübner), "1806" [1807]. The nymotypical form does not occur north of Mexico. *A. t. tamenund* (Edwards), "1870-1" (1871), described from Texas and differing from *thraso* has, therefore, been removed from the synonomy where placed by EVANS (1953, p.172) and recognized as a valid subspecies.

Xenophanes ruatensis Godman & Salvin, (1895). This name, placed by EVANS (1953, p.155) in the synonomy of *X. trixus* Stoll, 1782, is omitted from the List on the advice of BELL (*in litt.*), who believes that it is a valid subspecies not occurring in our fauna.

Gorgythion begga Prittwitz, 1886. This name cited by EVANS (1953, p.100) is a *nomen nudum,* not having been proposed as a binominal. The first author to use the name properly is KIRBY (1870), to whom it must be ascribed.

Pellicia costimacula Herrich-Schäffer, 1870. The insect recorded by H. A. FREEMAN (1951, p.17) from Texas under the above name is *P. angra* Evans, (1953, p.59). It was determined from Godman & Salvin (1894) pl.83, ff.16, 17, 18, but EVANS (1953, p.58) claims correctly that the first two (ff.16, 17) are *arina* and the last (f.18) *angra.*

Cogia Butler, 1870. ORFILA and ROSSI (1956, p.29) sink *Cogia* as a homonym of *Kogia* Gray, 1846, claiming that WALLACE (1876, p.208) emended *Kogia* to *Cogia.* Perhaps this action was a typographical error but if intended as an emendation it appears to have been an unjustified one and should not be permitted to upset an earlier name that was properly proposed.

Generic names that differ from each other by a single letter are not homonyms although there were exceptions to this Règle between 1948 and 1953. Since the action by Wallace was taken prior to the former date and there is no evidence that *Cogia* and *Kogia* are of the same origin and meaning, the action of Orfila and Rossi is not followed.

Thorybes bathyllus Smith, 1797. Evans (1952, p.130) uses *daunus* (Cramer), "1779" [1777], for this species. Cramer's figure is a very poor illustration of any species of *Thorybes*. Consequently, this change in the nomenclature has not been followed and is now confirmed by Evans (*in litt.*).

Thorybes pylades Scudder, (1870). Mr. Paddy B. McHenry of Burbank, California, has called the author's attention (*in litt.*) to a name which may have priority over *pylades* but has not been used for over one hundred years. It is deemed best not to revive such a name and to apply to the International Commission on Zoological Nomenclature for its suppression.

Nascus Watson, 1893. The species listed under this name by McDunnough (1938, p.29) has been transferred to *Dyscophellus* Godman & Salvin (1893). This generic name is not used in the List.

Astraptes Hübner, "1816" [1819]. Hemming (1934, p.158) claims that the type of this genus, *Papilio aulestis* Cramer, "1782" [1780], is a homonym of *Papilio aulestes* Cramer "1779" [1776], but that is an error. This name appears first in *De Uitlandsche Kapellen* (vol.2, p.47), where it is invalid, because not a binominal. In the index to that volume (p.147) it is written *"Pap. Pleb. ural. aulestes"* with a reference to the plate and figure (this reference applying also to the text) and is, therefore, valid but dating from 1776 when the index was published. This insect is a Lemoniinæ. The next use of *aulestes* by Cramer (vol.3, p.161) is also invalid, because again it is not a binominal. As before, this name must be dated from the index (p.173) where Cramer emended the name to *aulestis,* probably having in mind the prior use of *aulestes*. Here the name is written *"Pap. pleb. Urbicol. aulestis"* and is valid from the date of publication of the index 1780. This insect is a hesperiid and the one with which the Check List is concerned.

Urbanus Hübner [1806] (Opinion 278). This generic name employed by Evans (1952, p.85) has been rejected by the International Commission on Zoological Nomenclature (Opinion 278) and must be replaced by *Goniurus* Hübner, "1816" [1819]. The type species of this genus is also *Papilio proteus* Linnæus, (1758), so there is no change in the conception.

Urbanus proteus ab. *proteoides*. This name, spelled by Evans (1952, p.86) *"proteides"*, is placed by him as a subspecies of *U. p. domingo* Scudder, 1872. The insect does not occur in our fauna and is omitted from the List.

Polygonus leo savigny (Latreille), "1819" [1824]. This subspecies is omitted from the List because it does not occur in our fauna.

Polygonus lividus Hübner, [1825]. Comstock (1944, pp.541-2) fixed the type locality of *lividus* as Hispaniola. It should therefore be removed from the synonymy of *P. leo* where Evans (1952, p.54) places it and supplant *ishmael* Evans (*ibid.* p.54) as the Haitian subspecies. It is not in the List.

Proteides mercurius sanantonio (Lucas), 1857. This insect has been added to the Nearctic List on the advice of Mr. CHARLES P. KIMBALL (*in litt.*) who reports a specimen from Florida, most probably a stray from Cuba.

Phocides Hübner, "1816" [1819]. The type is *P. cruentus* Hübner, "1816" [1819], which is not a *nomen nudum* as claimed by EVANS (1952, p.7).

Phocides pigmalion batabano Lucas, 1857. This insect described from Cuba is omitted from the List on the strength of EVANS' (1952, p.14) statement that the Nearctic subspecies occurring in Florida is *okeechobee* Worthington, 1881.

Phocides pigmalion mancinus Herrich-Schäffer, 1862. This name is a synonym of *P. batabano* Lucas, 1857, and is omitted with that subspecies for the same reason.

References

Banks, N., & A. N. Caudell, 1912. *The entomological code. A code of nomenclature for use in entomology.* 32 pp. Judd & Detweiler, Inc., Washington, D. C.

Barnes, W., & J. H. McDunnough, 1912. Revision of the Megathymidæ. *Contrib. nat. hist. Lepid. N. Amer.* vol.1, no.3: 56pp., 6 pls., 1 fig.

Bell, E. L., 1938. A catalogue of the original descriptions of the Rhopalocera found north of the Mexican border. The Hesperioidea. *Bull. Cheyenne Mt. mus.,* vol.1, pt.1: 36 pp.

----------, 1946. A catalogue of the Hesperioidea of Venezuela. *Bol. ent. Venezolana* 5: 65-204.

Butler, A. G., 1870. The genera of Hesperidæ in the collection of the British Museum. *Ent. mon. mag.* 7: 92-99.

Clench, H. K., 1948. Notes on some Michigan butterflies. *Lepid. news* 2: 105.

Comstock, J. A., 1956. Notes on metamorphoses of the giant skippers (Lepidoptera; Megathyminæ) and the life history of an Arizona species. *Bull. so. Calif. acad. sci.* 55: 19-27, pl.8.

dos Passos, C. F., 1947. Notes on Grinnell's types of *Erynnis* Schrank (Lepidoptera, Hesperiidæ). *Amer. mus. novitates* 1337: 3 pp.

Druce, H., 1881-1900. Insecta. Lepidoptera-Heterocera. *in* Godman, F. D., & O. Salvin (eds.), *Biologia Centrali-Americana,* vol.2 (1891-1900): [4] + 622 pp.; vol.3 (1881-1900): [4] pp. + 101 pls. (colored). Taylor & Francis, London.

Ehrlich, P. R., 1958. The comparative morphology, phylogeny and higher classification of the butterflies (Lepidoptera: Papilionoidea). *Univ. Kansas sci. bull.* 39: 305-370, 64 figs.

Evans, W. H., 1949. *A catalogue of the Hesperiidæ from Europe, Asia and Australia in the British Museum (Natural History).* xx + 502 + [4] (corrigenda) pp., 52 pls. (11 colored). British Museum (Nat. Hist.), London.

----------, 1951-1955. *A catalogue of the American Hesperiidæ indicating the classification and nomenclature adopted in the British Museum (Natural History).* Part I (1951): x + 92 pp., pls.1-9; Part II (1952): vi + 178 pp., pls.10-25; Part III (1953): vi + 246 pp., pls.26-53; Part IV (1955): vi + 500 + 4 pp. (addenda & corrigenda), pls.54-88. British Museum (Nat. Hist.), London.

Freeman, H. A., 1945. Notes on some Hesperiidæ, with new records for the United States (Lepidoptera, Rhopalocera). *Ent. news* 56: 102-104.

----------, 1950. The distribution of *Wallengrenia otho* (Abbot & Smith) and its subspecies in the United States (Lepidoptera, Rhopalocera, Hesperiidæ). *Field & Lab.* 18: 78.

Kirby, W. F., 1871. *A synonymic catalogue of diurnal Lepidoptera.* viii + 690 pp. John van Voorst, London.

Klots, A. B , 1951. *A field guide to the butterflies of North America, East of the Great Plains.* Boston, Houghton Mifflin Company, xvi + 350 pp., 40 pls. (16 colored).

Lindsey, A., E. L. Bell, & R. C. Williams, Jr., 1931. The Hesperioidea of North America. *Denison univ. bull., journ. sci. labs.* 26: 1-142, 33 pls.

Lintner, J. A., 1878. On some species of *Nisoniades. 30th ann. rep. New York state mus. nat. hist.*: 172-178.

McDunnough, J. H., 1938. Check list of the Lepidoptera of Canada and the United States of America. Part 1 Macrolepidoptera. *Mem. so. Calif. acad. sci.* 1: 1-273 + 4 (corrigenda).

Orfila, R. N., & N. H. Rossi, 1956. Nuevos nombres genéricos en Lepidoptera. *Rev. soc. ent. Argentina* 19: 27-29.

Scudder, S. H., 1872. A systematic revision of some of the American butterflies, with brief notes on those known to occur in Essex County, Mass. *Report Peabody acad. sci. for 1871*: 24-82.

............, 1889. *The butterflies of the eastern United States and Canada with special reference to New England.* 3 vols.: xliv + 1958 pp., 92 pls., 3 maps. Published by author, Cambridge.

Walker, F., 1856. *List of the . . . Lepidopterous insects in the . . . British Museum (Natural History)*: pt.7: 1508-1808. British Mus. (Nat. Hist.), London.

Wallace, A. R., 1876. *The geographical distribution of animals, with a study of the relations of living and extinct faunas as elucidating the past changes of the Earth's surface.* 2 vols., illust. London.

Warren, B. C. S., 1947. Some principles of classification in Lepidoptera, with special reference to the butterflies. *Entomologist* 80: 208-217; 235-241; 262-268; 280-282.

Washington Corners, Mendham, N. J., U. S. A.

DANAUS GILIPPUS IN OHIO

On July 1, 1959, Brother Donald Ray Geiger found a specimen of *Danaus gilippus* (Cramer) on a gravel road on the grounds of The Pontifical College Josephinum located in Sharon Township, Franklin County, Ohio, a few miles north of Columbus. The insect was easily captured in the fingers.

The specimen was given to me and has been deposited in the entomological collection at The Ohio State University. The insect is in excellent condition, except for a small piece broken from one of the hind wings.

Dr. Edward S. Thomas, Ohio State Museum, examined the specimen with me. Adequate comparative material was not available, but the white edging of the veins of the upper sides of the hind wings and the relatively large spots in the border of them led us to assign the specimen to the southwestern race *strigosus* Bates.

One can only speculate on the means by which this lepidopteran reached the Columbus area, a locality which is far distant from the insect's normal range. So far as I can ascertain this is the first recorded occurrence of this species for Ohio.

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STUDIES OF THE CHROMOSOMES OF NORTH AMERICAN RHOPALOCERA 2. HESPERIIDÆ, MEGATHYMIDÆ, AND PIERIDÆ

by Kodo Maeki and Charles L. Remington

The first of this series of papers was on eleven species of Papilionidæ and included an introduction and a description of the sources of our material and of the techniques we use (Maeki & Remington, 1960). The present paper is a continuation of the first and covers species of the two families of the superfamily Hesperioidea and the family Pieridæ. The remaining families are being covered in two papers immediately following this one. The numbers in square brackets are the designations of individuals studied and can be found on the specimens and slides preserved for permanent reference in the Peabody Museum of Yale University. In the following lists "*n*" represents the haploid chromosome number, "I" refers to the primary spermatocyte division and "II" to the secondary spermatocyte division. No female meiosis was investigated in these three families.

Most of the specimens for which the chromosomes are reported here were taken in 1959, the principal exception being the interesting genus *Erynnis*. We extracted our 1960 *Erynnis* data and inserted it as the manuscript was going to press. Counts for many additional species of Papilionidæ, Pieridæ, and Hesperiidæ are being made from 1960 material and will be published in a supplementary paper. We have also worked up about two dozen species of African Rhopalocera collected by S. A. Hessel in 1960, including 7 Pieridæ. These are being reported separately from the present North American series.

We found no meiotic divisions in males of the following species: two *Oarisma garita* (Reakirt), three *Polites draco* (Edwards), one *Hesperia* (*colorado* Scudder?), and one *Pyrgus communis* (Grote) from Colorado; one *Ancyloxipha numitor* (Fabricius), and one *Hesperia leonardus* (Harris) from Connecticut; fourteen *Erynnis brizo somnus* (Lintner) from Florida; one *Megathymus y. yuccæ* (Boisduval & Leconte) from Georgia; and two *Agathymus estelleæ* (Stallings & Turner) from Mexico. Hesperioids in general tend to have meiosis completed before or soon after eclosion, and it is necessary with some species to try several young males or even pupæ to get suitable divisions.

A. HESPERIIDÆ:

1. *Achalarus toxeus* (Plötz). The haploid chromosome number is 16 but there was a single exception. Unequivocal counts of 16 were made in 24 nuclei in the primary spermatocyte division and 32 nuclei in the secondary spermatocyte division; a single secondary spermatocyte division showed 17

chromosomes. All 57 nuclei were in the testes of a single male [M21] taken at Ciudad Victoria, Tamaulipas, Mexico, 1 August 1959. In all of the 16-chromosome nuclei there are 15 larger chromosomes and 1 smaller unit. Since the 17-chromosome nucleus shows 14 larger chromosomes and 3 smaller units, it is reasonable to suppose that 2 of the 3 small bodies are normally fused into a single element in *A. toxeus*. Most cytologically known species of this subfamily (Pyrginæ) have 31 or 30 as the haploid number. The normal 16 of *A. toxeus* may have evolved by 1 + 1 fushions of 30 of the ancestral 31 small elements. The unusual nucleus with 17 suggests that at least one of the fusions is sometimes unstable.

2. *Chioides catillus* (Cramer). $N = 31$. Counts were made in 4 nuclei (I) in the testes of one male [M 20] taken at Cuidad Victoria on 1 August. There is considerable diversity in size, 6 or 7 of the chromosomes being larger than the others. This male was somewhat old, and the testes were full of spermatozoa and connective tissue, with very few dividing cells.

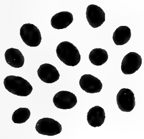
3. *Erynnis icelus* (Scudder & Burgess). $N = 30$. Counts were made in 30 nuclei (I) and 16 nuclei (II) in testes of 2 males [461, 467] taken at the mouth of Nettleton Hollow, Woodbury, Litchfield Co., Connecticut, 28 May 1960, by C. L. REMINGTON. As with *E. juvenalis*, 5 chromosomes are small, about 20 medium, about 4 large, and 1 very large. We have also studied chromosomes of an apparently new species in Connecticut which is a foodplant sibling of *E. icelus*. The new sibling also has $n = 30$.

4. *Erynnis juvenalis* (Fabricius). $N = 30$. Counts were made in 10 nuclei (I) and 8 nuclei (II) from one male [476] taken at Nettleton Hollow, Woodbury, Litchfield Co., Connecticut, 28 May 1960. No meiotic divisions were found in 4 other males taken at the same time nor in 1 male taken at Lakehurst, New Jersey, 7 May 1960. As with other *Erynnis*, 5 chromosomes are small, 20 medium, 4 larger, and 1 distinctly the largest.

5. *Erynnis horatius* (Scudder & Burgess). $N = 31$. Counts were made in 4 nuclei (I) and 8 nuclei (II) in the testes of 2 males [F76, F196] taken 18 and 24 April 1960 at the Archbold Biological Station, Highlands Co., Florida, by KODO MAEKI. The determinations were checked by JOHN M. BURNS. Apparently 5 chromosomes are small, 5 large, and the others medium.

6. *Erynnis persius* (Scudder). $N = 31$. Counts were made in 15 nuclei (I) and 10 nuclei (II), in the testes of 3 males [462, 463, 465] taken at Nettleton Hollow, Woodbury, Litchfield Co., Connecticut, 28 May 1960, by C. L. REMINGTON. Determinations were checked by JOHN M. BURNS. The size relations of the chromosomes are like those of *E. horatius*.

7. *Erynnis baptisiæ* (Forbes). $N = 31$. Counts were made in 78 nuclei (I) and 34 nuclei (II) from 3 males [402-1, 402-2, 402-3] reared on *Baptisia tinctoria* from one wild mother taken in New Haven, Connecticut, by R. W. PEASE, JR., and emerging *ex-pupis* on 6 October 1959. The testes were fixed the day the males emerged, and meiotic divisions were numerous. About 16 of the chromosomes are larger than the others. (See *E. lucilius*, below, for discussion of a probable hybrid.)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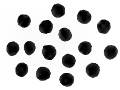
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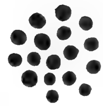
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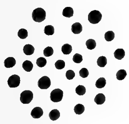
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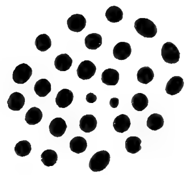
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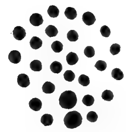
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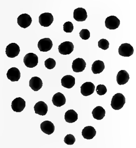
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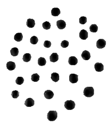
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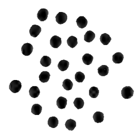
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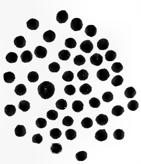
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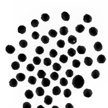
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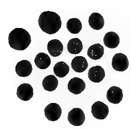
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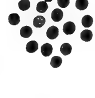

7b

Fig. 1a — *Achalarus toxeus* (I); fig. 1b — same (II; $n = 16$); fig. 1c — same (II; $n = 17$); fig. 2 — *Chioides catillus* (I); fig. 3a — *Ochlodes sylvanoides* (I); fig. 3b — same (II); fig. 4a — *Nastra l'herminieri* (I); fig. 4b — same (II); fig. 5 — *Megathymus violæ* (II); fig. 6a — *Stallingsia maculosa* (I); fig. 6b — same (II); fig. 7a — *Agathymus mariæ* (I); fig. 7b — same (II). [On plates 1-5: I = primary spermatocyte division, II = secondary spermatocyte division; magnifications all 3900 diameters; drawings made with camera lucida.]

8. *Erynnis lucilius* (Scudder & Burgess). $N = 31$. Counts were made in testes of 2 males reared from larvæ taken on *Aquilegia canadensis* on Rattlesnake Mt., Hartford Co., Connecticut, in June 1960 by R. W. PEASE, JR., and W. A. CHRISTIAN. These emerged in late June and July, and the testes were fixed soon after eclosion. Counts of 31 were invariably obtained for male 617 in 15 nuclei (I) and 10 nuclei (II), and many other suitable nuclei could have been counted. There are 4 small, 11 large, and 16 intermediate chromosomes. Male 836 was apparently a wild hybrid, since the 21 countable metaphase nuclei (all 1st spermatocyte) showed the following chromosomal tally:

chromosome no. (n) =	32	33	34	35	36	37
number of nuclei —	4	4	2	3	5	3
apparent univalents (extra tiny elements)	2	4	6	8	10	12

This suggests that the other parent of the hybrid was a 31-chromosome species, and distributional facts point to *E. baptisiæ*. Probably the female parent was *E. lucilius*, since the egg was laid on the *lucilius* foodplant. The few secondary spermatocytes were not satisfactory for counting.

9. *Grais stigmaticus* (Mabille). $N = 31$. Counts were made in 37 nuclei (I) and 22 (II), in the testes of 2 males [M23-6, M23-7] taken at Ciudad Victoria on 1 August. Of 11 males whose testes were fixed, meiotic divisions were found only in these 2. Most of the specimens were collected at muddy spots in a river bed. There is some diversity in the sizes of the chromosomes, with about 8 being smaller than the others.

10. *Ochlodes sylvanoides* (Boisduval). $N = 29$. Counts were made in 17 nuclei (I) and 14 nuclei (II), in the testes of 2 males [275, 276] taken near Somerset, Gunnison Co., Colorado, on 15 August 1959. No meiotic divisions were found in the testes of 6 other males taken at the same time. Especially in the secondary spermatocyte 2 of the chromosomes are much larger than the other 27, suggesting 1 + 1 fusions of 4 of 31 ancestral chromosomes.

11. *Nastra l'herminieri* (Latreille). $N = 30$. Counts were made in 12 nuclei (I) and 5 nuclei (II), all in a single male [329] taken on West Rock, New Haven, Connecticut, on 5 September 1959. It was clearly observed that 5 of the chromosomes in the primary spermatocytes are about one-half as large as the other 25. The few secondary nuclei were somewhat oblique in our sections, and size differences could not be safely estimated.

B. MEGATHYMIDÆ:

1. *Megathymus violæ* Stallings & Turner. $N = 27$. Counts were made in 5 nuclei (II) in a single male [417] reared at Yale from an egg collected 29 July 1959 at 4000′ on *Yucca treculeana* on the highway pass over the Sierra de la Gavia, Coahuila, Mexico. The testes were fixed immediately af-

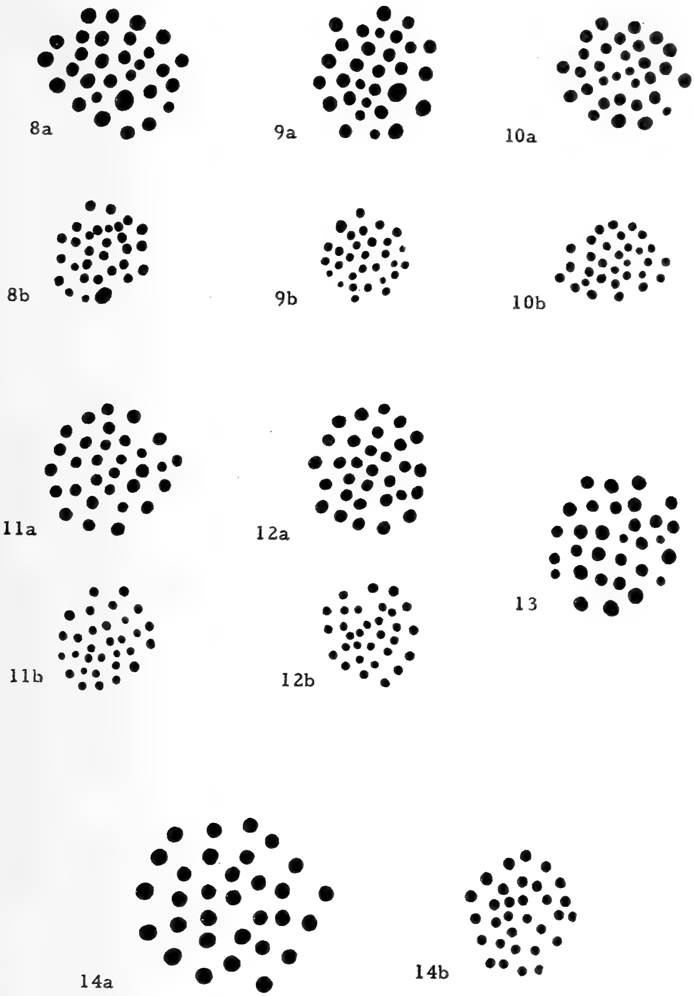


Fig. 8a — *Erynnis icelus* (I); fig. 8b — same (II); fig. 9a — *E. juvenalis* (I); fig. 9b — same (II); fig. 10a — *E. horatius* (I); fig. 10b — same (II); fig. 11a — *E. persius* (I); fig. 11b — same (II); fig. 12a — *E. baptisiæ* (I); fig. 12b — same (II); fig. 13 — *E. lucilius* (I); fig. 14a — *Grais stigmaticus* (I); fig. 14b — same (II).

ter eclosion the morning of 31 December 1949, and fortunately there were still a few dividing cells, none at the first division. All the chromosomes are similar in size.

2. *Stallingsia maculosa* (H. A. Freeman). $N = 50$. Counts were made in 23 nuclei (II) in testes of a pupa [424] ready to hatch and 22 nuclei (I) and 46 (II) in testes of a very young pupa [425]. Both were dissected on 2 April 1960. They had recently been collected as mature larvæ by Don B. Stallings at Floresville, Wilson Co., Texas. One of the chromosomes is much larger than the other 49.

3. *Agathymus mariæ* (Barnes & Benjamin). $N = 21$. Counts were made in 5 nuclei (I) and 4 nuclei (II) all from a single newly hatched male [398] which emerged 28 September 1959 and had been collected as a blue larva in early August, 5½ miles east of Langtry, Val Verde Co., Texas, in *Agava lecheguilla* Torrey by C. L. Remington. Two chromosomes are larger than the other 19.

C. PIERIDÆ:

1. *Euchloe ausonides* Lucas. $N = 31$. Counts were made in 17 nuclei (I) and 6 nuclei (II), all from a single male [45-1] taken at Gothic, Gunnison Co., Colorado, 19 July 1959. No dividing cells were found in the testes of a second male taken at the same place. All the chromosomes are similar in size.

2. *Colias eurytheme* Boisduval. $N = 31$. Counts were made in 53 nuclei (I), and 34 nuclei (II), in testes of 4 males [316-1, 316-a, 316-b, 354] taken in New Haven Co., Connecticut, 3 and 11 Sept. 1959. There are 7 large, 19 medium-sized, and 5 small chromosomes.

3. *Colias philodice* Godart. $N = 31$. Counts were made in 74 nuclei (I) and 62 (II), from 9 males taken in New Haven Co. from 3 to 19 Sept. 1959 [315-1, 315-2, 315-3, 315-4, 315-6, 315-7, 330, 352, 382]. About 7 or 8 chromosomes are larger than the others. Wild hybrids of *C. philodice* × *eurytheme* were also studied and showed no failure of pairing at first meiotic metaphase; these are being reported elsewhere in a separate paper on cytology of wild hybrids.

4. *Colias alexandra* Edwards. $N = 31$. Counts were made in 58 nuclei (I) and 17 nuclei (II) from testes of 3 males [82, 154, 162] taken at Gothic from 22 to 30 July 1959; testes of a fourth male showed no meiotic divisions. Several of the chromosomes are more or less larger than the others.

5. *Colias scudderii* Reakirt. $N = 31$. Counts were made in 40 nuclei (I) and 22 nuclei (II) from testes of 6 males [3, 17, 19, 29, 129, 131] taken at Gothic from 17 to 27 July 1959. There are 5 or 6 chromosomes which are larger than the others. Wild hybrids of *C. scudderi* × *alexandra* showed some failure of meiotic pairing; as with *C. philodice* × *eurytheme* these studies are being reported elsewhere.

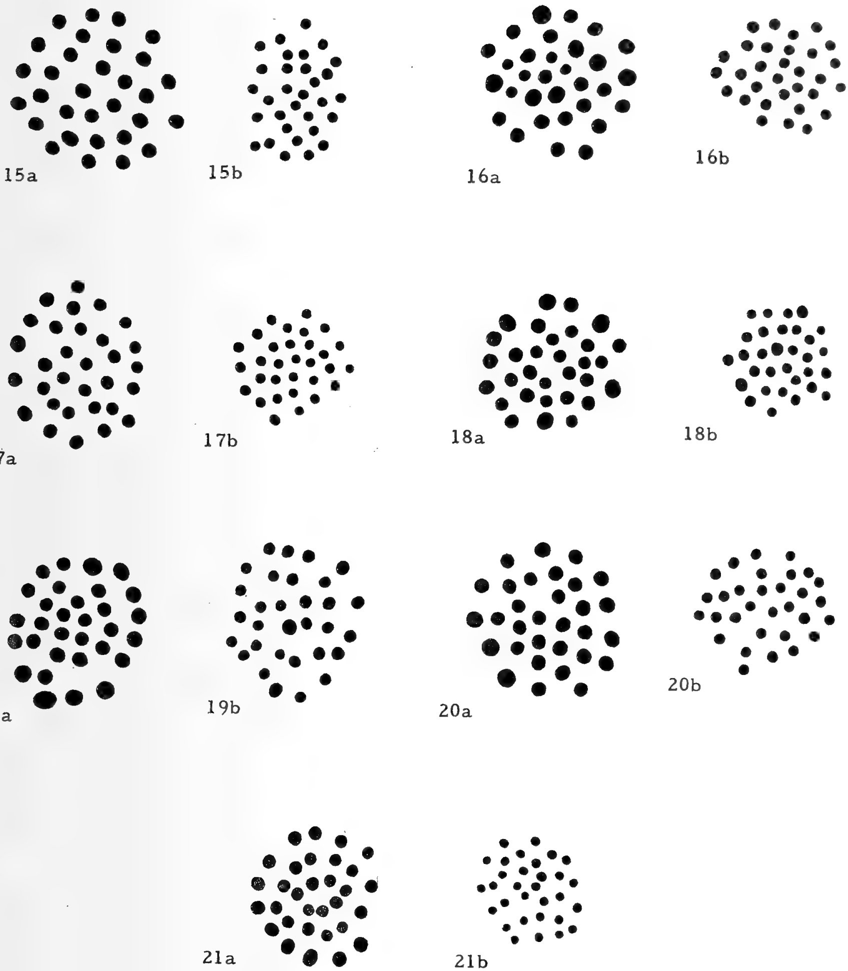


Fig. 15a — *Euchloe ausonides* (I); fig. 15b — same (II); fig. 16a — *Colias eurytheme* (I); fig. 16b — same (II); fig. 17a — *C. philodice* (I); fig. 17b — same (II); fig. 18a — *C. alexandra* (I); fig. 18b — same (II); fig. 19a — *C. scudderii* (I); fig. 19b — same (II); fig. 20a — *C. meadii* (I); fig. 20b — same (II); fig. 21a — *Zerene cesonia* (I); fig. 21b — same (II).

6. *Colias meadii* Edwards. $N = 31$. Counts were made in 15 nuclei (I) and 12 nuclei (II) from 3 males [189, 216, 218] taken in Gunnison Co., Colorado, found at Copper Lake, el. 10,500′, on 2 August, and Cumberland Pass, el. 11,500′, on 11 August 1959. As with other high altitude butterflies, dividing cells and also germ cells were few in number. About 7 or 8 chromosomes are large, 4 or 5 small, and the remainder medium-sized.

7. *Zerene cesonia* (Stoll). $N = 31$. Counts were made in 26 nuclei (I) and 23 nuclei (II) all in the testes of a single male [M7] taken at Ciudad Victoria, 1 August 1959. About 15 chromosomes are somewhat larger than the others.

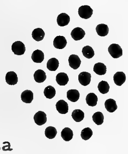
8. *Anteos clorinde* (Godart). $N = 31$. Counts were made in 41 nuclei (I) and 46 nuclei (II) in testes of 5 males [M6-1, M6-3, M6-4, M6-5, M6-6] taken at Ciudad Victoria, 1 and 2 August 1959. There is some diversity of chromosome size.

9. *Phœbis philea* (Johansson). $N = 31$. Counts were made in 53 nuclei (I) and 39 nuclei (II) in testes of 7 males [M5-1, M5-2, M5-3, M5-4, M5-5, M5-6, M5-7], taken at Ciudad Victoria, 1 and 2 August 1959. There is some diversity of chromosome size.

10. *Kricogonia lyside* (Godart). $N = 31$. Counts were made in 81 nuclei (I) and 58 nuclei (II) in testes of 7 males [M28-1, M28-2, M28-3, M28-4, M42-1, M42-2, M42-3] taken at Ciudad Victoria, 1 and 2 August 1959. The chromosomes are all similar in size. Assuming that two species, *K. lyside* and *K. castalia* (Fabricius), were present at Ciudad Victoria, we had separated two groups of males and their fixed testes. It is believed by present taxonomists that these two "species" represent only one. The chromosomes being indistinguishable in our two groups, we can offer no cytological test of the species question in *Kricogonia*. It is possible, of course, that most closely related but discrete species show no conspicuous chromosomal differences.

11. *Eurema proterpia* (Fabricius). $N = 31$. Counts were made in 30 nuclei (I) and 32 nuclei (II) in testes of 2 males [M31-1, M31-2] taken at Ciudad Victoria, 2 August 1959. As with other *Eurema*, there is little size difference among the chromosomes.

12. *Eurema mexicana* (Boisduval) or *E. boisduvaliana* Felder & Felder. $N = 31$. Counts were made in 24 nuclei (I) and 33 nuclei (II) in testes of one male [M37-2] taken 2 August at Ciudad Victoria. In contrast to *E. lisa*, meiotic divisions were very numerous and the testes much larger. Unfortunately, in one vial testes were fixed together of two males which appeared in the field to be of the same species. When Dr. A. B. KLOTS checked the specimens, one proved to be *E. boisduvaliana* and the other *E. mexicana*, but meiotic divisions were present in testes of only one of the specimens and there is no way of knowing which. It is highly probable that both species have a haploid number of 31 since all 4 North American species studied by us show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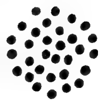
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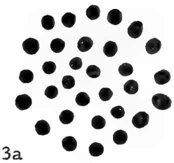
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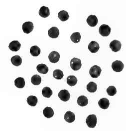
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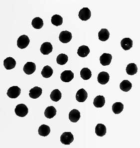
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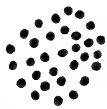
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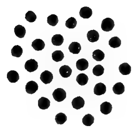
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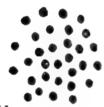
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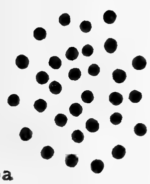
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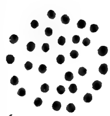
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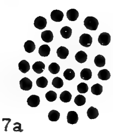
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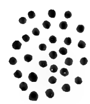
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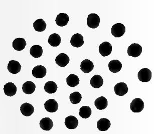
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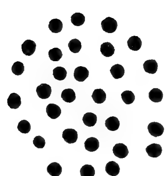
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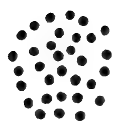

29b

Fig. 22a — *Anteos clorinde* (I) ; fig. 22b — same (II) ; fig. 23a — *Phœbis philea* (I) ; fig. 23b — same (II) ; fig. 24a — *Kricogonia lyside* (I) ; fig. 24b — same (II) ; fig. 25a — *Eurema proterpia* (I) ; fig. 25b — same (II) ; fig. 26a — *E. mexicana* or *boisduvaliana* (I) ; fig. 26b — same (II) ; fig. 27a — *E. nicippe* (I) ; fig. 27b — same (II) ; fig. 28 — *E. lisa* (I) ; fig. 29a — *Appias drusilla* (I) ; fig. 29b — same (II).

this number; however the two known Japanese species show $n = 29$ and $n = 31$, respectively, and it will be essential to check the present case with unquestionably correlated specimens and testes.

13. *Eurema nicippe* (Cramer). $N = 31$. Counts were made in 6 nuclei (I) and 15 nuclei (II) in testes of 2 males [M8-1, M8-2] taken at Ciudad Victoria, 1 August 1959.

14. *Eurema lisa* (Boisduval & Leconte). $N = 31$. Counts were made in 19 nuclei (I), in testes from 2 males [314-A, 314-B] taken at West Rock, New Haven Co., Connecticut, 3 Sept. 1959. The gonads were small and had few dividing cells, none in the secondary division.

15. *Appias drusilla* (Cramer). $N = 32$. Counts were made in 102 nuclei (I) and 76 nuclei (II) in testes of 6 males [M43-1, M43-2, M43-3, M43-4, M43-5, M43-6] taken at Ciudad Victoria, 2 August 1949. All the chromosomes are similar in size.

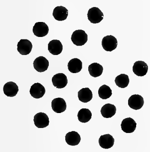
16. *Pieris napi macdunnoughii* Remington. $N = 25$. Counts were made in 18 nuclei (I) and 8 nuclei (II) in testes of 3 males [14, 15, 16] taken at Gothic, Colorado, 17 July 1959. All the chromosomes are similar in size.

Testes of one *P. napi oleracea* Harris fixed as soon as it eclosed from refrigerated pupæ from Katonah State Park, Berkshire Co., Massachusetts, reared by H. P. WILHELM, showed no dividing cells. It is essential to determine the precise count for this and other so called *napi* races in view of the count shown below for *P. virginiensis* and those for Palearctic populations (see Discussion, below).

17. *Pieris virginiensis* Edwards. $N = 26$. Counts were made in 13 nuclei (I) and 2 nuclei (II) in testes of 2 males [426, 427] reared from larvæ taken at New Ashford, Berkshire Co., Massachusetts, by W. J. REINTHAL. The pupæ had been refrigerated since late summer 1959 and removed to 20°C on 2 April 1960; both hatched 5 days later, and the testes were removed and fixed on the same morning. The chromosomes are like those of *P. napi macdunnoughii* but there is an additional very small element (see Discussion, below).

18. *Pieris rapæ rapæ* (Linné). $N = 25$. Counts were made in 162 nuclei (I) and 106 nuclei (II), in testes of 13 males [322, 325, 326, 335, 338, 339, 340, 342, 343, 349, 350, 355, 383] taken in New Haven Co., Connecticut, 5 to 19 Sept. 1959. Without exception these 268 nuclei show exactly 25 elements. Thus the small "m-chromosome" present in the nucleus or the cytoplasm in the Japanese *P. rapæ crucivora* is not in the individuals we have studied from Connecticut. (See Discussion, below.)

19. *Pieris beckerii* Edwards. $N = 26$. Counts were made in 8 nuclei (I) and 6 nuclei (II) in testes of 2 males [35-1, 35-3] taken at Iola, Gunnison Co., Colorado, 18 July 1959, by R. W. PEASE, JR. A third male taken at the same time showed no meiotic divisions. All the chromosomes are similar in size.



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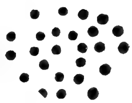

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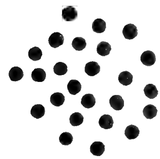

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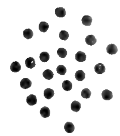

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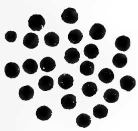

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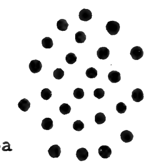

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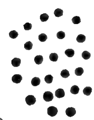

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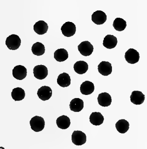

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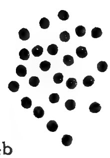

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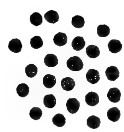

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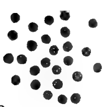

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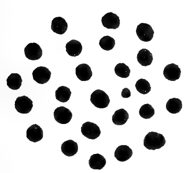
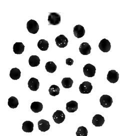


36a



36b

Fig. 30a — *Pieris rapæ rapæ* (I); fig. 30b — same (II); fig. 31a — *P. napi macdunnoughii* (I); fig. 31b — same (II); fig. 32 — *P. virginiensis* (I); fig. 33a — *P. beckerii* (I); fig. 33b — same (II); fig. 34a — *P. occidentalis* (I); fig. 34b — same (II); fig. 35a — *P. calyce* (I); fig. 35b — same (II); fig. 36a — *Ascia monuste* (I); fig. 36b — same (II).

20. *Pieris occidentalis* Reakirt. $N = 26$. The chromosomes are all similar in size. This use of the name is not meant to imply any firm conviction on the relation of *occidentalis* to *protodice* Boisduval & Leconte or to *calyce*. The insect we are calling *occidentalis* is very similar to *protodice* of the eastern states and may well be the same species and not even a worthy subspecies. It tends to be fairly common at middle altitudes in Colorado, although it sometimes flies to the tops of the highest peaks. It should be remembered that in the East *P. protodice* is a characteristically restless butterfly with extensive emigration going on all the time; *P. protodice* is often found in Connecticut, sometimes even breeding in large numbers, but it is never a permanent resident and temporary colonies do not survive most, if any, winters. Its western population (or perhaps distinct species), *occidentalis*, apparently has the same long-distance movement and may turn up anywhere in Colorado. In contrast to BROWN, *et al.* (1956), we regard *calyce* as a very different entity and are inclined to believe that it will be recognized as a distinct species when more is known of its biology (and perhaps morphology). It is consistently much smaller than *occidentalis*, is restricted to high altitudes (we know it well in Boulder County and Gunnison County), and has a different aspect in color, markings, and shape from all *protodice-occidentalis* populations known to us. The insect we call *calyce* is not the spring brood of *occidentalis*, which closely resembles form "vernalis" of the eastern *protodice*. None of these problems affects the use of chromosome characters with which this paper is concerned, because we have found no chromosomal differences between *calyce* and *occidentalis*. It would of course have simplified the taxonomy if *calyce* had turned out to have a different number, as *P. virginiensis* does. Our counts of *occidentalis* were made in 86 nuclei (I) and 47 nuclei (II) in testes of 4 males: 3 taken at Gothic, el. 9,500′, Colorado, 28 and 29 July 1959, [143, 155, 156] and 1 male [278] taken near Somerset, el. 7,800′, Colorado, 15 August 1959. All these males had large testes.

21. *Pieris calyce* Edwards. $N = 26$. Counts were made in 23 nuclei (I) and 9 nuclei (II) in testes of 5 males taken at Copper Lake, el. 10,500′, Gunnison Co., Colorado, on 1 August [180-1, 180-2, 180-3, 180-5] and 7 August 1959 [204]. One of the [180] specimens seems to be *occidentalis*, not *calyce*. Three other males, from Copper Lake, Gothic, and Cumberland Pass, showed no meiotic divisions. The chromosomes are all similar in size. The gonads were rather small, and the chromosomes showed a poor affinity for the stain, a condition commonly found in Nymphalidæ with imaginal winter diapause and in various high altitude butterflies. (See remarks under *P. occidentalis*, above).

22. *Ascia monuste* (Linné). $N = 27$. Counts were made in 14 nuclei (I) and 1 nucleus (II) in testes of 2 males [M4-1, M4-3] taken at Ciudad Victoria, 1 August 1959. A third male taken at the same time shows no meiotic divisions. One chromosome is much smaller than the others.

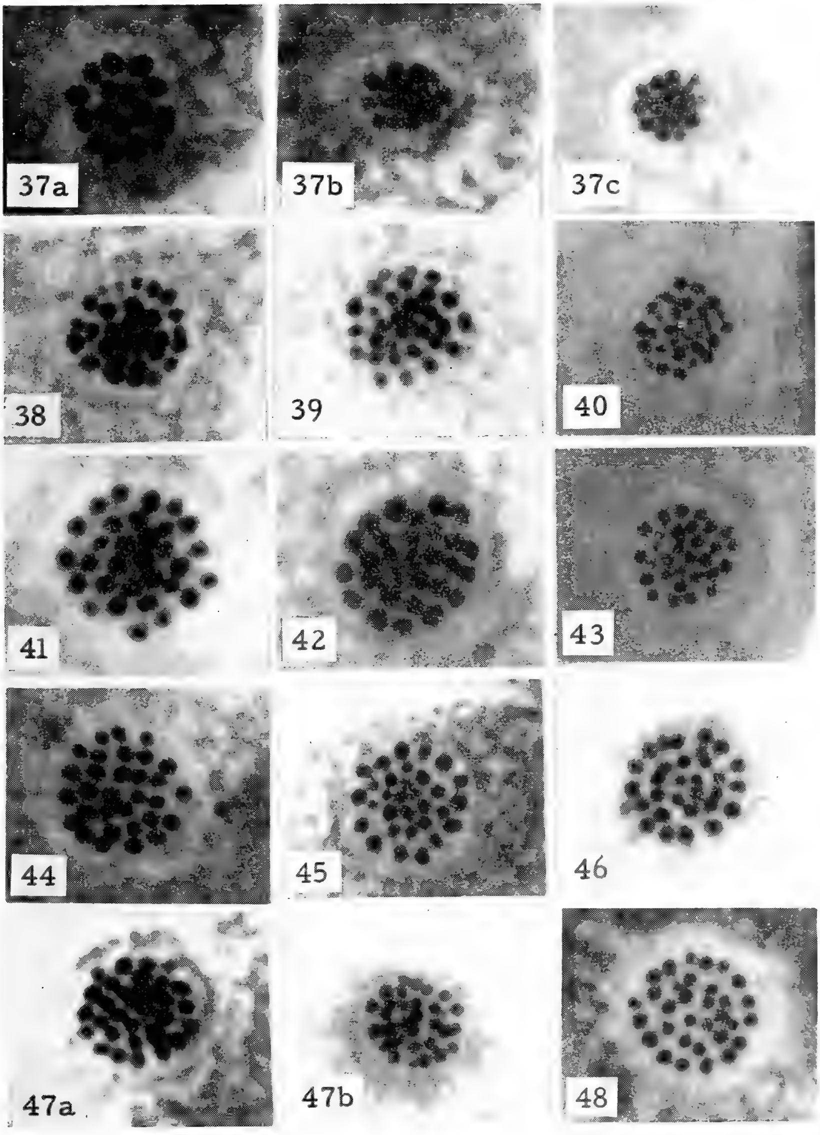


Fig. 37a — *Achalarus toxeus* (I); fig. 37b — same (II; $n=16$); fig. 37c — same (II; $n=17$); fig. 38 — *Erynnis icelus* (I); fig. 39 — *E. persius* (I); fig. 40 — *E. baptisiæ* (I); fig. 41 — *Grais stigmaticus* (I); fig. 42 — *Ochlodes sylvanoides* (I); fig. 43 — *Nastra l'herminieri* (I); fig. 44 — *Euchloe ausonides* (I); fig. 45 — *Colias eurytheme* (I); fig. 46 — *C. philodice* (I); fig. 47a — *C. meadii* (I); fig. 47b — *C. meadii* (II); fig. 48 — *Zerene cesonia* (I).

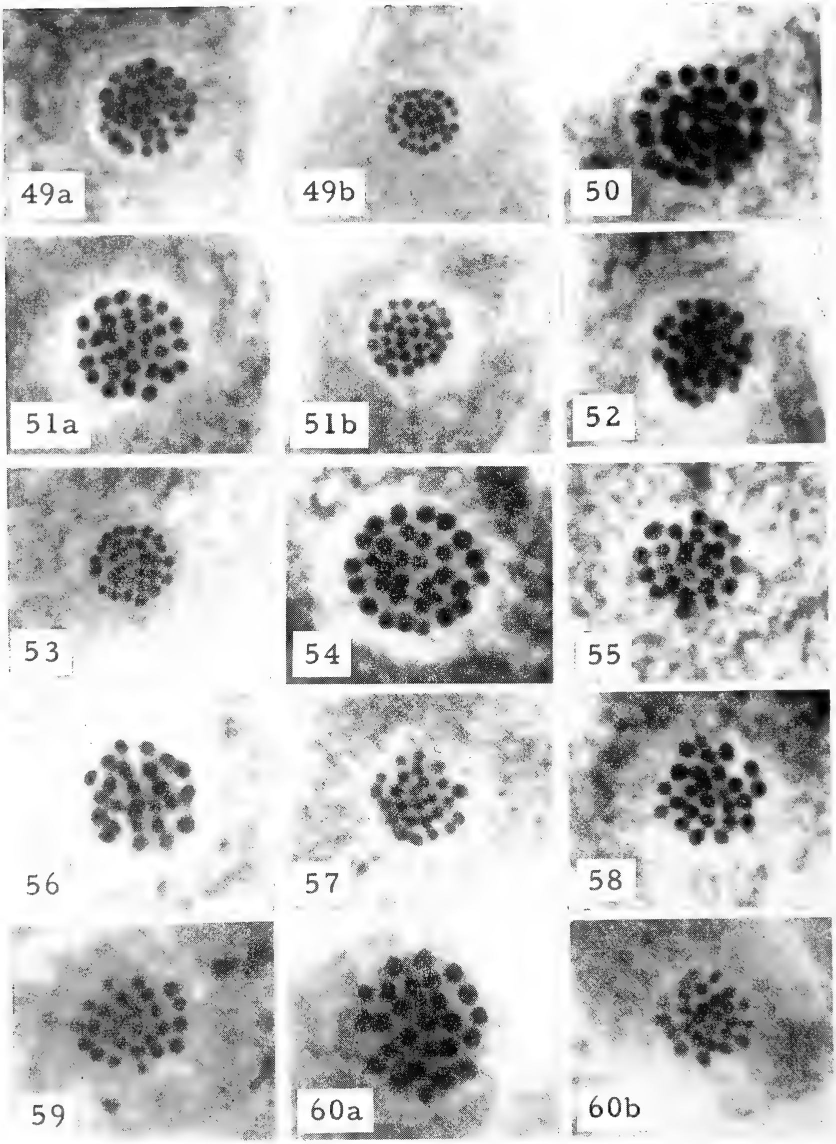


Fig. 49a — *Anteos clorinde* (I); fig. 49b — same (II); fig. 50 — ***Phœbis philea*** (I); fig. 51a — ***Kricogonia lyside*** (I); fig. 51b — same (II); fig. 52 — ***Eurema proterpia*** (I); fig. 53 — ***E. mexicana*** or ***boisduvaliana*** (II); fig. 54 — ***Appias drusilla*** (I); fig. 55 — ***Pieris rapæ rapæ*** (I); fig. 56 — ***P. napi macdunnoughii*** (I); fig. 57 — ***P. calyce*** (I); fig. 58 — ***P. occidentalis*** (I); fig. 59 — ***P. beckeri*** (I); fig. 60a — ***Ascia monuste*** (I); fig. 60b — same (II).

Table 2.[1] CHROMOSOME NUMBERS OF THE HESPERIOIDEA.

Species	Number (n)	Division	Reference
1. HESPERIIDÆ			
A. Cœliadinæ:			
Bibasis aquilina (Speyer)	29	♂ (I)	Maeki, 1953
Choaspes benjaminii (Guérin)	31	♂ (I)	Maeki, 1953
B. Pyrginæ:			
ACHALARUS TOXEUS (Plötz)	16	♂ (I, II)	Present paper
CHIOIDES CATILLUS (Cramer)	31	♂ (I)	Present paper
Spialia orbifer (Hübner)	30	♂ (II)	Lorkovič, 1941
Pyrgus malvæ (L.)	31	♂ (II), ♀ (I)	Federley, 1938 Lorkovič, 1941
Pyrgus onopordi (Rambur)	30	♂ (I, II)	Lorkovič, 1941
Pyrgus serratulæ (Rambur)	30	♂ (I)	Lorkovič, 1941
Pyrgus alveus (Hübner)	24	♂ (I, II), ♀ (I)	Federley, 1938 Lorkovič, 1941
Carcharodus alceæ (Esper)	31	♂ (I, II)	Lorkovič, 1941
Carcharodus lavatheræ (Esper)	30	♂ (I, II)	de Lesse, 1953
Erynnis montanus (Brem.)	31	♂ (I, II)	Maeki, 1953
Erynnis tages (L.)	31	♂ (I, II)	Lorkovič, 1941
ERYNNIS ICELUS (Scudd.&Burg.)	30	♂ (I, II)	Present paper
ERYNNIS JUVENALIS (Fab.)	30	♂ (I, II)	Present paper
ERYNNIS HORATIUS (Sc. & B.)	31	♂ (I, II)	Present paper
ERYNNIS PERSIUS (Scudder)	31	♂ (I, II)	Present paper
ERYNNIS BAPTISIÆ (Forbes)	31	♂ (I, II)	Present paper
ERYNNIS LUCILIUS (Sc. & B.)	31	♂ (I, II)	Present paper
GRAIS STIGMATICUS (Mab.)	31	♂ (I, II)	Present paper
Daimio tethys (Mén.)	30	♂ (I)	Maeki, 1953
C. Hesperiinæ:			
Thymelicus lineola (Ochs.)	29	♂ (I), ♀ (I)	Federley, 1938
Ochlodes venata (Br. & Grey)	29 (28)	♂ (I, II), ♀ (I, II)	Federley, 1938 Lorkovič, 1941
OCHLODES SYLVANOIDES (Bd.)	29	♂ (I, II)	Present paper
Ochlodes ochracea (Brem.) [Japan]	24	♂ (I)	Maeki, unpublished
NASTRA L'HERMINIERI (Latr.)	30	♂ (I, II)	Present paper
Thoressa varia (Mur.)	31	♂ (II)	Maeki, 1953
Polytremis pellucida (Mur.) [Japan]	16	♂ (I)	Maeki, unpublished
Pelopidas mathias (Fab.) [Japan]	16	♂ (I)	Maeki, unpublished
Parnara guttata (Br. & Grey)	16	♂ (I)	Maeki, 1953
2. MEGATHYMIDÆ			
A. Megathyminæ:			
MEGATHYMUS VIOLÆ S. & T.	27	♂ (II)	Present paper
STALLINGSIA MACULOSA (Fr.)	50	♂ (II)	Present paper
B. Ægialinæ:			
AGATHYMUS MARIÆ (B. & B.)	21	♂ (I, II)	Present paper

[1]Table 1, for the Papilionidæ, is in Part 1 of this series of papers (*Journ. Lepid. Soc.* 13: 199; 1960).

Table 3. CHROMOSOME NUMBERS OF THE PIERIDÆ.

Species	Number (n)	Division	Reference
A. Pierinæ:			
Anthocaris scolymus Butler	31	♂ (I, II)	Maeki, 1953, 1959
Euchloe cardamines (L.)	31(-32)	♂ (I, II), ♀ (I)	Federley, 1938 Lorkovič, 1941
Euchloe crameri Butler	31	♂ (I, II)	Lorkovič, 1941
EUCHLOE AUSONIDES Lucas	31	♂ (I, II)	Present paper
Colias croceus (L.)	31	♂ (I, II), ♀ (I)	Lorkovič, 1941 Federley, 1942
COLIAS EURYTHEME Bdv.	31	♂ (I, II)	Present paper
COLIAS PHILODICE (Godart)	31	♂ (I, II)	Present paper
COLIAS ALEXANDRA Edw.	31	♂ (I, II)	Present paper
COLIAS SCUDDERII Reak.	31	♂ (I, II)	Present paper
Colias hyale (L.)	31(-32)	♂ (I, II), ♀ (I)	Lorkovič, 1941 Federley, 1942
Colias erate (Esper)	31	♂ (I, II)	Maeki, 1953, 1959
Colias palæno (L.)	31(-32)	♂ (I, II), ♀ (I)	Federley, 1938, 1942 Maeki, 1959
Colias nastes Bdv.	31	♀ (I)	Federley, 1942
Colias hecla Lefebre	31	♀ (I)	Federley, 1938, 1942
COLIAS MEADII Edw.	31	♂ (I, II)	Present paper
ZERENE CESONIA (Stoll)	31	♂ (I, II)	Present paper
Gonepteryx rhamni (L.)	31(-32)	♂ (I, II), ♀ (I)	Beliajeff, 1930 Federley, 1938 Lorkovič, 1941 Maeki, 1959
Gonepteryx mahaguru (Gistel)	31	♂ (I, II)	Maeki, 1959
ANTEOS CLORINDE (Godart)	31	♂ (I, II)	Present paper
Hebomoia glaucippe (L.)	17	♂ (I, II)	Maeki, 1959
PHŒBIS PHILEA (Joh.)	31	♂ (I, II)	Present paper
KRICOGONIA LYSIDE (Godart)	31	♂ (I, II)	Present paper
Eurema læta (Bdv.)	29	♂ (I, II)	Maeki, 1959
Eurema hecabe (L.)	31	♂ (I, II)	Maeki, 1953, 1959
EUREMA PROTERPIA (Fab.)	31	♂ (I, II)	Present paper
EUREMA [*MEXICANA* Bdv. or *BOISDUVALIANA* F. & F.]	31	♂ (I, II)	Present paper
EUREMA NICIPPE (Cramer)	31	♂ (I, II)	Present paper
EUREMA LISA (Bdv. & Lec.)	31	♂ (I)	Present paper
APPIAS DRUSILLA (Cramer)	32	♂ (I, II)	Present paper
Aporia cratægi (L.)	25(-26)	♂ (I, II), ♀ (I)	Kernewitz, 1914,1951 Beliajeff, 1930 Federley, 1938 Lorkovič, 1941 Maeki, 1953, 1959
Aporia hippia (Brem.)	25	♂ (I, II)	Maeki, 1959

Table 3 — continued.

Pieris brassicæ (L.)	15	♂ (I, II), ♀ (I, II)	Henking, 1890 Doncaster, 1912 Beliajeff, 1930 Federley, 1938, 1942 Lorkovič, 1941
Pieris rapæ rapæ (L.)	25(-26?)	♂ (I, II), ♀ (I)	Beliajeff, 1930 Federley, 1938 Lorkovič, 1941 Present paper
Pieris rapæ crucivora Bdv.	26(-25)	♂ (I, II)	Maeki, 1953, 1959
Pieris manni Mayer	25	♂ (I, II)	Lorkovič, 1941
Pieris bryoniæ Ochs.	25	♂ (I, II)	Lorkovič, 1941
Pieris napi napi (L.)	25	♂ (I, II), ♀ (I)	Henking, 1890 Federley, 1938 Lorkovič, 1941
P. N. MACDUNNOUGHII Rem.	25	♂ (I, II)	Present paper
Pieris napi nesis Fruhst.	26	♂ (I, II)	Maeki, 1959
PIERIS VIRGINIENSIS Edw.	26	♂ (I, II)	Present paper
Pieris ergane Hübner	26	♂ (I, II)	Lorkovič, 1941
Pieris melete Mén.	27-31	♂ (I, II)	Maeki, 1953
Pieris daplidice (L.)	26	♂ (I, II)	Lorkovič, 1941
PIERIS BECKERII Edw.	26	♂ (I, II)	Present paper
PIERIS OCCIDENTALIS Reak.	26	♂ (I, II)	Present paper
PIERIS CALYCE Edw.	26	♂ (I, II)	Present paper
ASCIA MONUSTE (L.)	27	♂ (I, II)	Present paper
B. Dismorphiinæ:			
Leptidea sinapis (L.)	26-41	♂ (I, II), ♀ (I)	Federley, 1938 Lorkovič, 1941
Leptidea morsei Fenton	54	♂ (I)	Lorkovič, 1941 Maeki, 1958, 1959
Leptidea amurensis (Mén.)	61	♂ (I, II)	Maeki, 1958, 1959
Leptidea duponcheli Staud.	104	♂ (I)	Lorkovič, 1941

Discussion

Tables 2 and 3 show the chromosome numbers of the 32 species of Hesperioidea and 48 of Pieridæ for which counts have now been recorded. Of the 36 species described in the present paper 34, plus 1 subspecies, are new to cytology and are shown in capitals in the Tables.

Some major groups are notably constant in number. Of the 19 known Pyrginæ, 17 have $n = 30$ or 31. The count of 16 for *Achalarus toxeus* is an extreme variant but can be accounted for by 1 + 1 fusions of all but one chromosome (the X-chromosome?). The 9 Hesperiinæ shown in Table 2 are diverse, but we will soon publish accounts of several more species having $n = 29$, and this seems to be the most usual number for the many small brown temperate-region hesperiines. The 3 $n = 16$ Asiatic species appear to be in a distinctive phylogenetic line. Their caryotype is remarkably similar to that of *A. toxeus.* Our finding of $n = 48$ for the hesperiine *Asbolis capucinus* (Lucas), to be reported in detail in our forthcoming supplementary paper, is an extreme departure from the previously published counts for any Hesperiidæ.

The chromosomes of the Pierinæ are now well enough known to show that on cytological grounds there are two very discrete groups: the Euchloini with 31 as the usual base number and the Pierini with 25-26 as most characteristic. There is no cytological support for the separation of the *Colias* relatives from the *Euchloe* relatives. The known American Pieridæ have no large variants in number, *Ascia monuste* and *Appias drusilla* having only one more chromosome than their relatives. In the known Old World Pierinæ two species have large differences from their nearest relations: *Pieris brassicæ* ($n = 15$ instead of 25 or 26) and *Hebomoia glaucippe* ($n = 17$ instead of 31), and we will soon describe an African *Leptosia* with $n = 12$. It will be of great interest to work out the numbers for the many American Dismorphiinæ, in view of the wide numerical range and the suggestion of polyploidy in the one Palearctic dismorphiine genus, *Leptidea.*

The family Megathymidæ is structurally and biologically divergent and specialized as compared to the Hesperiidæ, and the megathymids also prove to be distinctive chromosomally. All 3 known species (and genera) have totally different numbers: $n = 21$, $n = 27$, and $n = 50$. The latter is the highest known count for any Hesperioidea. Too few of these remarkable Skippers have been worked out for safe generalizations to be made. We intend to give this group special attention, with the help of the STALLINGS, TURNER, and FREEMAN group of specialists.

The introduced *Pieris rapæ rapæ* is believed to have come to North America from Europe in the 19th Century. Our many counts all agree with those of BELIAJEFF (1930) and LORKOVIC (1941) for eastern European material. FEDERLEY (1938) reported $n = 26$ for both spermatocyte and oocyte divisions in *P. rapæ* from Finland. There is a need for counts from a substantial series of Scandinavian, especially Finnish, *P. rapæ* to determine how regular is the haploid number of 26 in that region and whether the 26th element is a normal chromosome or a m-chromosome. (See our remarks on the m-chromosome in our first paper, page 200.) In the Japanese *P. rapæ crucivora* there is one m-chromosome in addition to the 25 normal chromosomes, and this minute element was found (Maeki, 1959) sometimes among the normal chromosomes and sometimes in the cytoplasm outside the nucleus. If Finnish *P. rapæ* consistently have the m-chromosome there will be a suggestion of phylogenetic affinity with the Japanese race. If there is a 26th normal chromosome there will be the possibility that hybridization experiments will show that the Finnish stock is not true *rapæ* but an unrecognized sibling or a member of a 26-chromosome species such as *P. ergane.*

A similar situation exists in so-called *Pieris napi.* HENKING (1890), FEDERLEY (1938), and LORKOVIC (1941) found $n = 25$ in spermatocyte divisions in European material (Federley also reported $n = 23$ in a female). We found $n = 25$ regularly in race *macdunnoughii* in Colorado. Maeki (1959) showed that the number is 26 consistently in the Japanese "subspecies" *nesis* and that the extra chromosome is apparently a regular autosome, not a m-chromosome. (His earlier report (1953) of $n = 25$ was corrected in the later paper.) It is now suggested that *nesis* is a species distinct from true *napi,* as is certainly true for the North American *virginiensis* ($n = 26$). In the eastern U. S. A. *P. virginiensis* is mainly more southern than *P. napi* but has an overlap zone of sympatry in Masachusetts and Vermont and perhaps to the west as well. It is univoltine and very early in its flight, whereas *napi* is commonly bivoltine and even its first brood is later than the single brood of *virginiensis.* There is some tendency for foodplant separation, with *P. virginiensis* larvæ always on *Dentaria* and *P. napi* on several Cruciferæ including *Dentaria.* Our finding of a chromosome difference is a piece of clinching evidence for the full species status of *virginiensis,* and the long debate on the question appears to be ended.

The cytological data are not significant in clarifying the status of members of three other complexes we have examined. In these there are no differences in chromosome number. This need not indicate conspecifity (and certainly does not in the second and third complexes), since separate species often have identical haploid numbers. *Pieris occidentalis* and *P. calyce* (see notes above) both have $n = 26$. In the sibling species group including *Erynnis baptisiæ, E. lucilius,* and *E. persius,* all three prove to have $n = 31$. The eleven known species of *Colias,* some phenotypically extremely alike, all have $n = 31$. However, the five *Colias* we have studied have 7 large chromosomes clearly distinguishable in the metaphase plate of the primary spermatocyte division; we found these larger chromosomes still recognizable in the secondary spermatocyte division only in *C. alexandra* and *C. scudderii;* possibly this is a significant character.

Summary

1. Chromosome counts are presented for 11 species of Hesperiidæ, 3 of Megathymidæ, and 22 of Pieridæ. All the Hesperiidæ are species new to cytology. No Megathymidæ had previously been studied. Of the Pieridæ, 20 species are likewise new and another count is the first for an American subspecies (*Pieris napi macdunnoughii*). The cytologically new species are: *Achalarus toxeus* (Mexico), *Chioides catillus* (Mexico), *Erynnis icelus, juvenalis, horatius, persius, baptisiæ,* and *lucilius* (all Connecticut), *Grais stigmaticus* (Mexico), *Ochlodes sylvanoides* (Colorado), *Nastra l'herminieri* (Connecticut), *Megathymus violæ* (Mexico), *Stallingsia maculosa* (Texas), *Agathymus mariæ* (Texas), *Euchloe ausonides* (Colorado), *Colias eurytheme* and *philodice* (Connecticut), *C. alexandra, scudderii,* and *meadii* (all Colorado), *Zerene cesonia* (Mexico), *Anteos clorinde, Phœbis philea, Kricogonia lyside, Eurema proterpia, nicippe,* and [*mexicana* or *boisduvaliana*] (all Mexico), *E. lisa* (Connecticut), *Appias drusilla* (Mexico), *Pieris vir-*

giniensis (Massachusetts), *Pieris beckerii, occidentalis,* and *calyce* (all Colorado), and *Ascia monuste* (Mexico). All these counts are from spermatocyte divisions.

2. Meiotic divisions are numerous in most adult, flying males of Pieridæ and Hesperiidæ. Meiosis has almost or entirely ended by the time of eclosion in males of the Megathymidæ, the five high mountain Hesperiidæ, and the many early spring *Erynnis brizo* examined by us.

3. The haploid number tends to be 30 or 31 for Pyrginæ, 29 for Hesperiinæ, 31 for Euchloini (including the *Colias* group) and 25-26 for Pierini. Some deviant species have been found in each of these groups. The numbers for Megathymidæ are widely scattered, the three known species (each in a separate genus) having $n = 21$, 27, and 50, respectively.

4. The North American sibling species, *Pieris napi* and *virginiensis,* have haploid numbers of 25 and 26, respectively. Japanese supposed *P. napi* ("subspecies" *nesis*) has $n = 26$. The Japanese *P. rapæ crucivora* has an extra minute element not present in the European and American *P. rapæ rapæ.* In both cases the Japanese forms may actually prove to be separate species rather than subspecies.

5. Three other complexes of possible or positive sibling species prove to have no difference in number among the similar forms: *Pieris occidentalis* and *calyce*; *Erynnis persius, baptisiæ,* and *lucilius*; and *Colias* spp.

6. The haploid number is only mentioned for *Asbolis capucinus, Ochlodes ochracea, Polytremis pellucida,* and *Pelopidas mathias*; descriptions and full records will be reported in later papers.

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References

Baliajeff, N. K., 1930. Die Chromosomenkomplexe und ihre Beziehung zur Phylogenie bei den Schmetterlingen. *Zeitschr. induk. Abstamm. - und Vererbungsl.* 54: 369-399.

Doncaster, L., 1912. The chromosomes in the oogenesis and spermatogenesis of *Pieris brassicæ,* and in the oogenesis of *Abraxas grossulariata. Journ. genetics* 2: 189-200.

Federley, H., 1938. Chromosomenzahlen finnländischer Lepidopteren. I. Rhopalocera. *Hereditas* 24: 397-464, 47 figs.

............, 1942. Chromosomenzahlen von vier Tagfaltern von ozeanischen Inseln. *Hereditas* 28: 493-495.

Henking, H., 1890. Untersuchungen über die erster Entwicklungsvorgänge in den Eiern der Insekten. I. Das Ei von *Pieris brassicæ* L. nebst Bemerkungen über Samen und Samenbildung. *Zeitschr. wiss. Zool.* 49: 503-564, pls.24-26.

Kernewitz, B., 1914. Über Spermiogenese bei Lepidopteren. *Zool. Anz.* 45: 137-139.
............, 1915. Spermiogenese bei Lepidopteren mit besonderer Berücksichtigung der Chromosomen. *Archiv. Naturgeschichte (A)* 81: 1-34, 3 pls., 14 figs.
de Lesse, H., 1953. Formules chromosomiques de *Boloria aquilonaris* Stichel, *B. pales* D. et Schiff., *B. napæa* Hoffm. et quelques autres Lépidoptères Rhopalocères. *Rev. franç. lépid.* 14: 24-26, 1 pl., 5 figs.
Lorkovič, Z., 1941. Die Chromosomenzahlen in der Spermatogenese der Tagfalter. *Chromosoma* 2: 155-191, 13 figs.
Maeki, K., 1953. Chromosome number of some butterflies (Lepidoptera-Rhopalocera). *Jap. journ. genetics* 28: 6-7, 5 figs.
............, 1958. On the cytotaxonomical relationship in *Leptidea* (Lepidoptera-Rhopalocera). *Jap. journ. genetics* 33: 283-285, 6 figs.
............, 1959. A chromosomal study in fifteen species of the Japanese Pieridæ (Lepidoptera-Rhopalocera). *Kwansei Gakuin Univ. annual studies* 7: 361-368, 32 figs.
............, & C. L. Remington, 1960. Studies of the chromosomes of North American Rhopalocera. I. Papilionidæ. *Journ. lepid. soc.* 13: 193-203, 3 pls.

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A CORRECTION ON *HESPERIA PAWNEE* IN MICHIGAN

Since the publication of my article entitled, "Observations of *Hesperia pawnee* in Michigan" (*Lepid. news* 12: 37-40; 1958), I now realize that a serious error in determination was made. All of the records and observations for *H. pawnee* Dodge in Michigan referred to in this article should be those of *H. ottoe* Edw. This error was first called to my attention by Mr. C. Don MacNeill of the California Academy of Sciences after I had sent him specimens determined by me as *pawnee*. I then shipped to MacNeill, later to Dr. A. W. Lindsey, additional *pawnee* specimens (my determinations) of both sexes from several localities over a wide range of dates, including the pair originally determined as *pawnee* by Mr. W. D. Field of the U. S. National Museum, for further examining. In each case the specimens were found to be *Hesperia ottoe*! Dr. Lindsey stated that my dates of capture, June 19 to August 9, were sufficient to separate the two species, as *pawnee* flies later than *ottoe* in the same area. Recently, in checking the left valve of several males in my collection, I found the terminal tooth shorter than the basal tooth — characteristic of *ottoe*.

It is entirely possible that *H. pawnee* may occur in Michigan in the same habitat as that of *ottoe* but during late August and September. In time, I hope to explore this possibility and will report any interesting results.

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NOTES ON *AGATHYMUS* IN TEXAS, AND THE DESCRIPTION OF A NEW SPECIES FROM MEXICO (MEGATHYMIDÆ)

by H. A. Freeman

As more extensive study is made of the habits and life histories of the various known species of *Agathymus* the less we seem to know about them. Some few years ago it seemed as if all the species known fit into a definite pattern with each one using a specific *Agave* as a host plant. Since working with *Agave lecheguilla* Torr. we have found this to be untrue. Apparently many species do have very definite *Agave* host plants; however in the *lecheguilla* group it is not unusual to find two or possibly three species of *Agathymus* in the same plant. In the Hueco Mountains of Texas there occur apparently three species of *Agave*. One is a broad-leafed species in the *parryi* group, with a sordid white shade to the leaves. Another is *lecheguilla,* while in between there is either a hybrid of the two or what is called *chisosensis* Muller. In this particular area only *Agathymus mariæ* (B. & B.) is found in the *lecheguilla*. In the *"chisosensis"* plants I have found *A. mariæ* and *A. judithæ* (S. & T.), plus one that I thought at first to be a new species; however as it has characteristics of both *mariæ* and *judithæ* I presume it to be a hybrid of the two species. In the *parryi*-like *Agave* only *judithæ* and three specimens of this possible hybrid were found, with no *mariæ* ever having been observed.

During July 1949, while returning home from the Big Bend section of Texas with my family, I located a colony of *lecheguilla* growing about twenty-eight miles north of Del Rio on the highway to Sonora. I did not stop at that time to examine those plants; however if I had I would have located a new species as I have since found that they contained the recently described *Agathymus estelleæ* (S. & T.) as well as *A. mariæ*.

On 28 August 1958 I brought home seven specimens of *Agave lecheguilla* from 28 miles north of Del Rio, Texas, containing what I thought to be larvæ of *Agathymus mariæ*. I did not examine the larvæ in the field else I would have detected that they were not all *mariæ*. Each plant had fairly fresh frass near the base of the leaves; however no trap doors had been constructed on that date. Four of the larvæ made their doors during the first week of September, and on 24 September a female *estelleæ* emerged, the first one to be seen from the United States. On the following day two males and another female emerged. Only one *mariæ* came from this group of plants, a female about two weeks later.

On 4 July 1959 I brought home eleven plants from the same location and on 5 September I dug up 21 more plants; from those 32 plants 31 males and 27 females emerged from 3 September to 8 October. One plant had eight pupæ, while two others had seven in each. All specimens were *estelleæ* except three which were *mariæ*.

Eight miles west of Dryden, Texas, I dug up nine *lecheguilla* plants that were infested with larvæ. From these, two males and three females of *estelleæ* emerged during September (9-27), and three males of *mariæ* emerged during October (11, 13, 18).

Twelve miles south of Juno, Texas, five infested plants were carried home from which two males of *estelleæ* emerged during September (21, 23) and one female *mariæ* which emerged 18 October. One of the plants contained a female pupa of *estelleæ* which died and the other contained a female pupa of *mariæ* which was not able to get out of its pupal skin and thus eventually died without expanding.

The above-mentioned specimens of *estelleæ* differ slightly from specimens obtained from the type locality, near General Bravo, Nuevo Leon, Mexico, in that the spots on the upper surface of the secondaries are somewhat narrower and a little lighter in coloration. The spots on the upper surface of the primaries are somewhat longer and the female genitalia shows slight deviations; however not enough to indicate that it is more than individual variation.

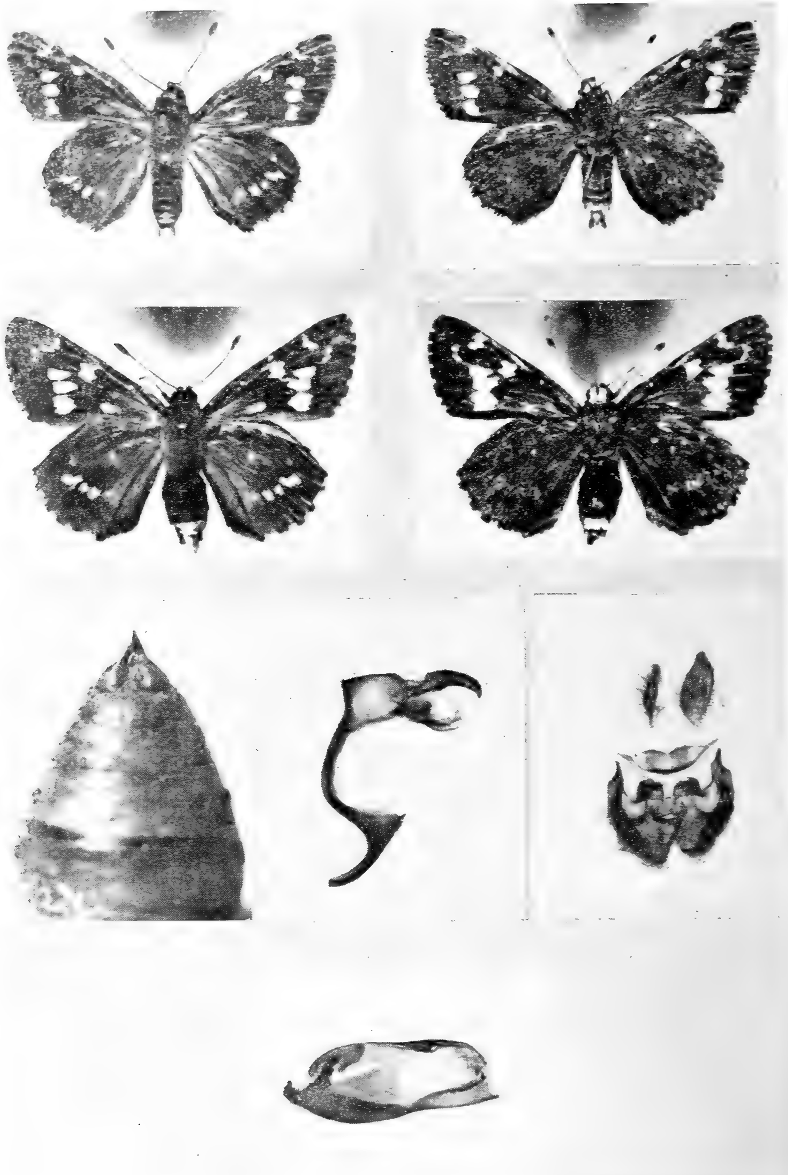
This is a new *Agathymus* record for the United States.

Several years ago I learned that there were three specimens of an *Agathymus* in the United States National Museum tentatively identified as *Megathymus smithi* Druce. Mr. William D. Field of that institution, was kind enough to loan those specimens to me and when I examined them I at once saw that they were specimens of an undescribed species. In 1957 Stallings and Turner made a special effort to get more specimens of this new species and some of the information contained in the following description is based on their results. It gives me great pleasure to name this species after William D. Field of the United States National Museum because of his help in this particular project as well as in others.

AGATHYMUS FIELDI H. A. Freeman, new species

Male (upper side): Primaries are brownish black, with some lighter brown hairs and scales near the base. There is a spot near the end of and extending across the cell. The three subapical spots are somewhat linear and the one in interspace 6 is somewhat out of line, being nearer the apex. The two extradiscal spots are small and are situated outward from the subapical and discal spots. The discal band is composed of three separated spots, which are in line, the one in interspace 1 is somewhat broadly columnar, the one in interspace 2 is round, and the one in interspace 3 is pointed inward at the top toward the cell spot. All spots are creamy yellow in color. Fringes are alternately brownish black and creamy.

Secondaries are brownish black, sparsely overscaled with brown hairs over the basal half of the wing. There is a discal band composed of five small creamy spots, the ones in interspaces 2-5 form a straight line, while the one in interspace 6 is minute and situated above the spots in interspaces 4 and 5. The discal band is situated one-third of the way inward from the outer margin toward the base. Fringes are alternately brownish black and creamy yellow.



Agathymus fieldi. Top row: ALLOTYPE ♂, Guadalajara, Mexico, 27 Sept. 1957; 2nd row: HOLOTYPE ♀, Guadalajara, Mexico, 30 Sept. 1957 (upper surfaces left, under surfaces right). 3rd row: left, pupal cremaster; middle, ♂ uncus; right, ♀ genital plate (Paratypes, same locality as Holotype). Bottom: ♂ valva (Paratype, same locality). Photographs by DON B. STALLINGS.

Male (under side): Primaries are somewhat lighter brownish black than above, with some grayish scales near the apex. All spots reappear and are more yellowish in color. Secondaries have the ground color grayish black with an indistinct darker discal area. There are three indistinct sordid white spots below the costal area.

Thorax above is brown, somewhat lighter beneath. Abdomen is of the same coloration as the thorax. Palpi beneath are gray. Legs are brown. Antennæ are tan above, beneath sordid white, with the club black.

Size of ALLOTYPE made — primaries: base to apex 24 mm., apex to outer angle 14 mm., outer angle to base 18 mm.; secondaries: base to end of Cu_1 17 mm., costa to anal angle 20 mm.; total expanse 48 mm. (average of the paratypes 48 mm.)

Female (upper side): Primaries are brownish black, with a tan area midway between the base and spot in interspace 1. All of the spots found in the male are present and the spots in interspaces 1, 2, and 3 are larger; the one in interspace 2 is 4 mm. wide. Fringes are alternately brownish black and tan. Secondaries are brownish black, with some hairs of the same color near the base. The discal band is very similar to that found in the males except in some cases the spots are a little larger.

Female (under side): Primaries are very similar to the male except the spots are somewhat larger. Secondaries are like the male except the discal band is faintly visible. The thorax, abdomen, palpi, legs, and antennæ are the same as in the male.

Size of HOLOTYPE female — primaries: base to apex 25 mm., apex to outer angle 16 mm., outer angle to base 19.5 mm.; secondaries: base to end of Cu_1 19 mm., costa to anal angle 20 mm.; total expanse 50 mm. (average of the paratypes 50 mm.).

Type material: Described from 31 specimens. 18 males and 10 females were collected in the larval stage during August 1957 at Guadalajara, Mexico, Jalisco Highway 15, Kilometer 724, elevation 4400 feet, by Stallings and Turner. The remaining two males and a female were collected at Guadalajara, Mexico, with no other data present and were borrowed from the United States National Museum for this study. The HOLOTYPE and ALLOTYPE are in the Stallings and Turner Collection, along with 12 male and four female Paratypes. One pair of Paratypes will be placed in the following collections: Charles L. Remington, Yale University; American Museum of Natural History; and the United States National Museum, plus their original two males and one female. There are two pairs of Paratypes in the author's collection.

Superficially *A. fieldi* does not closely resemble any other known species of *Agathymus*. Actually the wing shape is a great deal like *Stallingsia maculosus* (Freeman) and the general coloration is somewhat similar. The males have the maculation on the primaries arranged much as in *A. aryxna* (Dyar), while the females resemble specimens of *A. baueri* (S. &. T.) that have reduced maculation. The coloration is much darker black than either of these two species. The maculation on the upper side of the secondaries slightly resembles *A. remingtoni* (S. & T.). The male genitalia bear some slight resemblance to *A. hoffmanni* (Freeman), whereas the form of the female genital plate slightly resembles some members of the *mariæ* complex. The cremaster also bears some resemblance to members of the *mariæ* complex.

This particular species does not seem to fit into any of the known species complexes as it appears to be a connecting link between the *baueri* complex and the *mariæ* complex. The general coloration, maculation of the secondaries, general shape of the female genital plate, and cremaster of pupa approach those of the *remingtoni* group of the *mariæ* complex. The maculation of the primaries and what is known of the life history would indicate a *baueri* complex relationship. When more information is known this species may well represent another species complex.

Host plant: *Agave tequilana* Weber.

Life history: What is known of the life history of this species was observed at the type locality by STALLINGS and TURNER on 24 August 1957, while they were collecting the larvæ. They inform me that the tan trap doors were on either side of the leaf and that the day that they were found the larvæ were cutting holes in the leaves just prior to making their trap doors. Some of the burrows were not powdered on that date while others were. A few larvae used two leaves with their burrow, while most used but a single leaf. There was no frass to be observed anywhere. The larvæ were a sordid green with pink tints. Pupæ resemble those of the *mariæ* complex in general shape and size.

I wish to express my deepest thanks to the National Science Foundation for a very generous research grant, making it possible for me to continue my work with the Megathymidæ.

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CAPTURE OF *NYMPHALIS J-ALBUM* IN MARYLAND AT NIGHT

This note was stimulated by the observation of BRYANT MATHER (1959) concerning the capture of butterflies at night and by his restatement of the Editor's desire for further information in this field.

On the night of August 22, 1941, I noticed a perfect specimen of *Nymphalis j-album* Boisduval & Leconte hanging from the light fixture of an open side porch of a friend's house in a northern residential section of Baltimore city. It was easily captured because it seemed to be lethargic and I simply knocked it off into a killing jar.

This capture is of interest in that it occurred at 9 p.m. and in that it is the first recorded capture of this species in Baltimore since that of OTTO LUGGER in 1882 (January 2nd!) as reported by CLARK (1932).

References

Mather, Bryant, 1959. *Vanessa atalanta* taken at Atlantic City at 2 A.M. *Journ. lepid. soc.* 13: 18.

Clark, Austin H., 1932. The butterflies of the District of Columbia and vicinity. *Bull. U. S. Nat. Mus.* 157: 245.

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A METHOD FOR ESTIMATING THE WING RADIUS IN LEPIDOPTERA

by P. H. H. Gray

In measuring the wing radius of spread Lepidoptera, or their antennæ, by means of a ruler, dividers, or callipers, there is a risk of damaging the specimens. C. B. Williams developed a device for measuring specimens through the glass cover of the cabinet drawer; it consists of two plates of glass with identical scales on each, one superimposed on the other in exact register, about 1.5 cm. apart. This appears to be a simple solution for measuring the expanse of the spread wings, or the radii of light-coloured wings, but is difficult for radii of such species as *Vanessa cardui* L., *Nymphalis antiopa* L., and many others whose wing-bases spring from a mass of dark hairs in which the zero points of the scale are lost.

The author has found it possible to obtain satisfactory measurements of wing radii, and lengths of straight antennæ, by placing a translucent ruler on the glass cover, provided that the distance between the plane of the object and the scale marks on the ruler is known. The discrepancy between the observed and the true values, caused by parallax, can be overcome by the application of a divergence-factor to the observed values.

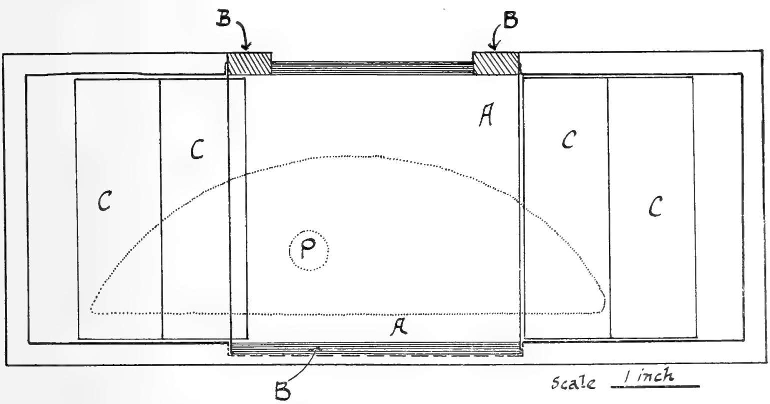


Fig. 1. Measuring chamber.

A measuring chamber, simulating a fraction of a Cornell-type cabinet drawer, was made as follows (see Fig. 1): the top was removed from a rectangular wooden box, of ¼″ material, measuring 8½″ by 3½″, by 2″ high inside. An opening 2¼″ wide was made in the middle of one side, to admit light. Lengthwise slots were cut in the top edges of the two long sides to accommodate two sides of a $3\frac{1}{4}''$ square glass plate (A); they were cut as deep as the thickness of the glass. The edges of the plate lying in the slots were bound with gummed paper tape (B), with narrow straps of the same to serve as hinges (B, B) on the far (window) side.

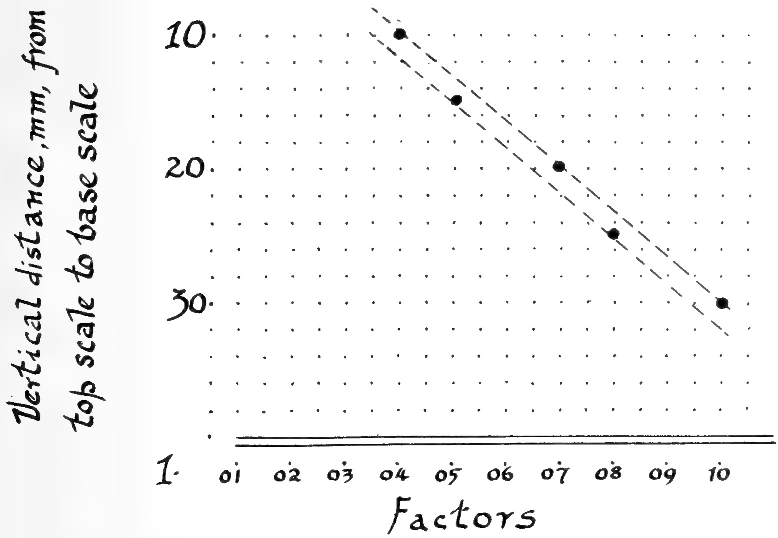
A pinning card of compressed paper pulp is shown in dotted outline in the diagram, resting on microscope slides (C), which are held in place on the box floor by paper straps; the slides raise the card so that the points of the pins are not damaged. The distance from the pinning surface to the top of the glass plate should be 4 cm. The author uses two layers of slides to adjust the card to the required height. A card of the shape shown is easy to move horizontally. For observing specimens mounted with the underside upwards, a small piece of plasticine can be used to hold the head of the pin; it is shown in Fig. 1 as embedded in a hole (P) in the pinning card.

In operation the pinned specimen is placed with the wing to be measured as nearly horizontal as possible. A zero mark on the translucent ruler, a cm./mm. scale, is placed so that it (say the 5 cm. mark) is coincident with the base of the wing when viewed with one eye, at normal vision height (the author uses a Magni-focuser No. 7) then, without moving the head, the position of the apex of the wing in relation to another mark on the scale is noted. For example, the apex of a forewing with radius measured directly as 27 mm. may coincide with the 25 mm. mark from zero; one of 25 mm. with the 23 mm. mark. If both wings lie in the same plane below the scale only one factor is required to convert the observed into the true values; if they lie in different planes factors applicable at these different planes must be found.

This was done as follows: a duplicate scale, of white celluloid with black markings, was placed below the plate at various distances below the plane of the observer's scale; these distances were provided by different numbers of microscope slides arranged in a pile on the pinning card; the exact distances were determined by means of an identical scale held vertically with the marks in juxtaposition with the marks on the observer's scale. The following results were obtained:

Distance below observer's scale, mm.	Observer's scale zero at 50 mm. (a); 100 mm. mark at basic scale mm. (b)	Divergence factor $\frac{b - a}{a}$
10	101.5	1.03
15	102.5	1.05
20	103	1.06
25	104	1.08
30	105.5	1.10

Allowance has also to be made for divergence at different horizontal distances from the zero point. The averages of the horizontal divergences, at 20, 30, 40, and 50 mm. distances, at each vertical distance, brought the divergence factors to 1.04, 1.05, 1.07, 1.08, and 1.10.



The nomogram above was constructed from the above 'corrected' factors. This allows for insects fixed on pins between 1.0 and 2.5 cm. below the head; the useful factors thus lie between 1.04 and 1.10 for normally pinned insects.

The following tests were made with butterflies:

1. Wings at 20 mm. below observer's scale; factor 1.07.

Forewing radius	Radius by direct measure mm.	Divergence reading mm.	Estimated radius mm.
P. rapæ L.	23.0	21.0	22.5
C. eurytheme Bdv.	26.0	24.5	26.2
C. philodice Godt.	28.0	26.0	27.8
V. cardui L.	33.0	31.0	33.0
P. polyxenes Fab.	38.5	36.0	38.5

2. Wings at various distances below observer's scale; random specimens of *C. philodice*.

Direct measure mm.	Divergence reading mm.	Distance below scale mm.	Factor	Estimated radius mm.
27	25	27	1.09	27.3
29	27	20	1.07	28.9
28	26	18	1.06	27.6
26	24	20	1.07	25.7
21	20	20	1.07	21.4
27	25	19	1.065	26.6
23	21.5	18	1.06	22.8

The average values from 23 specimens, of which the above seven are a part, were as follows; by direct measure 25.98 ± 0.42; by estimation 25.76 mm. A random series of *C. eurytheme,* 5 males and 4 females, was measured and found to have a mean forewing radius of 25.8 mm; the radii were then estimated after readings through a glass cover on the storage box, as well as through the glass of the small box; the results were, for measurements in the storage box 25.6 mm., and for those in the small box 25.5 mm.

Comparative measurements and estimates have so far been quoted for objects lying between 20 and 40 mm. For comparisons of objects extending less than 20 mm. the antennae of 10 *V. cardui* were examined by both methods; the mean of the measured lengths was 15.9 mm. and that of the estimated was 16.0 mm.

In order to demonstrate the correlations of values obtained by the two methods the figures for forewing radii and antennal lengths of 9 *Colias philodice* males, reared in Quebec Province in November 1952, from eggs laid by one female, are given below:

Wings		Antennæ	
Estimated mm.	Measured mm.	Estimated mm.	Measured mm.
23.54	23.5	9.1	9.0
24.61	25.0	9.6	9.5
24.61	25.0	9.6	9.3
24.61	25.0	9.6	9.5
24.08	23.5	9.1	9.0
24.61	25.0	9.4	9.5
24.08	24.5	9.1	9.0
23.54	24.5	9.1	9.0
22.47	22.5	9.1	9.0

Means and their standard deviations:
for wings, Estimated: 24.01 ± 0.279
Measured: 24.26 ± 0.396
for antennæ, Estimated: 9.3 ± 0.14
Measured: 9.2 ± 0.14

Correlation coefficients:
for wings, Estimated × Measured, $r = 0.9827$
for antennæ, Estimated × Measured, $r = 0.8875$
$n = 7$, $P < .01$ for both sets.

A method of this kind should be useful to students of other orders of insects as well as to lepidopterists.

Reference

Williams, C. B. 1943. A safe method of measuring the wings of set butterflies. *Proc. Roy. ent Soc. London* 18:3-5.

R. R. 2, Digby, Nova Scotia, CANADA

ESPECIALLY FOR FIELD COLLECTORS

(Under the supervision of Fred T. Thorne, 1360 Merritt Dr., El Cajon, Calif., U.S.A.)

THE PRESERVATION OF LEPIDOPTEROUS LARVÆ USING THE INFLATION AND HEAT-DRYING TECHNIQUE

by H. E. Hammond

Introduction

The preservation of lepidopterous larvæ by the inflation and heat-drying method is the method adopted when specimens are required for cabinet display or in making up life-history cases and is particularly useful for those who wish to study the color and superficial structural characteristics of the larvæ. This method, too, is a very great help to the field-worker for, as his collection grows, he absorbs a great deal of knowledge and except in the case of critical species, he is enabled to name promptly most of the species already encountered. Apart from this, the formation of a well-preserved and neatly mounted collection of larval skins is a real asset to the appearance and value of his collection of imagines giving, as it does, a wider and more interesting aspect to the whole.

The preservation of skins by this method takes but little longer than does the setting of imagines and the whole process can be completed in a matter of minutes with the resultant mount ready for the cabinet.

It is to be regretted that the preservation of larvæ is not more universally practised and the object of this paper is to explain and illustrate a simple method, in the hope that others will be encouraged to take up this absorbing work.

A number of the more critical species need to be bred to make certain of larval identity for very few can claim to identify larvæ of more than a fraction of the species. This alone makes the project well worth the effort and if one adds to this the increase in botanical knowledge which must automatically be acquired it can give the thoughtful student a great deal of pleasure and profit.

My own collection has been formed over many years and now embraces about 90% of the British species. To effect this I estimate I have, to date, preserved some 25,000 specimens and many collaborators and institutions are the richer by drawing on the surplus. This does, I am informed, give me the experience necessary to try to pass on to others what I have learned of the subject.

Before passing on to the main part of this paper I must make one remark. Do please pay strict regard to detail; it is so important, I want to stress the point. Success does so much hinge on care.

Apparatus

This is neither bulky nor expensive and the handyman can easily construct some of it. It consists of the oven, spirit (alcohol) lamp or bunsen burner, glass blowpipe jets, rubber inflator, silk or cotton covered copper wire, pins and a few miscellaneous items to be mentioned later.

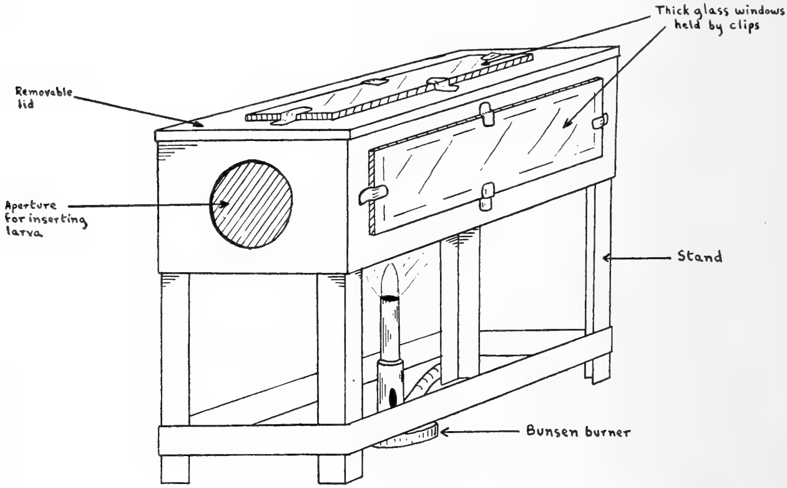


Fig. 1. Hammond-pattern drying oven, heated by a Bunsen burner.

1. The Oven.

I use one type only - a rectangular box with a removable lid. It is made of aluminium to avoid rust, but a box made from stout tinplate will answer as well. A suitable size is about 7 inches (18 cm.) long x 4 inches (10 cm.) wide x 2½ inches (6 cm.) deep. This will accommodote all larvæ likely to be dealt with unless it is desired to preserve some of the very large tropical species. At one end is cut a circular aperture for admission of the skin. The aperture should be be about 1¼ inches (3.5 cm. approx.) in diamter. In the lid is cut an aperture 5 inches (12-13 cm.) x 1½ inches (4 cm. approx.), and in the sides similar apertures 5 inches (12-13 cm.) x 1 inch (25-30 cm.). Over these apertures are placed pieces of glass slightly larger than the aperture. These are held in position by clips of brass or other soft metal. It is necessary to ensure that glass and metal fit perfectly to avoid loss of heat. I advocate a fairly loose lid, for occasionally a skin may pop off the jet and speed in recovery is essential; a few seconds' contact with the oven base will ruin a good skin. If a piece of non-ferrous gauze is fitted at about ¼ inch (4 mm.) from the oven base it will minimize the possibility of damage if recovery of the skin is reasonably prompt.

The drying oven is placed on a stand which may be another box cut to a suitable size and trimmed neatly to make a framework. If a spirit lamp is used for heating it must be protected from draughts, but *must* have ample ventilation or it will continually be extinguished or get over-heated and burst into flames. With a bunsen burner, the stand will need longer legs.

An ordinary cocoa can or similar container can be used with or without the lid in place of a more complicated oven. An aperture must, of course, be made at one end. The chief disadvantages of this form of oven are a tendency to overheat and the impossibility of watching progress without continual withdrawal of the skin for inspection; with the glass windows perfect observation and control is possible. Flat metal or fine wire gauze (not zinc, which melts over a flame) can be used as a substitute, but drying takes much longer and burnt fingers are usually a further penalty.

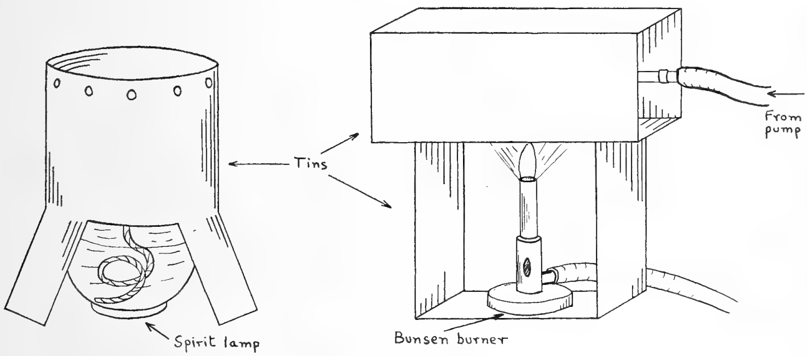


Fig. 2. Alternative drying ovens.

2. Source of Heat

For speed in operation and complete control of the heat a bunsen burner is much to be preferred, but as many would-be enthusiasts are relegated to the garden shed for "blowing" their larvæ, a spirit lamp can be used effectively in such circumstances. It is necessary, however, to use either a somewhat smaller oven or compensate for the gentler, but less easily controlled heat, by using a lamp of suitable size or, in the case of large ovens, to use two lamps. Temperature, of course, must be constant and not allowed to rise or the skins will be discolored or scorched. With the oven I use (as described) in conjunction with a bunsen burner, I have the top end of the bunsen burner 2 inches (5 cm.) from the oven base and after igniting the gas, adjust the flame so that its tip *just touches* the oven base without any lateral spreading. After reaching maximum heat at this adjustment I can do a hundred skins, if necessary, without even looking at the flame. Any other oven would, of course, need a different flame adjustment but very little variation would be needed for oven of comparable size and thickness of the metal used.

3. The Glass Blowpipe.

A stock of various sized jets should be available if many larvæ are to be prepared. Many dealers in scientific apparatus will supply these cheaply but they are extremely simple to make. Take a piece of glass tubing about 8-10 inches (20-25 cm.) in length. Hold this centrally over a bunsen flame until soft, continually rotating it to keep the jet central to the tube. When it is sufficiently hot draw the two ends gently and steadily apart, when the heated portion will narrow to a fine waist. After cooling, mark with a fine file and snap into two portions. If the two ends are rough, hold *for a second only* in the flame to smooth them. A longer period will close the jet and make it useless. If any jets get broken they may be re-drawn by placing two together—end to end — in the flame until red hot. The two ends will adhere, when one may be drawn out. The other piece will need to be fused to a piece of waste tubing when it, too, may be re-drawn.

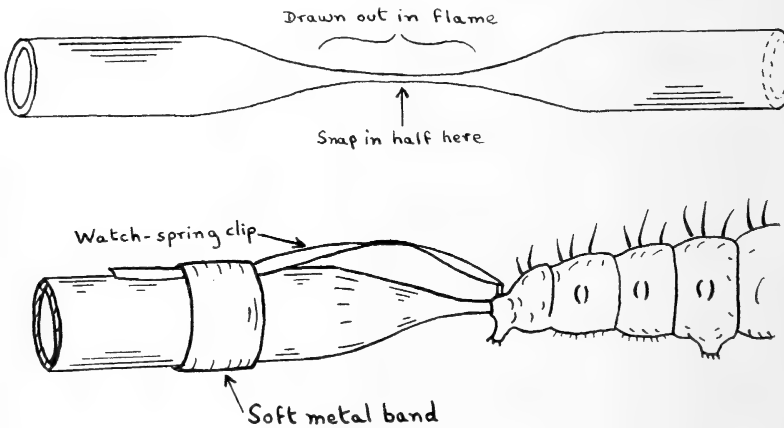


Fig. 3. Above, making the jets: glass tube drawn out in flame to narrow waist. Below, the method of attaching the spring clip to the glass jet, to hold the caterpillar skin firm during inflation and drying.

A point to remember is that the longer the portion which is actually heated, so the longer and finer will be the resultant nozzles. Onto the tubing slide a metal band and insert a piece of watch-spring to act as a clip to secure the skin to the jet. In practice I find that a piece of fine copper wire wound around the tube and clip is most effective in holding them in position. Before these are assembled the watch-spring should be made red-hot at one end and about $\frac{1}{8}$ inch (3 mm. approx.) bent at right angles. In the tip of the short piece thus formed a V-cut should be made with a fine file so that it fits snugly on the tip of the glass jet. Only heat the extreme end of the spring or the temper of the whole will be lost.

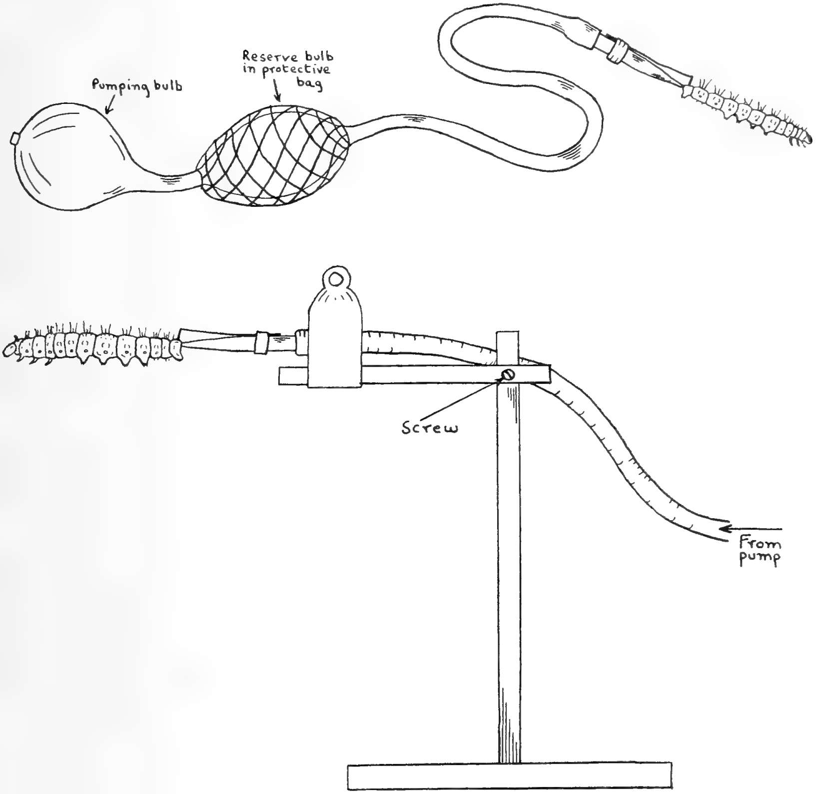


Fig. 4. Above, the arrangement of the double-bulb pump. Below, the apparatus for supporting the jet.

4. The Inflator.

If a sufficiently long blowpipe is used, the skin can be inflated by mouth. I do not recommend this as the pressure is, naturally, intermittent and moisture is apt to enter and delay the drying. A far better method is to purchase a rubber double bulb of the type used for throat sprays. Most drugstores stock them or will obtain one at a small cost. A medium size is best, and make sure it is of good quality with the reserve bulb of fine, flexible rubber. These bulbs are made in segments and are apt to split at the joints. They can be repaired with self-adhesive rubber strips as used for bicycle tire repairs, but I prevent splitting by removing the net protector and affixing strips of the rubber along all the seams prior to use. A good quality bulb thus treated will last for years and do thousands of skins if not ill-treated. It should never be exposed to high temperatures and if allowed to get very cold will turn hard but can be easily softened if gently warmed prior to use. Of course, if anyone wishes to go in for a pressure bottle worked off the water faucet, or even to the length of purchasing an electric diaphragm pump, it would make mass-production easier but will not give such good results owing to a lesser degree of control.

5. Other Apparatus.

You will also need a small glass jar to hold spirit, setting needle, forceps, scissors, a few small wooden rollers of various sizes (about 6 inches (15 cm.) long and the thickness of pencils or smaller — a graduated one is, perhaps, better), silk or cotton covered copper wire, entomological pins, a sheet of cork for use when mounting, blotting paper, a tube of glue (not gum), vaseline.

6. Support For The Jet.

When doing several larvæ it is helpful to use a support to hold the jet and skin whilst drying, thus leaving both hands free to prepare the next skin for drying. A simple piece of apparatus is all that is needed. A piece of wood about 6 inches (15 cm.) square for the base, with a central upright piece and an arm secured horizotally on a line with the oven opening is all that is necessary. The jet may then be clipped to this with a largish spring paper clip. Mine is rather more ambitious as it is of metal and the horizontal arm slides up and down the upright and is secured with a wing nut and bolt, and the arm is made in two pieces with universal joints to allow the jet to be manipulated to any angle.

7. Killing Agent.

Larvæ may be killed in the cyanide bottle or by dipping into spirit. Alcohol of good strength is excellent but I simply use methylated spirit (wood alcohol) and find it perfectly satisfactory. It is quick in action and being so cheap can be replaced often, thus avoiding the use of a soiled fluid. The larvæ should be removed as soon as dead and placed to dry on blotting paper. This applies particularly to the hairy species for, if wet when the larval contents are being removed, the hairs are more liable to fouling.

Selection of Suitable Larvæ

The caterpillar must be mounted to look as natural as possible. This can only be done if a suitable specimen is chosen. No matter what care is taken during inflation, a success cannot be made of a larva molting, and nothing looks worse than an oversized, balloon-like object. Some caterpillars assume different markings at each instar (between each molt) and you may wish to show the changes; but if only one specimen is required, it is best to wait until the final larval molt and "blow" it about one day after it has recommenced feeding. Never, on any account, attempt "blowing" just before the molt or just before pupation, for the outer skin, which is all we require, is then not only lacking in color, but is extremely thin and even if successfully emptied, always distends in an unnatural manner.

The exceptions to this are the larger Hawk-moths and other very large species. Unless it is absolutely necessary to show the final instar it is by far the best to "blow" these larger species in the penultimate larval instar, for if one wishes to have a neat mount it is almost impossible to avoid stretching the skin in the heat when fully grown. Should it be necessary to preserve these large species when fully grown I do not use the normal oven but stand a metal box of suitable size upright over the flame and suspend the skin in it. By so doing a minimum of air-pressure is required to keep the skin shapely and thus much of the oversize is obviated. It does, of course, take longer to dry out.

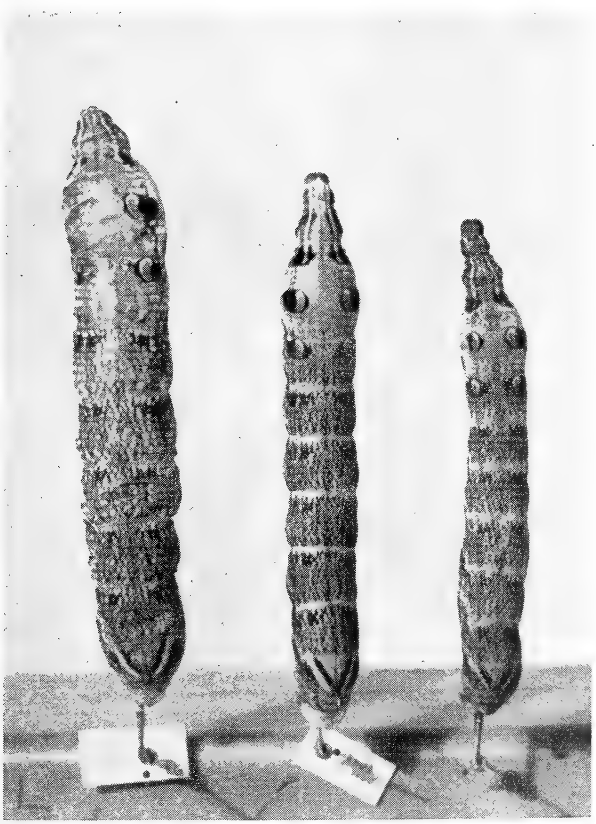


Fig. 5. Examples of over-inflated (left), correct (center), and under-inflated (right) larval skins. All are *Deilephila elpenor* L. (Sphingidæ), and the left larva was remarkable in lacking a left eye-spot and in having segmental abnormalities on abdominal segment V.

The hairy species are worth spending more time on. If the skin is placed in a very hot oven the hairs are liable to curl in the heat. This can be avoided if the operator has patience enough to start off the drying in a cold or cool oven and allow it to heat up as drying continues. The same remark applies to a number of the fawn and light brown Geometridæ, which often turn red or pink if placed in a hot oven; by the exercise of patience in starting off with a cool oven, better results are obtained. Should these skins turn reddish do not discard them, as they almost invariably tone down after a few weeks in the cabinet.

The green larvæ also pose a problem, as they almost certainly will lose all or most of the color, generally when emptied, and of course heat aggravates it. I will deal with this later.

Emptying the Skin

Place several thicknesses of blotting paper on a perfectly flat surface and on this lay the dead larva *on its back*, with the anus away from you. I stress *on its back*, because no larva is hairy underneath (the side we are about to roll), and the colors we wish to retain, those of the back and sides, are in this way less likely to be damaged, while the larval liquid has more chance of getting away freely.

With the forefinger on the roller, gently press the abdominal contents towards the anus, so that a little pressure is evident at the anal opening. With the needle carefully prick the slightly protuding gut, which will give the liquid a chance to escape and thus avoid bursting the skin. Move back the roller about one quarter the length of the larva and *gently* roll towards the anus. this will start the contents emptying. Again move the roller back, this time halfway towards the head and once more roll to the anus. The third time go right back to the head and roll yet again. The great secret of success is to do this very gently. Do not attempt it in one or two rolls but start by giving half a dozen gentle rolls; this will give you the touch needed to retain the colors. Neither is it necessary to extract every atom of moisture; far better to leave the skin a little too moist than too dry to begin with.

In all probability the entire digestive tract will come away with simple rolling; should it not, however, seize the protruding part at the anus and gently draw it out with the forceps, whilst holding the skin in the left hand; it can then be snipped off as near the head as possible. If it is allowed to remain within the skin it will contract in drying and show as a dark blob through the skin. Avoid allowing any moisture to touch the setæ of a hairy larva.

The larval skin is now ready for inflation and drying, but before proceeding further make sure the oven is sufficiently hot. The insertion of a finger into the round aperture will, with practice, be a good guide to this. A moderate heat is required.

Too high a temperature will scorch or discolor the skin whilst, if too low, the job can become tedious. The safest plan is to regulate the heat so that a small skin, e.g., a fully grown *X. fluctuata* (Garden Carpet) is thoroughly dry in about 2 minutes, a medium one, e.g., *B. brassicæ* (Cabbage Moth) in 4 minutes, and large ones, such as the Hawk-moths, is approximately 8 minutes.

With practice, a good average working speed is 10 to 12 skins an hour, including emptying, fixing to blowpipe, and drying. Never empty more than one skin at a time as they dry out quickly and then, especially if small, become difficult to fix satisfactorily to the jet.

Fixing to the Blowpipe

Take the skin between the thumb and forefinger of the left hand with the anus away from you and the anal claspers facing you so that the merest trifle of the anal end of the body is visible. Moisten the end of the fine nozzle of the blowpipe with the lips or with the merest suspicion of vaseline and carefully insert it into the anus for not more than $1/8$ inch in the case of very small larvæ and proportionately more for larger skins, according to the size of the opening; with the spring clip secure the smallest possible portion of the V-shaped anal flap so firmly that the skin will not blow off when inflated. Two clips are sometimes needed for the larger species. If two are used, endeavor to secure the skin to the rear of the anal claspers.

Never insert the jet further than is necessary as it makes it more difficult to be removed after drying and is liable to split the skin or remove a patch of pigment.

Inflation and Drying

Give a gentle squeeze to the inflator. If properly secured, the skin will fill out to its former natural size. Be careful not to use too much pressure or a distended skin will result, which cannot be rectified. At the same time do not allow the skin to droop or sag. Insert the inflated skin into the oven and continue to blow only just strongly enough to keep the skin in a natural position until it remains as you require it without further pressure.

Owing to the impossibility of removing the head contents by rolling, this part and the first segment are always the last to dry, and a good test to find out if all is thoroughly dry is to remove the skin from the oven and gently touch the head from in front, with a finger or the setting needle. If all is as it should be the whole skin will be rigid. If the head is still moist and further drying is necessary, a slight movement will be noticed.

When dry the caterpillar is ready for removal from the jet. Whether moisture or vaseline has been used, a skin will occasionally stick to the glass; this may be cured by adding a spot of benzine to the offending part, which will loosen it in a few seconds. It also helps when removing the skin from the jet when several skins are to be blown, to use several blowpipes and allow each to get cold before removing the skin, thus allowing the hot glass to shrink.

Occasionally a skin will, when inserted into the oven, decide to be awkward and curve sideways into a semi-circle. This unpleasing attitude may be remedied by removing from the heat whilst still flexible, and by touching the convex side of the skin on the hot oven the convex side will be slightly shrunk and the skin straightened. Do this several times along the length of the skin if necessary. Never do this after the skin is hardened but first relax the skin by suspending it (still on the jet) in hot water. Then re-inflate and shape as above. Relaxing in hot water may also be done with older skins providing no punctures exist in the skin. If punctures or cracks exist, leave well alone, especially if it is a rare species. When relaxing older skins add a few drops of carbolic acid to the water to kill any mould spores which may be lurking and awaiting a chance to start growth.

Tinting

I am not in favor of painted larvæ; they do not please the eye at all, and water-colors invariably cause distortion of the skin. Very few larvæ, however, lose sufficient color to make them unsightly. The chief offenders are the green species and usually the color can be satisfactorily restored without causing offence to the fastidious. Use no water at all but employ dry pigment dissolved in spirit. The dyes used by the ladies for household articles will serve but are not very lasting. A substance known in Britain as chrysodine, used by anglers to dye blow-fly larvæ for bait, is very satisfactory and is usually obtainable from fishing tackle stores. This substance (or similar) should be dissolved in a little spirit and kept as stock. It is very strong, and a few drops should be suitably diluted to the appropriate tint, as needed.

This dilute dye will run smoothly and being transparent will not obscure any important characteristics but it will stain any white surface if allowed to spread. I have tried out many substances but always come back to chrysodine. Some skins need a second application after an interval. In the case of very hard chitinous skins the dye tends to run into beads. Lay on plenty, leave until it begins to dry, and then go over the skin with a tuft of cotton-wool. Sufficient will remain to effect a pleasing finish. If a skin takes too much color or is too deep in tone when stained it may readily be toned down or completely removed by the application of clean spirit. I do not recommend internal coloring; the result is usually a patchy mess.

Mounting for the Cabinet

Wire or fine twigs form the simplest and probably the best style of mount for cabinet use. If twigs are used, push a pin through one end and glue it firmly *before* mounting the skin. It is also necessary to see that the twig conforms to the underside contours of the skin and it should fit neatly betweeen the legs and claspers. If wire is used, it is only necessary to twist one end round a pin, bend the wire to shape, and glue the larva to the wire with a suitable adhesive. Data labels are then added and the mount is ready for the cabinet.

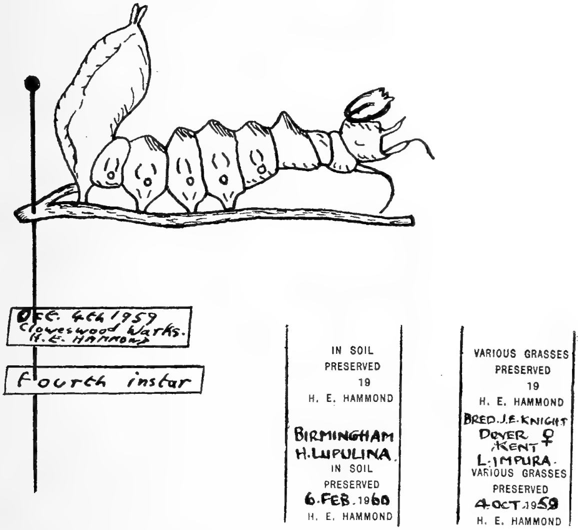


Fig. 6. Upper left, sketch of the bizarre larva of *Stauropus fagi* L. (Notodontidæ) mounted on a twig which is supported on a pin. Lower right, sample portions of data-label strips, showing printed blanks above and, below, completed labels ready to go on pins under larvæ.

Labelling

Labelling is undoubtedly the most important part of any collection of scientific objects but is so often regarded as unnecessary or at best, by careless folk, as a necessary nuisance. Someone once said "a good collection consists of a series of labels illustrated by specimens." This is more true today than ever it was. Fortunately I learned this early and have always labelled my specimens accordingly. Of course, styles of labelling must suit the individual but all relevant facts should be shown. I have all my labels printed as 4-line and specify plenty of spare space at the top and bottom to allow for any additional information to be written in. I carry a large assortment such that when a good number of species feed on any particular pabulum, I have the foodplant name printed individually. It all saves time and adds neatness to the label. The very minimum information shown is: locality with county, district, state, or whatever is needed; name of species, name of foodplant, date of preserving, and of course the name of the person preparing the specimen. If the name of the breeder or captor is different from the preparator, this can also be added at the top or bottom of the label or on the reverse. These 4-line labels can be cut into two if required, and placed on the pin so that both can be read without handling the specimen. Where a specimen is bred *ab ovo* I indicate this by simply adding the female sign after the locality name. I also carry a stock of labels which do not indicate the foodplant, for use with specimens which have fed on the less common plants. Written details should be done with a fine nib, using a permanent black ink. Some collectors' labels are a model of neatness but some, alas, are untidy and illegible and written with ink which fades; they are but little credit to the owner.

Mounting for Life History Cases

A life history display, showing not only the full series of stages but also a sample of the food plant with the larva mounted thereon in a feeding or resting attitude, is a great improvement in the usual cabinet series. Either natural or artificial twigs, leaves, or grasses may be used.

Acknowledgements

I am greatly indebted to Donald Allen, F.R.P.S., F.R.E.S., F.R.S.A., who contributed the photographs for the plates; the photograph of a living larva in Plate 6B, upon which Mr. Allen's photograph of a preserved skin has been superimposed, is by the late Alfred E. Tonge. Sincere thanks are due to Mrs. K. G. V. Smith who typed the manuscript and to Mr. K. G. V. Smith for his excellent line-drawings for the figures.

My special thanks are due to the Amateur Entomologists' Society (London) who have permitted me to use the photographs and extracts from my original paper "Preserving Caterpillars — How to "Blow" and "Pickle" Larvæ Successfully." This paper is still available as Leaflet No.20 from the A.E.S., 1 West Ham Lane, London, E. 15, at the modest price of 1s.2d. post free (U.S. 15 cents).

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MAINE BUTTERFLY SEASONS — GOOD OR BAD?

by A. E. Brower

The request for information on the poor collecting seasons for Lepidoptera concerns directly a subject in which I have been interested and in which I have been keeping some records for the past tweny-nine seasons in Maine. Any statements comparing seasons need to be based upon comparative knowledge over a considerable period of time. When Henry David Thoreau travelled through Maine over one hundred years ago, making detailed observations on the life he saw, he remarked on the great dearth of wild flowers and animals in the climax forest which dominated the greater part of Maine. He also noted the rapidity with which *Aster, Solidago,* Fireweed and some other genera came in on land cleared of the forest, and that insects were common with the flowers. Much of the cleared land became farm and pasture land, but great areas were heavily cut, often devastated by fire, and left to nature. The timber cut reached a maximum in 1909. The mantle of soil recently spread by the last ice sheet was probably already becoming low in lime and some other elements when the land was cleared. These elements and the scanty accumulation of humus by the forest rapidly decreased in the cleared land. Soon many plants found their environment unfavorable, and abandonment of farm lands began and still continues. The forest began to reclaim the fields and pastures. I know of more than one cellar hole in which large trees are growing, and of former settlements without an inhabitant. Thousands of acres are reverting annually to the category of forest land. The amount of land supporting roads, buildings, cities and manicured lawns has increased steadily. Along with these changes has been an inevitable decrease of some of the more commonly seen and widely distributed butterflies.

One species of butterfly, *Pieris rapæ* (L.), has, like the introduced weeds on which it feeds, increased until it swarms in areas, and the Alfalfa Butterfly (*Colias eurytheme* Bdv.) has recently colonized this region. In 1949 we had a notable flight of the Thistle Butterfly (*Vanessa cardui* L.) and in 1957 a great flight of Red Admirals (*Vanessa atalanta* L.) across Maine, but in both instances the butterflies came from far south of our border. Native species which increased with the clearing of the forest have, in turn, decreased as their environment became less favorable. The native species presumably always occurred in far less numbers than have been repeatedly reported in the middle West or far West. The writer has actually caught in the Ozark Mountains of south Missouri more butterflies in one day, and day after day, when collecting for jewelry workers, than he has seen some seasons in Maine, especially if *Pieris rapæ* is excluded. Apparently even larger numbers occur in the West. Some of the local butterflies or species occurring in very restricted areas of Maine do occur in good numbers some seasons. The last few seasons have had long periods of cold cloudy weather with comparatively few butterflies to be seen. In 1959 I was afield on some of the better days for Theclas, and I made some trips to the special habitats they frequent, but without seeing a specimen all season. If one is out at the right time and in favorable local habitats and not a specimen is seen, one or more poor seasons can be expected to follow. Collectors agree that collecting for diurnals in general has been extremely poor in Maine.

In casting about for an explanation of the poor collecting seasons, spraying has been advanced as an explanation or as the explanation. As Bodenheimer has pointed out in his book on *Insects as Human Food,* the Americans and west Europeans are the only peoples on earth who do not regularly use one or more insects as human food, and insects are a most important portion of the diet of many peoples. Insects were staple items in the diet of some American Indian tribes and were used by many tribes. But now in America the grower is being faced with a mounting demand for fewer and fewer larvæ of the Blueberry Fruit-fly per ton of blueberries, and for ever more nearly perfect apples. Control the pests; produce more nearly perfect produce. This demand has forced the grower to apply one to many applications of powerful sprays year after year in an attempt to eliminate crop pests. Possible effects on the other life of the blueberry barrens, apple orchards or potato fields has not mattered. The same attitude has dominated attempts to control mosquitoes and pests of man's shade trees. Despite these multiple applications to such crops, often of heavy dosages of spray materials, many insects, weeds, birds and animals are maintaining a high population in close contact with these heavily sprayed agricultural areas, possibly other more susceptible species are being eliminated without being noticed. The economic entomologist who is forced to study the biology of the particular pest species to determine the most effective time for spraying; who struggles to secure an application which will give 95% or higher kill, to reduce loss, and to hold down the number of necessary spray applications, can be expected to demand proof that other wild life is generally decimated, especially outside the area covered by the spray. This will not apply to aquatic life where the effect of a spray may show for a considerable distance beyond the area actually covered by spray. But few governmental agencies have initiated comprehensive studies on the complex and often long-time effects their spray operations might have on the web of life. To determine these over-all effects of a spray program requires a large outlay of time and money.

Spraying of nonagricultural or forest lands is often singled out for adverse criticism. In the case of habitats of limited extent, such as salt marshes, an attempt to spray the whole habitat could have disastrous effects on some species, other than the ones the spray was aimed at. On forest lands in Maine the dosages have been low and only one application has been made in a year. In 1958 when the only large forest acreage was sprayed (against the Spruce Budworm), less than 1.8% of the forested area was sprayed; and but a small part of an area sprayed has been resprayed or is included for respray in 1960 spray plans. Studies on spray effects have not shown any important effect on other groups of life in the spray area. One of twenty-five light traps has been operated during thirty days for years in an area sprayed in 1954 and 1958, but no obvious change in the yearly catch of many thousands of moths has been noticed. Close study might be expected to show a change in some species vulnerable at the time of spraying. No change in the numbers of Spruce Budworm (*Choristoneura fumiferana* Clem.) would be evident because a resident population of this species is poorly attracted to light and the value of the traps depends upon their attractiveness during a flight or migration. Due to the far larger number of species of moths, nocturnal flight, and adverse effect of cold nights on collecting in Maine, changes in moth population are far harder to determine and evaluate than for butterflies. If sprayed areas are added together the total average acreage sprayed per year is not much over one per cent of the area of Maine. The numbers of Lepidoptera on favored local habitats where I have collected repeatedly in the past have not been decimated by sprays applied many miles away. There must be some other explanation for the poor butterfly collecting.

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THE FIRST SOUTH AMERICAN CONGRESS OF ZOOLOGY AND THE LEPIDOPTERA

The First South American Congress of Zoology took place between the 12th and the 24th of October 1959 in the La Plata Museum, the Argentine Republic, with the attendance of more than 327 delegates, mainly from 10 South American countries.

A total of 268 scientific papers were approved, including 57 of Entomology, eight of which were on Lepidoptera. These papers will be published along with the discussions they raised, in the *Proceedings and Papers of the First South American Congress of Zoology,* the publication of which will be under the direction of the Scientific Committee of the Province of Buenos Aires. This volume will also include the 19 reports approved by the Congress.

Two field trips were organized: one to Chascomús, the other to the delta of the Paraná River. The Governor of the Province of Buenos Aires held a reception for the delegates at his home, and the County of Chascomús proclaimed them guests of honor.

At a plenary session, it was resolved that the next congress should be a Latin American one, and a Provisional Committee was set up, which included the Organizing Committee of the First Congress and the following members: Salvador de Toledo Piza Jr. (from Brazil), Luis Capurro S. (from Chile), Francisco Saez (from Uruguay), Alonso Gamero Reyes (from Venezuela) and Salvador L. de la Torre y Callejas (from Cuba). The decision as to where the congress should take place was put off until March.

Among the main resolutions approved at the plenary session, we wish to set off the one which recommends "the setting up of a South American Group for Zoology Nomenclature with the purpose of considering all problems related to the naming of neotropical fauna." Dr. Ricardo N. Orfila and Jose Pastrana (both from the I. N. T. A. Institute of Buenos Aires) and the writer were the authors of two of the reports approved at the plenary session: in one, "a universal nomenclature is recommended for writing the dates on specimens for collections, and the use of Roman numbers is suggested for the month and Arabic numbers for the day on which the specimens were picked up." In the other report, "uniformity is recommended in the illustrations representing the genital organs of Lepidoptera in scientific papers."

The eight papers on Lepidoptera presented at the congress were:

"Aislamiento y estudio de principios activos urticantes de las espículas de imágenes de *Hylesia* sp. (Family Hemileucidæ)," by M. E. Jorg.

"Sobre la identidad de *Pieris menciæ* Ramsden (Family Pieridæ)," by S. L. de la Torre y Callejas.

"Nuevas especies de Lepidópteros para la fauna del Uruguay," by C. M. Biezanko, A. Ruffinelli, & C. S. Carbonell.

"Observaciones sobre *Namuncuraia mansosotoi* Orfila (Family Hemileucidæ)", by Raul J. Llano.

"Quimioreceptor osmosensible en larvas de *Morpho catenarius*" by M. E. Jorg.

"Dos nuevas especies del género *Midila* (Pyralididæ) neotropicales," by J. A. PASTRANA.

"Geometridæ del Parque Nacional Lanín II", by R. N. ORFILA & S. SCHAJOVSKY.

"Nuevos Orneodidæ neotropicales", by J. A. PASTRANA.

The following members of the Lepidopterists' Society attended the Congress: A. BREYER (Argentine), BIEZANKO (Brazil), and the writer (Cuba).

SALVADOR LUIS DE LA TORRE Y CALLEJAS, Delegate of the University of Oriente, CUBA

THE BIRD AND EHRLICH COLLECTIONS DONATED TO THE AMERICAN MUSEUM OF NATURAL HISTORY

The Department of Entomology of the American Museum of Natural History proudly announces the accession of two outstanding collections of North American Lepidoptera.

The *Papaipema* (Noctuidæ) collection of HENRY BIRD was built up over a period of 60 years. Most of our knowledge of the species and the life histories in this group was the result of the research of Mr. BIRD. This fact has been acknowledged in the writings of HAMPSON, DRAUDT (in Seitz' *Macrolepidoptera of the World*), and FORBES. The collection consists of 1,118 specimens of moths; of this total, 32 are holotypes, 10 are allotypes, and 63 are labelled as paratypes. The collection contains the primary types of all the species and forms described by BIRD in this and related genera, plus the holotype of *Papaipema harrisi* ab. *mulieris* Strand. In addition, it contains early stage material and examples of the larval workings of nearly every species, over 400 reared parasites, and 64 genitalic slides. Three volumes of manuscript notes, descriptions, illustrations and correspondence on this group of moths have been depositd in the library of the American Museum.

The PAUL R. EHRLICH collection consists of 2,193 specimens, including 122 paratypes and 132 genitalic slides, of North American *Erebia* (Satyridæ). This collection is probably the finest one in this genus from North America ever assembled by a private collector. As a matter fact, several of the populations included in it are not even represented in most museum collections. Doctor EHRLICH, now of the Department of Biological Sciences at Stanford University, has collected the group extensively in the subarctic and arctic regions of Alaska and Canada. In this way he has been able to build up a firsthand knowledge of the ecology, flight habits, and occurrence of this genus. Several papers have resulted from his studies and field work, and more will be published as Dr. EHRLICH continues collecting and studying *Erebia*.

The specimens from both collections have had identifying labels placed on their pins, and have been incorporated into the collection of the Museum.

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RECENT LITERATURE ON LEPIDOPTERA

(Under the supervision of PETER F. BELLINGER)

Under this heading are included abstracts of papers and books of interest to Lepidopterists. The world's literature is searched systematically, and it is intended that every work on Lepidoptera published after 1946 will be noticed here; omissions of papers more than 3 or 4 years old should be called to Dr. BELLINGER's attention. New genera and higher categories are shown in CAPITALS, new species and subspecies are noted, with type localities if given in print. Larval foodplants are usually listed. Critical comments by abstractors may be made. Papers of only local interest and papers from *The Lepidopterists' News* and the *Journal* are listed without abstract. Readers, not in North America, interested in assisting with this very large task, are invited to write Dr. BELLINGER (Dept. of Natural Sciences, San Fernando Valley State College, Northridge, Calif., U. S. A.). Abstractors' initials are as follows: [P.B.] — P. F. BELLINGER; [I.C.] I. F. B. COMMON; [W.C.] — W. C. COOK; [A.D.] — A. DIAKONOFF; [W.H.] — W. HACKMAN; [T.I.] — T. IWASE; [J.M.] — J. MOUCHA; [E.M.] — E. G. MUNROE; [N.O.] — N. S. OBRAZTSOV; [C.R.] — C. L. REMINGTON; [J.T.] — J. W. TILDEN; [P.V.] — P. E. L. VIETTE.

D. VARIATION AND GENETICS

Hartwieg, Fritz, "Zwei neue Geometriden-Formen" [in German]. *Zeitschr. Lepid.,* vol.1: pp.163-164. 1951. Names "forms" of *Comibæna pustulata* & *Thalera fimbrialis.* [P. B.]

Hartwieg, Fritz, "Zwei neue Formen von *Myelois cribrella* Hbn. (Pyralidæ, Phycitinæ)" [in German]. *Zeitschr. Lepid.,* vol.2: p.104. 1952. Names 2 "forms." [P. B.]

Harvey, George T., "The occurrence and nature of diapause-free development in the Spruce Budworm, *Choristoneura fumiferana* (Clem.) (Lepidoptera: Tortricidæ)." *Canad. Journ. Zool.,* vol.35: pp 549-572, 1 pl., 9 figs. 1957. Most larvæ are univoltine irrespective of light conditions; their behaviour leading to diapause is described. A strain has been selected which will develop directly under day length of 15 hours or more; genetic control of behaviour apparently multi-genic. [P. B.]

Hoffmann, Emil, "Apolloraupen mit zitronengelber Fleckung" [in German]. *Ent. Nachrichtenbl.,* Vienna, vol.1: pp.74-75. 1954. Reports several broods, from various localities, of *Parnassius apollo* larvæ with yellow, instead of orange, spots. [P. B.]

Hopkins, G. H. E., "Two undescribed aberrations of British butterflies." *Entomologist,* vol.88: pp.73-75, 1 pl. 1955. Names variants of *Cœnonympha tullia* & *Pararge megera.* [P. B.]

Huard, G., & J. M. Corbe, "Études biométriques sur les surfaces portantes de *Parnassius apollo* L. Première note" [in French]. *Bull. Soc. zool. France,* vol.77: pp.356-362, 4 figs. 1952. Study of variations in wing area. [P. B.]

Ito, Yoshiaki, "Geographical variation of butterflies, an interpretation of Dr. Hovanitz's thesis" [in Japanese]. *Shin Konchu,* vol.6, no.10: pp.2-6, 3 figs. 1953.

Iwase, Taro, "Dr. Hovanitz and *Colias* (Pieridæ)" [in Japanese]. *Shin Konchu,* vol.6, no.13: pp.2-4, 2 figs. 1953. Further comments on Ito's paper (above). [T.I.]

Jakob, Otto, "Kurzer Bericht über den Fund eines Freilandhybriden von *D. euphorbiæ* ♀ × *livornica* ♂ [in German]. *Ent. Nachrichtenbl.,* Burgdorf, vol.3: p.41. 1949. Adult very similar to *Deilephila livornica,* but reared from larva apparently identical with that of *D. euphorbiæ.* [P. B.]

Kasy, F., "Über ein melanistisches Stück von *Antitype canescens* (Dup.) und ein geschwärzes Exemplar von *Maraschia grisescens* Osth. (Lep.,Agrot.)" [in German]. *Ent. Nachrichtenbl. österr. und Schweizer Ent.,* vol.9: pp.1-2, 4 figs. 1957. Describes & figures melanic specimens & names one. [P. B.]

Kauffmann, Guido, "*Spialia sertorius parataras* n. forma (Lep. Hesperiidæ)" [in German]. *Ent. Nachrichtenbl. österr. und schweizer Ent.,* vol.2: pp.90-93, 2 figs. 1950. New "form" named. [P. B.]

Kautz, Hans, "*Pieris napi* L. mod. ♂ ♀ *hibernica* Schmidt. Richtige Schreibweise" [in German]. *Zeitschr. wiener ent. Ges.,* vol.35: p.154. 1950. Corrects spelling of "form" name. [P. B.]

Kautz, Hans, "Richtigstellungen und Ergänzungen zum Aufsatz 'Die gelben Formen von *Pieris napi* L.' (Zeitschrift der Wiener Entomologische Gesellschaft, 35 Jg., 1950, S. 42-50)" [in German]. *Zeitschr. wiener ent. Ges.,* vol.37: pp.43-44. 1952. Corrections.

Kautz, Hans, "Die Rückschlags- und Zukunftsformen von *Pieris napi* L." [in German]. *Zeitschr. wiener ent. Ges.,* vol.40: pp.151-156, 1 fig. 1955. Believes pattern evolution in this sp. is orthogenetic, but that some specimens are "out of step." Divides named aberrations into "past forms" (with darker ground or increased markings), & "future forms" (with lighter ground & reduced markings). Figures hypothetical "Ur-*napi*" (dark with heavy pattern) & concludes that eventually *P. napi* will be completely white & patternless. [P. B.]

Kessler, P., "*Parasemia plantaginis* L." [in German]. *Ent. Nachrichtenbl. österr. und schweizer Ent.,* vol.2: pp.51-52. 1950. Preliminary note on a reared ♂ form with yellow abdomen. [P. B.]

Kettlewell, H. B. D., "Melanism and an answer to J. W. Heslop-Harrison." *Ent. Rec. & Journ. Var.,* vol.68: pp.286-290. 1956. Industrial melanism in moths; reply to criticism. [P. B.]

Kettlewell, H. B. D., "The contribution of industrial melanism in the Lepidoptera to our knowledge of evolution." *Adv. Sci.,* vol.13: pp.245-252, 6 pls. 1957. Summary of his recent work on industrial melanism. Figures 17 British moths in which melanic forms are known, & gives data on genetics & frequency of forms. Reports that when *Biston betularia* ♂♂ were released in an industrial area, recovery of melanics exceeded recovery of light form, while in uncontaminated area the reverse was true. Experiments show a significant tendency for both forms to settle on most concealing background. Larvæ of the melanic forms develop more slowly than larvæ producing normal adults, and melanic forms tend to emerge later; this can be explained either by selection (contamination is least early in year) or by the possibility that larvæ of melanic forms are able to excrete toxic substances better by prolonged development. In *Cleora repandata* melanic form survives better (as larva) under conditions of starvation or polluted food. Selection of ♀♀ by ♂♂ *Biston betularia* appears to depend on temperature, melanics being preferred at higher temperatures & normals at lower temperatures. Author believes the current spread of melanics in Britain is a redevelopment of an old phenomenon, and that melanics were widespread when the forests of Britain were largely coniferous. Reports that in Scotch pine forests melanics & normals co-occur in balanced polymorphism; in *Cleora repandata,* melanics are more conspicuous at rest, but normals are more conspicuous in flight, when predation is also frequent. [P. B.]

Kobayashi, Hiroshi, "Aberrant form of *Taraka hamada* Druce (Lycænidæ)" [in Japanese]. *Trans. lep. Soc. Japan,* vol.3: p.16, 1 fig. 1953. Beautiful specimens of ab. *abbreviata* are displayed in half-tone photos. [T. I.]

Komai, Taku, "Genetics of butterflies (3) — on *Neozephyrus taxila* (Lycænidæ)" [in Japanese]. *Shin Konchu,* vol.5: no.6: pp.5-8, 1 fig., 3 tables. 1952. Four forms of ♀♀ are discussed. [T. I.]

Kromer, Erich, "Aberrationsberichtigungen sowie neue Aberrationen von *Pieris napi* L. und *Pieris bryoniæ* O. Bemerkenswerte Funde in Niederösterreich und Tirol" [in German]. *Zeitschr. wiener ent. Ges.,* vol.40: pp.209-212. 1955. Names 2 aberrations; remarks on 2 others. [P. B.]

Kromer, Erich, "Weitere Aberrationsberichtigungen und neue Aberrationen von *Pieris napi L.* und *Pieris bryoniæ O.*" [in German]. *Zeitschr. wiener ent. Ges.,* vol.41: pp.285-287. 1956. Names 3 aberrations; notes on others. [P. B.]

Kühn, Alfred, "Die Wirkung der Mutation *va* (venis abnormibus) bei *Ptychopoda seriata*" [in German]. *Zeitschr. indukt. Abstammungslehre,* vol.82: pp.430-447, 12 figs. 1948. Describes effects of gene producing variable disturbances in venation. [P. B.]

Kühn, Alfred, "Zur Genetik der helläugigen Mehlmottenstämme" [in German]. *Zeitschr. indukt. Abstammungslehre,* vol.82: pp.136-154, 17 figs. 1948. Analysis of effects of the 3 alleles of the *a* series, and modifier genes, on eye color in *Ephestia kühniella.* [P. B.]

Kummerer, H., "Une aberration des *Heodes hippothoë* L." [in French; summary in Esperanto]. *Bull. Soc. ent. Mulhouse,* 1947: p.54. 1947.

Kurosawa, Yoshihiko, "7 melanic forms of *Argynnis* in the collection of the National Science Museum of Japan. Notes on aberrant forms of Japanese butterflies (1)" [in English & Japanese]. *Natural Science & Museums,* vol.20, nos.1/2: pp.13-16, 2 pls., 1 fig. on cover. 1953. 7 aberrations, all unnamed: 5 of *A. laodice japonica,* 1 of *A. ruslana lysippe,* & 1 of *A. charlotta basalis* (Nymphalidæ). [T.I.]

Landsman, H., "Geslechtsdimorphisme bij *Lampra fimbriata* Schreber (Lep.) [in Dutch]. *Ent. Berichten,* vol.14: p.48. 1952. Notes on some named "forms." [P. B.]

Lane, Charles, & Miriam Rothschild, "Notes on relative abundance of pale and dark forms of the Dark Arches (*Xylophasia monoglypha* (Hufn.) (Lep., Caradrinidæ)." *Ent. mo. Mag.,* vol.93: pp.379-380. 1956. Note on differences in frequency in nearby localities in different years. [P. B.]

"Lpk." [B. J. Lempke], *"Apatele tridens* Schiff., f. *virga* Tutt" [in Dutch]. *Ent. Berichten,* vol.13: p.336, 1 fig. 1951.

Lempke, B. J., "On some forms of *Aglais urticæ* L." *Ent. Rec. & Journ. Var.,* vol.68: pp.282-285. 1956. Nomenclature of some aberrations. [P. B.]

Lemvigh-Hammer, K., "En aberration" [in Danish]. *Lepidoptera,* Copenhagen, 1947: pp.41-42, 2 figs. Names aberration of *Polyommatus icarus.* [P. B.]

Lenek, Oskar, "Eine zweite Generation von *Das. pudibunda* L. (gen. æst. f. *pygmæa*)" [in German]. *Ent. Nachrichtenbl.,* Vienna, vol.4, no.2: p.3. 1957. Describes & names "summer generation" (reared broods of small moths which emerged in July). [P. B.]

Löberbauer, Rudolf, "Eine neue Form von *Lygris pyraliata* Schiff. (*dotata* Stgr.)" [in German]. *Zeitschr. wiener ent. Ges.,* vol.37: p.26. 1956. Named.

Loritz, Jean, "Note sur *Lithina partitaria* Hb. en France méridionale" [in French]. *Bull. Mus. Hist. nat. Marseille,* vol.10: pp.1-9. 1950. Describes adult & variation; names 2 "forms." Reviews distribution. Foodplants *Teucrium* & *Thymus.* [P. B.]

Mack, Wilhelm, "Über die Variabilität der *Rhyacia subrosea* Steph. ssp. *kieferi* Rbl. aus dem steirischen Ennstale" [in German]. *Zeitschr. wiener ent. Ges.,* vol.36: pp.61-63. 1952. Describes variation in reared series. [P. B.]

Meier, Bern., *"Colias electo* L. ssp. *croceus* Fourc. F. in. *circumcincta* nova" [in French]. *Bull. Soc. ent. Mulhouse,* 1948: p.57, 1 fig. 1948.

Meise, Alfred, *"Dyscia fagaria* Thbg. Fang und Variationsbreite" [in German]. *Zeitschr. wiener ent. Ges.,* vol.40: pp.353-355, 1 pl., 1 fig. 1955. Figures series, showing variation; collecting notes. [P. B.]

Meyer, J., "Eine neue Form der amerikanischen *Catocala relicta* Walker" [in German]. *Zeitschr. wiener ent. Ges.,* vol.37: pp.7-10, 2 pls. 1952. Describes & figures experimentally produced variants of *C. relicta, C. fraxini,* & a hybrid between these spp. [P. B.]

Miyao, Takeo, "Seasonal variation in the wing-length of *Colias hyale poliographus* Motschulsky (Pieridæ)" [in Japanese]. *Shin Konchu,* vol.6, no.5: pp.16-20, 2 figs., 5 tables. 1953. The length of the forewing is shortest & most variable in the May brood from hibernated larvæ. [T. I.]

Murayama, Shuichi, "Some new forms of butterflies from Honshu" [in Japanese; English summary]. *New Entomologist,* vol.3: pp.35-37. 1953. Names new "abs." of *Celastrina sugitanii* & *Wagimo signatus,* & a spring form of *Pieris napi.* [P. B.]

Neustetter, Heinricht, "Einiges über die Zucht von *Sarrothripus revayana* Sc. mit ihren Formen und *Sarr. degenerana* Hb." [in German]. *Ent. Nachrichtenbl.,* Vienna, vol.1: pp.73-74. 1954. Briefly describes both spp. & named "forms" of first; notes on larvæ & biology. [P. B.]

Nicolesco, E. V., "Sur une nouvelle aberration du lépidoptère *Melitæa maturna* L. — ab. *confusa* nov. ab." [in French]. *Bull. Sect. Sci. Acad. Roumaine,* vol.30: pp.216-217. 1947.

Nicolesco, Eugen V,, "Sur une nouvelle aberration de *Melitæa* recueillie en Roumanie: *Melitæa didyma* O. ab. *minor* nov. ab." [in French]. *Notationes biol.,* vol.6: pp.146-148, 3 figs. 1948. Single ♂ specimen differs from typical form in size, color, & structure of genitalia. [P. B.]

Okano, Masao, "Une forme aberrante de *Papilio machaon hippocrates* Felder et Felder" [in Japanese]. *Bull. Tôhoku ent. Soc.,* vol.2: p.49, 1 fig. 1953. A melanic ♂, unnamed. [T. I.]

Parsons, R. E., "On the butterfly *Delias descombesi leucacantha* Fruhstorfer." *Journ. Bombay nat. Hist. Soc.* vol.47: pp.554-556. 1948. Names a new "form" of ♀. Describes larva & pupa. Foodplant *Loranthus ligustrinus.* [P. B.]

Petersen, Bjorn, "Notes on Scandinavian Rhopalocera." *Proc. Trans. south London ent. nat. Hist. Soc.,* 1950-51: pp.107-111, 1 fig. 1951. On geographic variation in populations of *Pieris napi* & its causes. Northern & southern populations develop rapidly when reared at similar temperatures; intermediate populations develop more slowly & adults are larger. Explanation is that rapid development is of selective advantage in northern & in southern (double-brooded) populations, but not in intermediate population, where it would result in abortive second generation emerging in fall. Other aspects of variation also considered. [P. B.]

Popesco-Gorj, Aurelian, "Contributions à l'étude des lépidoptères de la region Sinaia et des Monts Bucegi" [in French]. *Notationes Biol.,* vol.6: pp.138-145, 1 pl. 1948. Notes on variation & distribution of 12 spp. (in *Erebia, Pararge, "Chrysophanus", Zygæna, Œonistis, Cidaria,* & *Horisme*). Names 3 "forms." [P. B.]

Reuss, F. A. Theodore, "On the changeability of eye color in *Gonepteryx rhamni* L. in correlation with different degrees of physical and psychical activity" [in English; German summary]. *Zeitschr. Lepid.,* vol.1: pp.101-105. 1951. Reports that eyes are initially green but darken at time of first flight; thereafter they are brown, darkening to black during active flight in sunshine. [P. B.]

Rijkoort, P. J., "De erfelijkheid van het melanisme bij *Dasichyra* [sic!] *pudibunda* L." [in Dutch; English summary]. *Ent. Berichten,* vol.15: pp.473-475. 1955. Melanic form "concolor" dominant to normal form. [P. B.]

Robson, J. P., "Variation in the November Moth *Oporinia dilutata* (Schiff.) (Lep.: Geometridæ)." *Ent. Gazette,* vol.7: pp.199-200, 2 pls. 1956. Figures numerous adult forms. [P. B.]

Roos, Gustav, "*Clossiana frigga frigga* (Thnbg.) ab. *exmacula* (Lep. Rhop.)" [Swedish]. *Opusc. ent.,* vol.18: pp.229-230, 1 fig. 1953. Names suffused aberration. [P. B.]

van Rossem, H. M., "A new form of *Pieris rapæ* L." *Ent. Berichten,* vol.15: p.147. 1954. Named.

Ryszka, Hans, "Noch einmal *Pieris napi* ssp. *britannica* Vty. mod. *hibernica* Schmidt" [in German]. *Ent. Nachrichtenbl. österr. und schweizer Ent.,* vol. 2: pp.99-100. 1950. Corrections to earlier paper (in *Wiener ent. Rundschau*). [P. B.]

Saitoh, Kazuo, "On an example of gynandromorphism of *Colias hyale poliographus* Motschulsky (Pieridæ)" [in Japanese; English summary]. *Kontyû,* vol.20: pp.18-21, 1 pl. 1953. Male valva & ædœagus side by side with female bursa copulatrix & lamina dentata. [T. I.]

Schneider, H., "Zuchtberichte" [in German]. *Ent. Nachrichtenbl.,* Vienna, vol.2, no.6: pp.6-7. 1955. Report on rearing several spp.; records variants in broods of *Colias hyale, Arctia caja, A. villica,* & *A. hebe.* [P. B.]

Schutze, Eduard, "Starkes Auftreten melanistischer Formen von *Apatele* (=*Acronycta*) *alni* L." [in German]. *Zeitschr. wiener ent. Ges.,* vol.40: pp.127-129, 1 pl. 1955. Names a melanic "form" & gives notes on some others (also melanic). Dark forms have entirely replaced typical specimens in Kassel since 1940. [P. B.]

Schwartz, Viktor, "Zur Phänogenese der Flügelzeichnung von *Plodia interpunctella*" [in German]. *Zeitschr. indukt. Abstammungslehre,* vol.85: pp.51-96, 24 figs. 1953. Describes factors interacting to produce wing pattern, and various mutant genes which modify pattern. [P. B.]

Schwingenschuss, Leo, "Einige neue Lepidopterenformen aus Niederösterreich" [in German]. *Zeitschr. wiener ent. Ges.,* vol.39: pp.177-178. 1954. Names "forms" of *Polia persicariæ, Chloroclystis rectangulata,* & *Asthena candidata.* [P. B.]

Sevastopulo, D. G., "The genetics of East African Lepidoptera." *Entomologist,* vol.85: p.260. 1952. Records variation in intensity of adult maculation, presumably multifactorial, in *Spilosoma maculosa,* & green (instead of brown) larval form, probably a simple recessive. [P. B.]

Smith, S. Gordon, "Aberrations of British Lepidoptera." *Ent. Rec. & Journ. Var.,* vol. 66: pp.97-98, 1 pl. 1954. Names & figures 12 (moths). [P. B.]

Smith, S. Gordon, "Notes on *Arctia caja* L. with description of a new aberration." *Entomologist,* vol.88: pp.241-242, 1 pl. 1955. Names a melanic aberration; notes on other melanic specimens. [P. B.]

Smith, S. Gordon, "New aberrations of *Arctia caja* (Linn.) (Lep: Arctiidæ)." *Ent. Gazette,* vol.8: pp.90-92, 2 pls. 1957. Names & figures 10, all from related broods. [P. B.]

Speyer, W., "Die Flugzeit von *Cheimatobia brumata*" [in German]. *Zeitschr. wiener ent. Ges.,* vol.39: pp.20-23. 1954. Local populations of this sp. differ in season of adult emergence, each being genetically adapted to local climate so that eclosion takes place at latest possible date. Gives notes on diurnal flight time, duration of overwintering egg stage, & effect of cold on adults. [P. B.]

Stammeshaus, H. J. L. T., "New forms of Dutch butterflies." *Ent. Berichten,* vol.15: p.271, 1 fig. 1954. Names 5 "forms" (Pieridæ, Nymphalidæ, Satyridæ). [P. B.]

Sterzl, Otto, "Bemerkenswerte Lepidopterenfunde am Prebichl (1204 m.) in Steiermark" [in German]. *Zeitschr. wiener ent. Ges.*, vol.39: pp.179-181, 2 figs. 1954. Names a "form" of *Anaitis præformata.* Records *Heliothis scutosa* & some geometrids. [P. B.]

Stipan, Franz, "*Pieris bryoniæ* O. und *Pieris napi* L. I. Berichtigung und Nachtrag zur Veröffentlichung in dieser Zeitschrift 4. Jahrg. Nr.1-3, S.33 ff. II. Ergänzungen zum Handbuch *P. bryoniæ* O. und *P. napi* L. von Dr. L. Müller und Ing. H. Kautz" [in German]. *Ent. Nachrichtenbl.*, Vienna, vol.1: pp.36-43. 1954. Corrections to earlier paper (in *Ent. Nachrichtenbl. österr. und Schweizer Ent.*). Notes on *P. napi* & *P. bryoniæ,* with tables showing "correct" names for over 100 possible variant forms. [P. B.]

Storace, Luciano, "Note sul *Papilio demodocus* Esper (Lepidoptera, Papilionidæ)" [in Italian]. *Ann. Mus. civ. Stor. nat.*, Genoa, vol.68: pp.127-142, 13 figs. 1956. Catalogue of named races & "forms" & discussion of their status. Figures valves of some. [P. B.]

Thompson, J. Antony, "Interim note on *Pieris napi* L." *Proc. Trans. south London ent. nat. Hist. Soc.*, 1952-53: pp.120-125. 1954. Names a "form". Notes on variation & on biology of all stages. [P. B.]

Vázquez G., Leonila, "Observaciones sobre pieridos mexicanos, con descripciones de algunas formas nuevas" [in Spanish]. *An. Inst. Biol.,* Mexico, vol. 19: pp. 469-484, 4 figs. 1948. Notes on variation in spp. of *Pseudopieris, Dismorphia, Hesperocharis, Zerene, Phœbis,* & *Aphrissa,* from S. Mexico; names some "forms". [P. B.]

Vázquez G., Leonila, "Papilios nuevos de Mexico" [in Spanish]. *An. Inst. Biol.,* Mexico, vol. 19: pp. 233-240, 3 figs. 1948. Describes "forms" & aberrations of 6 spp. of *Papilio;* names most. [P.B.]

Vázquez G, Leonila, "Observaciones sobre pieridos mexicanos. II. *Phœbis sennæ eubule* L. y sus formas en Mexico" [in Spanish]. *An. Inst. Biol.,* Mexico, vol. 21: pp. 417-429, 2 figs. 1950. Summarizes seasonal & individual variation. [P. B.]

Vázquez G., Leonila, "Observaciones sobre pieridos mexicanos con descripciones de algunas formas nuevas" [in Spanish]. *An Inst. Biol.,* Mexico, vol. 22: pp. 533-555, 2 figs. 1951. Extended discussion of variation in *Anteos clorinde, A. mærula,* & *Phœbis intermedia.* [P.B.]

Vázquez G., Leonila, "Observaciones sobre pieridos mexicanos con descripciones de algunas formas nuevas. IV. *Zerene cæsonia* Stoll" [in Spanish]. *An. Inst. Biol.,* Mexico, vol. 23: pp. 257-267, 2 figs. 1952. Describes variation. [P.B.]

Vázquez G., Leonila, "Observaciones sobre Papilios de Mexico, con descripciones de algunas formas nuevas; una especie nueva para Mexico y localidades nuevas de algunas otros" [in Spanish]. *An. Inst. Biol.,* Mexico, vol. 24: pp. 171-175, 2 figs. 1953. Notes on variation in *P. laodamus* & *P. philolaus; P. oberthueri* new to Mexico. [P.B.]

Vázquez G., Leonila, "Observaciones sobre pieridos mexicanos, con descripcion de algunas formas nuevos. VI. Dos formas nuevas de *Phœbis* (*Rhabdodryas*) *trite* Linn." [in Spanish]. *An. Inst. Biol.,* Mexico, vol. 25: pp. 389-390. 1954.

Wagner, Hans, "Beobachtungen im Sammeljahr 1955" [in German]. *Nachrichtenbl. bayer. Ent.,* vol. 5: pp. 57-59. 1956. Describes black larva of *Panthea cænobita* (perhaps a simple recessive mutant). Reports some offspring of spring generation of *Pieris napi* entering diapause instead of emerging in same year. Records *Callimorpha quadripunctaria* from Bavaria. [P.B.]

Walsh, Geo. B., "Industrial melanism at Scarborough." *Ent. mo. Mag.,* vol. 91: pp. 231-233. 1955. Notes on appearance of melanics in this area, away from heavy industry; comments by Kettlewell. [P.B.]

Wark, D. C., "A heritable variation in tobacco of palatability to looper caterpillars (*Plusia argentifera*)." *Journ. Austr. Inst. agric. Sci.,* vol. 21: pp. 189-192, 2 figs. 1955. Variable palatability of tobacco varieties to young larvæ of *P. argentifera* (Noctuidæ) shown, though no discrimination observed in moth oviposition. [I.C.]

Warnecke, G., "(Lep. Notodont.) *Drymonia querna* F. n.f. *concolora*" [in German]. *Bombus,* no. 76/77: p. 322. May 1953.

Wilcke, H., "Zucht und Besonderheiten von *Hibernia aurantiaria* Esp." [in German]. *Ent. Nachrichtenbl.,* Burgdorf, vol. 3: pp. 52-53. 1949. Notes on variation, adult behaviour, and rearing. [P.B.]

van Wisselingh, T. H., "Bijzondere vangsten van Macrolepidoptera in 1954" [in Dutch; English summary]. *Ent. Berichten,* vol. 15: pp. 388-390. 1955. Unusual records in Holland; names a "form" of *Pheosia gnoma.* [P.B.]

Classey, E. W., L. Christie, & G. Haggett, "*Calophasia lunula* Hufn. in Britain." *Ent. Gaz.,* vol. 5: pp.66-70, 3 pls. 1954. History of this recent arrival in Britain; notes on collecting larvæ; desecription of larvæ and pupæ, and figures of these and adults. [P.B.]

Close, R., "A muscardine fungus on a caterpillar of *Antheræa eucalypti* Scott (Lepidoptera, Saturniidæ)." *New Zealand Ent.,* vol.2: pp.1-2. 1956. The fungus *Beauveria bassiana* recorded from a larva of the Australian species, *A. eucalypti,* now established in New Zealand. [I.C.]

Cloudsley-Thompson, J. L., "The significance of fluctuating temperatures on the physiology and ecology of insects." *Entomologist,* vol.86: pp.183-189. 1953. Gives evidence from work on various insects that fluctuating temperatures, within tolerable range, may accelerate growth and increase longevity & fertility. [P.B.]

Cockayne, E. A., "*Hadena compta* Schiff. (Varied Coronet) at Dover." *Ent. Gaz.,* vol. 2: pp.76-79. 1951. Rearing notes on this rare British species. [P.B.]

Cockayne, E. A., "Notes on the larva of *Luceria virens* Linnæus." *Ent. Rec. & Journ. Var.,* vol.63: pp 271-273. 1951.

Collier, A. E., "Larvæ of *Limenitis camilla* L. affected by parasites." *Ent. Rec. & Journ. Var.,* vol. 65:145-146. 1953. *Meteorus* sp.

Collier, A. E., "Hibernation of *Lysandra coridon* Poda in the larval state." *Ent. Rec. & Journ. Var.,* vol.68: pp.33-34. 1956. Some larvæ hatch in fall instead of spring. [P.B.]

Comstock, John Adams, "Collecting butterflies in the coastal area of Mexico near Manzanillo, Colima, with notes on the life history of a rare skipper." *Bull. southern Calif. Acad. Sci.,* vol.52: pp.43-45, 2 figs. 1953. Describes early stages of *Timochares ruptifasciata;* foodplant an undetermined sp. of Malpighiaceæ. [P.B.]

Comstock, John Adams, "Life history notes on four southern Arizona butterflies." *Bull. Southern Calif. Acad. Sci.,* vol.52: pp.127-136, 3 figs. 1953. Describes early stages of *Asterocampa leilia* and *A. subpallida,* eggs of *Philotes rita* and *Emesis zela ares.* [P.B.]

Comstock, John Adams, "Life history notes on *Ascia monuste crameri.*" *Bull. southern Calif. Acad. Sci.,* vol.53: pp.46-49, 1 pl. 1954. Describes and figures early stages. Reared on species of Rhamnaceæ; other foodplants listed. [P.B.]

Comstock, John Adams, "Notes on the early stages of *Forsebia perlæta* (Hy. Edw.), Lepidoptera: Phalænidæ." *Bull. Southern Calif. Acad. Sci.,* vol.53: pp.166-168, 1 fig. 1954. Describes larva and pupa; foodplant *Cercidium torreyanum.* [P.B.]

Comstock, John Adams, "A partial life history of a California butterfly." *Bull. southern Calif. Acad. Sci.,* vol.54: pp.57-60 (correction, p.168), 2 figs. 1955. Records *Plebeius sæpiolus hilda* ovipositing on flowers of *Trifolium involucratum;* describes egg & young larva. [P.B.]

Comstock, John Adams, "Brief notes on the life histories of six California moths." *Bull. southern Calif. Acad. Sci.,* vol.54: pp.60-66, 11 figs. 1955. Descriptive notes on early stages (foodplants in parentheses): *Aseptis characta* (*Artemisia*)*; Andropolia lichena* (*Ribes malvaceum*)*; Palada scarletina* (*Stephanomeria virgata*)*; Heteranassa minor* (*Prosopis juliflora*); *Drasteria howlandi*; *Glaucina golgolata* (*Eriogonum fasciculatum*). [P. B.]

Comstock, John Adams, "Miscellaneous notes on North American Lepidoptera." *Bull. southern Calif. Acad. Sci.,* vol.54: pp.30-35, 3 figs. 1955. Describes and figures: egg of *Heliconius charitonius vazquezæ*; egg of *Euptoieta claudia* (new foodplant records: *Borrhavia intermedia, Metastelma arizonicum*); early stages of *Neoterpes edwardsata* (Geometridæ) (foodplant *Romneya coulteri*). [P.B.]

Comstock, John A., "The egg, and first larval instar of a geometrid moth from Arizona." *Bull. southern Calif. Acad. Sci.,* vol.54: p.105. 1955. *Destutia rubricincta* form 'nigripuncta'.

Comstock, John A., "The egg and young larva of a geometrid moth from California." *Bull. southern Calif. Acad. Sci.,* vol.54: p.105. 1955. *Pherne subpunctata.*

Comstock, John A., "A surmise confirmed." *Bull. southern Calif. Acad. Sci.,* vol.54: p.167. 1956. *Neoterpes edwardsata* feeding on *Romneya coulteri.* [P.B.]

Comstock, John A., "Is this a new and giant clothes moth?" *Bull. southern Calif. Acad. Sci.,* vol.55: pp.51-53. 1956. Records of *Litoprosopus coachella* feeding on cloth & paper. [P.B.]

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A STUDY OF FIRST INSTAR LARVÆ OF THE SATURNIIDÆ, WITH SPECIAL REFERENCE TO NEARCTIC GENERA

by Roger W. Pease, Jr.

Introduction

First instars of many species of Lepidoptera have been described, usually with non-comparative and non-technical descriptions. Occasionally it has been done with an eye toward interpreting structures of the mature larvæ and correctly homologizing them with those of other groups. This has been singularly successful, since the first instar represents a link with the past in that primitive characters may occur in this stage which are completely modified after the first molt. This paper will consider first instar larvæ in their own right with only passing reference to other stages of development. Such concentration may seem arbitrary until an attempt is made to classify first instar larvæ using a key constructed for mature larvæ. The number and degree of structural changes taking place during the first molt require that a separate study be made of the first instar just as exclusive comparative studies have been made of adults, pupæ, and later instar larvæ.

The original intention was to include only the Nearctic genera of the Saturniidæ, but a few species from other areas were available and since their structures suggested some interesting problems, they are included. The subfamilies represented are the Saturniinæ, Hemileucinæ, Citheroniinæ, Rhescyntidinæ, and Agliinæ.

There are about as many systems of setal nomenclature as there have been workers in the field. Only a few have been applied to the first instar larvæ of the Saturniidæ. Packard (1905,1914), following Dyar, used numbers to identify a few setæ, numbering them from the dorso- to ventromeson. He depicted first instar larvæ of many species of Saturniidæ in color and by line drawings. Unfortunately, setæ are omitted from many of the color figures, and some plates do not agree with descriptions in the text (*e.g., Coloradia pandora*). Abdominal segments eight, nine, and ten are also sometimes confused. On the other hand, the line drawings, which are Dr. Packard's own, agree more closely with actual specimens. As a means to quick visual identification of larvæ, the color figures are, of course, unsurpassed, but they should not be considered structurally complete.

FRACKER (1929) constructed a key to the mature larvæ of North American Saturniidæ using his system of Greek letters to identify setæ. Characters used in his key will sometimes hold for the first instar. Particularly important are the relationships of the most dorsal setæ on segments eight and nine of the abdomen.

In the following discussion the setal nomenclature of GERASIMOV (1935) as modified by HINTON (1947) is followed as closely as possible. The almost mathematically precise definitions of groups of setæ could be applied to the Saturniidæ even though this family was not included in HINTON's paper. The notations of FRACKER, FORBES, or HEINRICH are alternate systems. For comparisons and synonymy see HINTON (1947) and PETERSON (1948).

Those setæ which occur throughout the Lepidoptera in the first instar are called primary setæ. Secondary setæ appear in succeeding instars but are usually absent in the first. It is an indication of advancement in the Saturniidæ that some of them have numerous secondary setæ in the first instar. HINTON recognized two types of setæ: long or tactile setæ and microscopic or proprioceptor setæ. The former are generally distributed over the body, while the latter are restricted to areas where overlapping of cuticle is likely to occur, such as at the juncture of segments. Most of the microscopic setæ on specimens preserved in alcohol were not clearly visible with the resolution and magnification (150×) used. Except for a single series of aberrant *Hemileuca* larvæ, the microscopic setæ will be omitted from this discussion.

Characters such as crochets, head structures, and thoracic legs are probably as diagnostic as body setæ, but they have not been so widely used and are less easily studied. Some reference will be made to the crochets on the prolegs. All structures except the most prominent may be ruined if specimens preserved in alcohol were ever allowed to dry out. The more conspicuous setæ are usually in satisfactory condition even in some of the most severely shrunken specimens. It is hoped that the key presented here will eventually be extended to include all the prominent structures of first instar larvæ.

A few terms need to be redefined for use with the first instar. If a seta is referred to as PRIMITIVE, it consists of a single stiff filament rising directly from the body wall. Presumably, this is the ancestral form. Chalazæ are extensions of cuticle bearing one to several setæ. FRACKER (1929) defines scolus as a "spinose projection" of the body wall, with reference to the Saturniidæ. The scoli of later instars, however, are homologous to structures in the first instar which are clearly divided into a chalaza and a seta. Here the term CHALAZA will be used for any projection on the body wall bearing primary setæ which are still distinguishable from secondary setæ. SCOLUS will be reserved for similar structures in the Saturniinæ having secondary setæ on the chalazæ which cannot be separated from the primary setæ. As a general rule, the setæ of first instar larvæ of Saturniidæ never become fused. It is the chalazæ which are fused to a varying degree. For example, on the dorsomeson of the ninth abdominal segment, all Hemileucinæ have a single chalaza. This bears two primary setæ, one from each side of the body, whose chalazæ are united. Very rarely an individual larva will have a seta split or forked, but in two individuals seen (one each of *Arsenura* and *Hemileuca*), the fork occurred on only one side of the body.

Primary and Secondary Setæ

The primary setæ are divided into several groups defined by their position and recurring on each segment. They are: dorsals (D1 and D2), subdorsals (SD1 and SD2), laterals (L1 and L2), subventrals (SV1 and SV2), and ventral (V1). In addition there are two extra setæ (XD1 and XD2) on the cervical shield of the prothoracic segment. The homologies of the setæ on the tenth abdominal segment are not clear at present. The abbreviations T-1, T-2, T-3, and A-1 to A-10 will be used to indicate thoracic and abdominal segments numbered from anterior to posterior. When fusion of chalazæ takes place, it occurs first within groups of setæ and then between different groups. Only the letters of the setal groups will be used to describe such united structures. For example, D would refer to a structure homologous to the dorsal setæ (D1 and D2) and XD-SD would be a structure made up of the two SD setæ combined with the two XD setæ of the prothoracic segment.

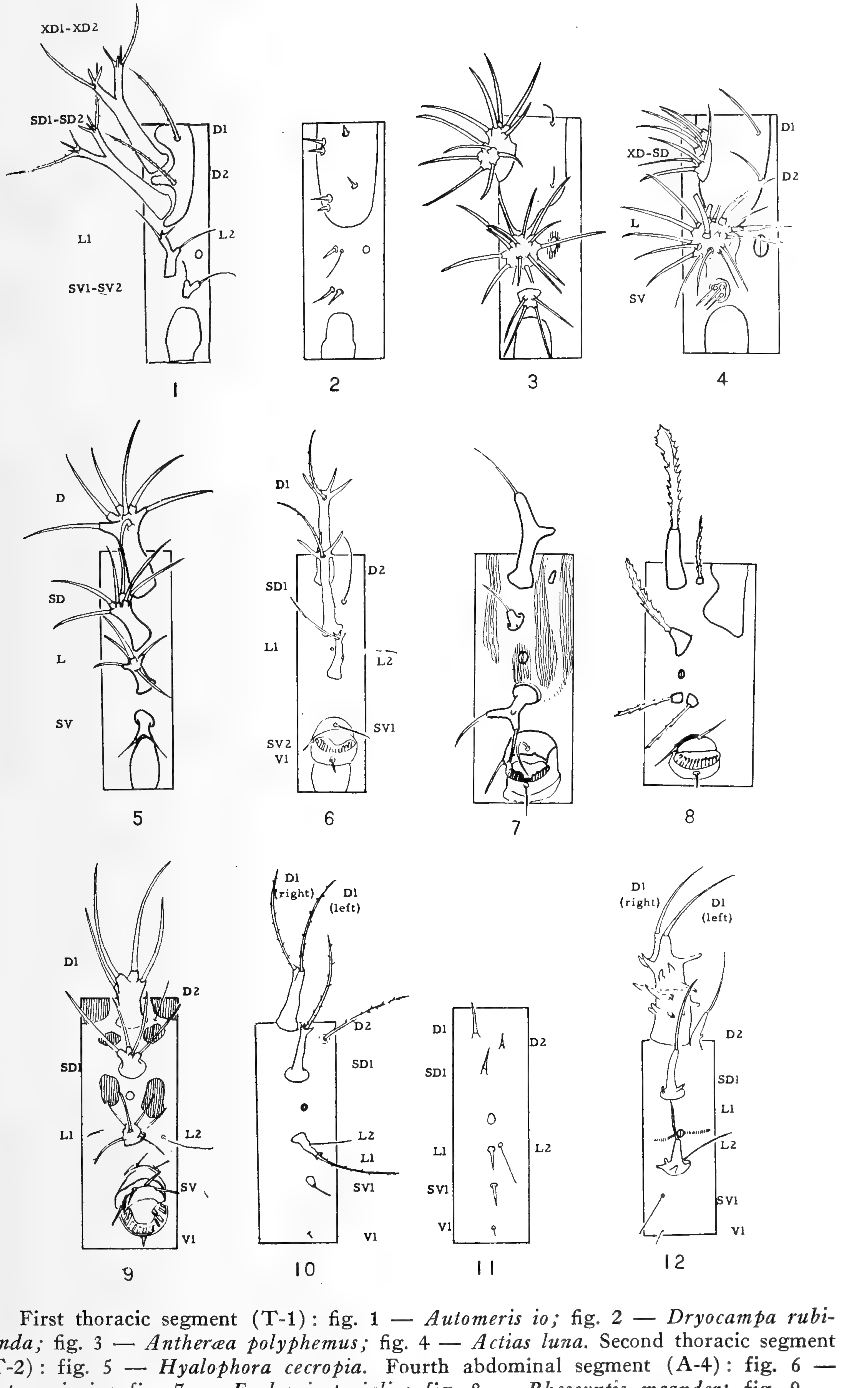
On the cervical shield of the prothorax (T-1) there are six primary setæ. In most Saturniidæ four of these are represented by two large bifurcate chalazæ or scoli on the anterior part of the shield and two primitive setæ on the posterior margin (Fig.1). In the Saturniinæ the bifurcation has disappeared, and the two scoli bear numerous secondary setæ. *Antheræa* and *Actias* show increasing degrees of fusion of the bases of the two scoli, the top being plainly double in the former and single in the latter (Figs.3 and 4). On the posterior edge of the plate, two single setæ rise directly from the shield without chalazæ. One is usually mesocaudad of the first chalaza, and the second is about midway between the two chalazæ. *Dryocampa rubicunda* (Fig.2) offers a chance to observe the relationships of the setæ when their chalazæ are reduced and almost wholly absent. The setæ of the more dorsal anterior pair are of subequal length, while one seta of the pair below them is longer than the other. In the higher Lepidoptera, XD1 and XD2 are of equal length and are on the anterior part of the cervical shield. The subdorsal group (SD1 and SD2) is below these with SD1 longer than SD2. The dorsal group (D1 and D2) forms the remaining setæ, with D1 shorter and more dorsal than D2. Therefore, in the Saturniidæ the more dorsal of the two anterior pairs of setæ on the cervical shield will be called XD, the more lateral SD, the more dorsal of the single setæ D1, and the more lateral single seta D2. D1 and D2 vary in their length relationship. Those on T-1 are of nearly equal length in most Saturniidæ. In *Eacles imperialis* D1 is bullet-shaped and much shorter than the normally developed D2.

On the meso- and metathorax (T-2 and T-3) the dorsal group is borne on a single chalaza or scolus in all Saturniidæ. On the abdominal segments D1 is antero-mesad of D2 and is usually on a chalaza. D1 is always present on A-1 to A-9 but may be fused on A-8 across the dorsomeson, in which case it is flanked on either side laterocaudad by D2 (Fig.15). D2 is present on A-1 to A-9 in the Hemileucinæ, Citheroniinæ, and Rhescyntidinæ but is fused on the dorsomeson of A-9 (Fig.18). The Saturniinæ may have D2 conspicuous on all abdominal segments (*Saturnia* — Fig.22), reduced to a weak bristle (*Actias* — Fig.23), or missing on A-9 and conspicuous on the other abdominal segments (*Hyalophora, Samia* — Fig.24).

The SD group consists of two setæ below the D group. SD1 and SD2 are both tactile on the thoracic segments and are borne on fused chalazæ. On abdominal segments, SD2 is prespiracular and microscopic. It usually looks like a small puncture when visible at all. SD1 is borne on a chalaza and is similar to abdominal D1.

The lateral group (L) is subspiracular on the abdomen and prespiracular on the prothorax. It consists of two setæ (L1 and L2) on T-1 and A-1 to A-8. Only L1 is present on T-2 and T-3 although it is usually specialized in the same manner as L1 on the abdomen. In the Saturniinæ, L1 is a well developed scolus on all segments except A-9, while L2 is of primitive form occurring caudad to L1 on A-1 to A-8 (Fig.15). On the prothorax L2 is mixed with the secondary setæ of the lateral scolus (L1), but it can often be identified by its thinner more fragile appearance. In subfamilies other than the Saturniinæ, L1 and L2 may be borne on the same chalaza at equal heights (*Eacles imperialis* on A-1 to A-7 — Fig.7), on different chalazæ (*Rhescyntis meander* — Fig.8), or on the same chalaza with L2 projecting caudad at halfmast (*Automeris io* — Fig.6). L2 is sometimes inserted slightly ventrad of L2 on A-1 to A-6 and slightly dorsad of L2 on A-7 and A-8. *E. imperialis* and *Neocarnegia basirei* have L2 projecting caudad from the base of L1 on T-1 and A-8. Also there are one to three secondary setæ on L of T-1 in these species.

The subventral group (SV) normally consists of two setæ on T-1 and A-3 to A-6, one seta on T-2 and T-3, one or two setæ on A-1, A-2, A-7, A-8, and one seta on A-9. The group is situated just above the true legs on the thoracic segments. If more than the allotted number of setæ occur, there is usually a larger number on T-1 than on T-2 and T-3. The Saturniinæ have at least two subventral setæ on all thoracic segments arranged in a more or less horizontal line (Fig.5). SV is a scolus on T-1 in *Rothschildia*. The Citheroniinæ, Rhescyntidinæ, and Hemileucinæ have two setæ on T-1 and only one on T-2 and T-3. On the proleg-bearing abdominal segments, the SV are primitive setæ borne on the distal part of the proleg, one lateral and one anterior. In some Saturniinæ one or more setæ are arrayed horizontally between the sclerotized plate bearing the secondary setæ on the prolegs of A-3 to A-6 and the body (Fig.36). None of the species which lacked secondary setæ had SV1 and SV2 in this position. Therefore, SV1 and SV2 are probably mixed with the secondary setæ.

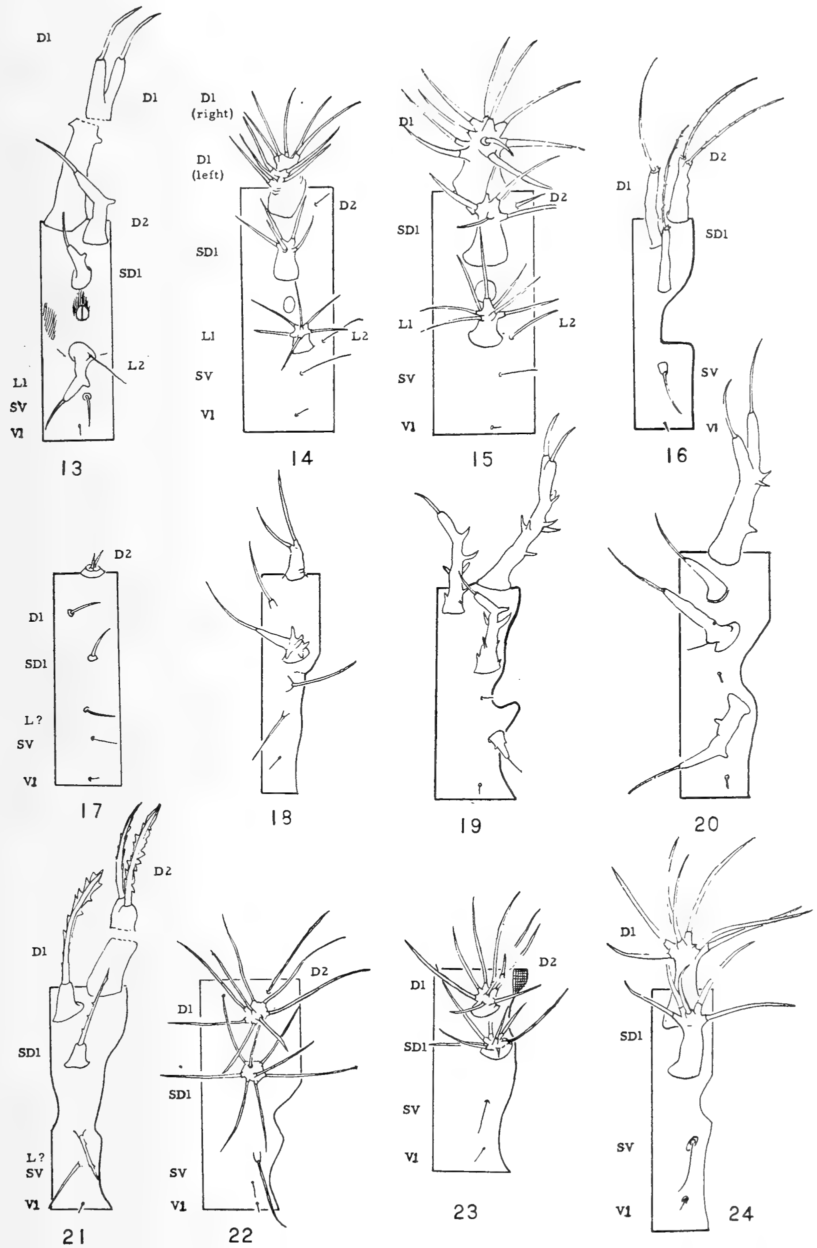


First thoracic segment (T-1): fig. 1 — *Automeris io;* fig. 2 — *Dryocampa rubicunda;* fig. 3 — *Antheræa polyphemus;* fig. 4 — *Actias luna.* Second thoracic segment (T-2): fig. 5 — *Hyalophora cecropia.* Fourth abdominal segment (A-4): fig. 6 — *Automeris io;* fig. 7 — *Eacles imperialis;* fig. 8 — *Rhescyntis meander*; fig. 9 — *Samia cynthia.* Eighth abdominal segment (A-8): fig. 10 — *Hemileuca maia*; fig. 11 — *D. rubicunda;* fig. 12 — *Syssphinx heiligbrodti.*

On abdominal segments A-1, A-2, A-7, and A-8, the number of subventral setæ is variable. Uusually there are two setæ arranged vertically on the first two abdominal segments. A third seta sometimes appears between the two. Specimens from the same batch of eggs have differed in the number of setæ which they possess in this group even from one side of the abdomen to the other. Except for SV1 on A-1, A-2, A-7, A-8, and A-9, the subventral setæ are primitive. SV1 on some or all of these segments may be on a chalaza and follow the modification of other setæ of the species under consideration. In some Hemileucinæ SV1 of A-7 and A-9 are on chalazæ while the chalazæ of A-8 are much reduced or absent. In general, the instability of the subventral setæ on segments without prolegs impairs their usefulness as taxonomic characters. However, the larger number of setæ in this group on the thoracic segments of the Saturniinæ in comparison with other subfamilies is a constant character.

There is some question as to whether a lateral or a subventral seta occurs on the ninth abdominal segment (A-9) in the Saturniidæ. The setæ on A-9 are arranged in a more or less vertical array unlike other abdominal segments. The three most dorsal setæ (two in some Saturniinæ) are easily identified as the two (or one) members of the dorsal group (D1 and D2) and the tactile seta of the subdorsal group (SD1). The seta close to the ventromeson is obviously a member of the ventral group (V1). The Hemileucinæ (Fig. 16) possess one other seta situated below the level of the lateral group on other segments. Either the lateral or the subventral group is missing. The seta and chalaza are similar to the subventral group of A-7 in some species, so the seta is probably SV1. The Saturniinæ (Fig.22) have two setæ in this area, both of primitive form. A specimen of *Hyalophora cecropia* was found in which both setæ were present on the left side of A-9, but only the outer one occurred on the right side. This suggests that both setæ are members of the subventral group in the Saturniinæ with the lower seta secondary. The Citheroniinæ and Rhescyntidinæ also have two setæ, but their form varies greatly. *Sysphinx heiligbrodti* (Fig.18) and *Dryocampa rubicunda* (Fig.17) have both setæ unmodified. However, the outer seta is larger, has a more prominent chalaza, and is level with L of A-8 or above it. In contrast the lower seta of *E. imperialis* (Fig.20) and *Citheronia* is more prominent and resembles L1 of other abdominal segments. The other seta is always small in comparison. Although the size relationship varies, the position of the two setæ is very nearly the same in *Sysphinx, Dryocampa, Eacles,* and *Citheronia.* The higher seta of *Rhescyntis meander* (Fig.21) has the saw-shaped structure peculiar to most setæ on the upper two-thirds of the body in this species, but the lower seta is of primitive form.

A probable interpretation is that the lateral group is typically absent on A-9 of the Saturniidæ with the exception of the Citheroniinæ and perhaps the Rhescyntidinæ. Since A-9 is smaller than the other abdominal segments, the loss of L1 may have been due to crowding of the setæ and to the increased flexibility of the segment which would result from a more spacious arrange-



Eighth abdominal segment (cont.): fig. 13 — *Eacles imperialis;* fig. 14 — *Antheræa polyphemus*; fig. 15 — *Actias luna.* Ninth abdominal segment (A-9): fig. 16 *Hemileuca maia;* fig. 17 — *Dryocampa rubicunda;* fig. 18 — *Syssphinx heiligbrodti*; fig. 19 — *Citheronia regalis;* fig. 20 — *E. imperialis;* fig. 21 — *Rhescyntis meander;* fig. 22 — *Saturnia pavonia;* fig. 23 —*Actias luna;* fig. 24 — *Hyalophora cecropia.*

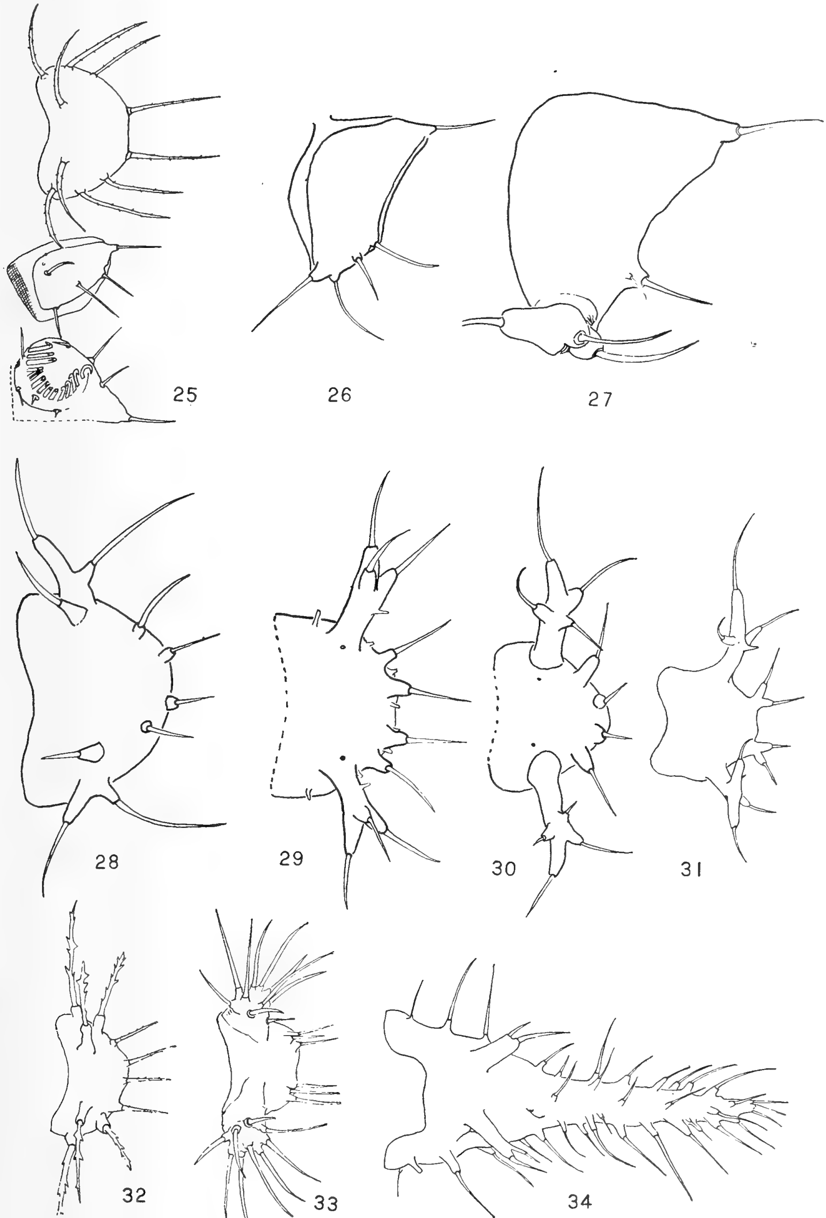
ment. Development of a subventral chalaza as in *Eacles, Citheronia,* and *Automeris* with a corresponding loss of the lateral seta would serve to protect the larva's flank and to eliminate crowding. Numerous secondary setæ on nearby chalazæ and on the anal prolegs in the Saturniinæ may be sufficient protection without modification of the subventral setæ.

The ventral seta V1 is posterior to the thoracic legs on T-1 to T-3. It is usually difficult to detect. On A-1 and A-2 V1 is mesad of the subventral setæ. It is on the inner side of the prolegs of A-3 to A-6 and near the meson on A-7 to A-9. On A-8 it is often nearer the meson than on A-7 and A-9.

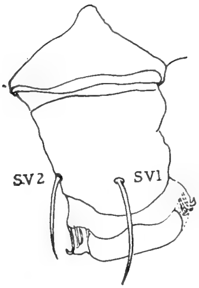
The tenth abdominal segment in its probable primitive form (Hemileucinæ) bears five setæ on the suranal plate, five on the lateral sclerite of the proleg, one seta on the anterior of the proleg, and three stubby setæ on the mesal side of the anal proleg (Fig.25). There is a tendency towards fusion of the three most anterior setæ on the suranal plate. All setæ on this plate are separate in *Rhescyntis meander* (Rhescyntidinæ) and in *Dryocampa* and *Anisota* (Citheroniinæ). Progressive fusion is clearly indicated by comparison of *Syssphinx heiligbrodti* (Fig.28), *Citheronia regalis* (Fig.29), and *Eacles imperialis* (Fig.30). In the first of these, the three setæ are fused only at the base, in *C. regalis* they are borne well up on the chalaza, and in *E. imperialis* a secondary seta or two are present. Saturniinæ have a scolus on the suranal plate with two or three setæ inserted behind it (Fig.33).

Secondary setæ, when present, are usually limited to the lateral plates of the prolegs and to the chalazæ of the primary setæ. All Saturniinæ have secondary setæ on the more prominent chalazæ. New World genera may have thorny cuticular eruptions of the cuticle of the chalazæ but usually have no secondary setæ on them. *Eacles* has extra setæ on the chalaza L of T-1 and the fused chalazæ of the suranal plate. Comparison of *Hemileuca, Automeris,* and *Hyalophora cecropia* might suggest that the secondary setæ of the Saturniinæ, which are mixed with and inseparable from the primary setæ, have developed directly from the cuticular processes of the Hemileucinæ. These range from the tiny bristles of *Hemileuca* to the conspicuous spines in *Automeris.* That this is not the case is indicated by the fact that some genera of the Saturniinæ (*Saturnia* and *Calosaturnia*) lack fusion of D1 on A8, and all have D2 of A-9 unfused. These setæ are almost always fused on the dorsomeson in New World species (exceptions are *Dryocampa* and *Anisota* which have only D2 of A-9 fused). In *Aglia tau* D1 is fused on A-8, but because of the size of the chalazæ on A-9 it is not certain whether they were once fused or whether they merely cover more surface of the dorsum and hence appear to approach fusion.

A series of specimens of *Hemileuca maia* from Long Island may shed a little light on the method of development of secondary setæ. In these, extra tactile setæ occur on the dorsum of the mesothoracic to eighth abdominal segments and tend to displace the microscopic seta MXD1 which is lateroanterior to D1 (Fig.48). Three times an extra seta was also found near D2. In one larva, both MXD1 and the tactile seta are present anterior to D1 (Fig.51).



Last abdominal segment: fig. 25 — *Automeris io* — dorsal plate, lateral aspect of proleg and ventral view (half only); fig. 26 — *Eacles imperialis* — lateral plate of proleg; fig. 27 — *Neocarnegia basirei* — lateral plate of proleg. Dorsal plate: fig. 28 — *Syssphinx heiligbrodti;* fig. 29 — *Citheronia regalis;* fig. 30 — *E. imperialis;* fig. 31 — *N. basirei;* fig. 32 — *Rhescyntis meander;* fig. 33 — *Samia cynthia;* fig. 34 — *Aglia tau.*



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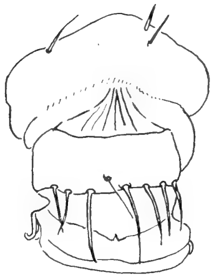

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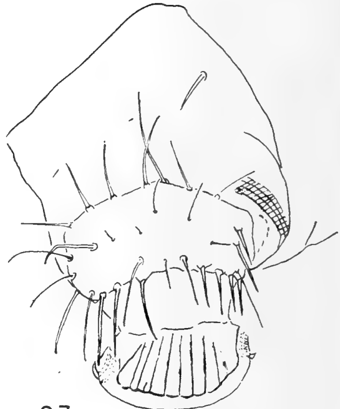

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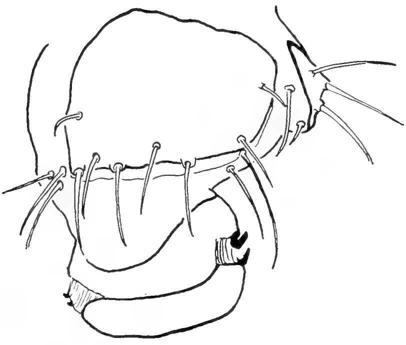

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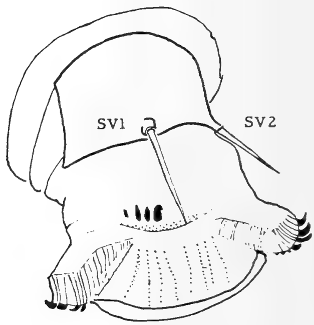

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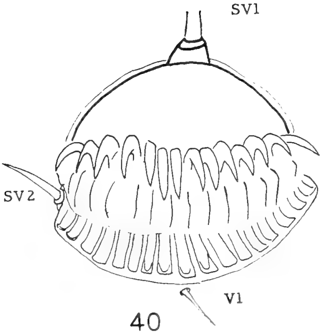

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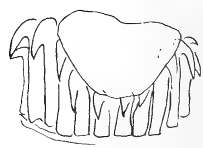

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Abdominal prolegs (A-3): fig. 35 — *Actias selene;* fig. 36 — *Hyalophora cecropia*; fig. 37 — *Attacus atlas;* fig. 38 — *H. cecropia* — anal proleg; fig. 39 — *Citheronia regalis* with crochet remnants; fig. 40 — *Rhescyntis meander* crochets; fig. 41 — *Rothschildia orizaba* crochets.

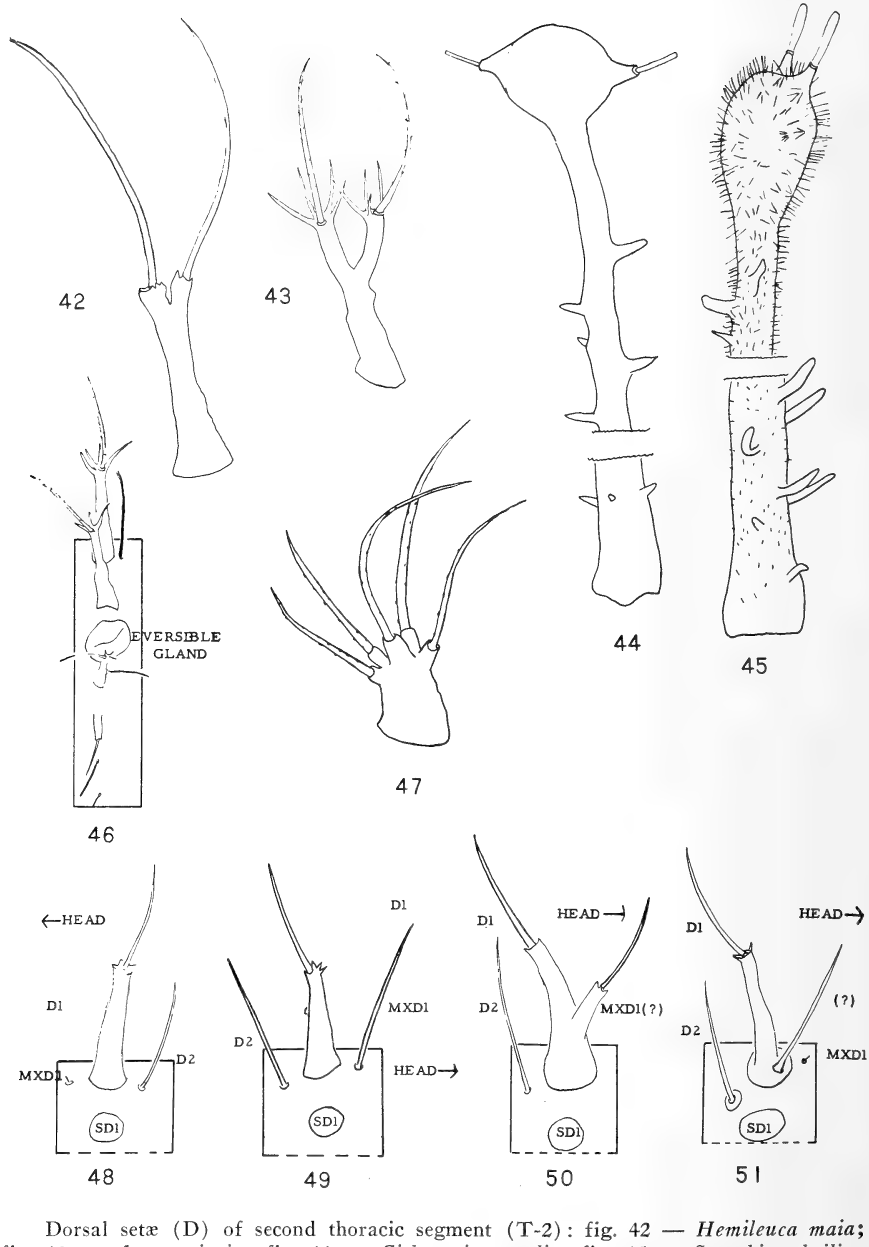
In all other individuals, when a tactile seta occurs anterior to D1, its position is close to where MXD1 would normally be, and MXD1 is not visible. In view of the presence and proximity of both MXD1 and the tactile seta on one specimen, it is not certain that this tactile seta represents a mutation of the microscopic seta. The occurrence of the extra tactile seta was not constant from segment to segment nor even symmetrical from left to right. On the same specimens, there is a tendency for the chalazæ D2 of A-9, which are fused on the dorsomeson, to separate and fuse with D1. The tactile seta in some instances even migrated part way up the chalaza of D1 so that the structure began to resemble the fused D group of the thoracic segments (Fig. 50). It is interesting to note that *Pseudohazis* has three setæ rising from chalazæ XD, SD on T-1, and SD on T-2 and T-3. This seems to be constant. PACKARD (1914) figures first instar larvæ of *Pseudohazis* with three-forked chalazæ. Related species have only two setæ on these chalazæ. The source of the third seta is not clear.

The secondary tactile setæ of the Saturniinæ may have appeared by a process of random mutation, with selection collecting the setæ on the chalazæ. It may be significant that the setæ sometimes migrated up the stem of the chalaza in some of the *Hemileuca maia*. [See the chart below for a complete list of these setæ.] Another explanation would be that the secondary setæ of the Saturniinæ arose by a lengthening of cuticular processes similar to the development of the processes indicated by comparison of *Hemileuca* and *Automeris*. As mentioned above, the Saturniinæ could not arise from the Hemileucinæ directly.

Hemileuca maia — distribution of aberrant MXD1 setæ on 5 specimens from West Hampton, Long Island, New York, ova collected by S. A. HESSEL.

SPECIMEN	TYPE OF SETA ON SUCCESSIVE SEGMENTS[1]										
	T-2	T-3	A-1	A-2	A-3	A-4	A-5	A-6	A-7	A-8	A-9
#1 LEFT	M	M	M	M	M	M	M	M	T	M?	T[3]
RIGHT	M	M	M	T	M	T	M	T	T	T	M
#2 LEFT	M?	M	M?	M	T	T[2]	M	M[2]	T	M?	T
RIGHT	M?	M	M	M	M[2]	T[2]	T	M	M[2]	M?	TfD
#3 LEFT	M	M	M	M	M	M	M	M	M	M	M
RIGHT	M	M	M	M	M	M	M	M	M	M	M
#4 LEFT	M?	M	T	M	M	T	M	M	T	T	M
RIGHT	M?	M	TfD	TfD +M	M	M	TfD	T	T	M	M
#5 LEFT	M	TfD	T	T	T	T	T	T	T	T	TfD
RIGHT	M	T	TfD	T	TfD	T	T	T	TfD	T	TfD

[1] Symbols: M = microscopic; TfD = tactile seta fused to D1; T = tactile.
[2] D2 double.
[3] #1 has no fusion of D2 on dorsomeson of A-9.



Dorsal setæ (D) of second thoracic segment (T-2): fig. 42 — *Hemileuca maia*; fig. 43 — *Automeris io;* fig. 44 — *Citheronia regalis;* fig. 45 — *Syssphinx heiligbrodti*; fig. 46 — *A. io* showing position of eversible gland on first abdominal segment (A-1). Aberrant setæ of *Hemileuca maia*: fig. 48 — normal left side A-2 of specimen #1; fig. 49 — MXD1 abnormal right side A-2 specimen #1; fig. 50 — extra setæ associated with D1 and MXD1 apparently missing on right side A-1 specimen #5; fig. 51 — extra seta associated with D1 and MXD1 present on right side A-2 specimen #4.

Aglia is unique among the species examined in that it possesses a lengthy XD group on T-1 and D group on T-3, while T-2 has a much smaller D-chalaza bearing two long and two shorter setæ. Several setæ are behind this chalaza on the segment. It is probable that the two long setæ represent D1 and D2, which are fused on T-1 and T-3. There are a few secondary setæ scattered over the body, and eruptions of cuticle on the long chalazæ of T-1, T-2, and A-8 bear single secondary setæ. *Aglia* also has a remarkable chalaza projecting caudally on the dorsomeson of the tenth abdominal segment (Fig.34).

Crochets

The most general arrangement of crochets seems to be a single series of crochets of similar size on the inner side of the distal part of each proleg. The embedded ends are distinctly bent or hooked as well as the free ends of the crochets except in the Saturniinæ, which have the embedded ends blunt. When the crochets are deeply set in the fleshy pad (spatula) on the proleg, the connections between the ends are obscured and there is an appearance of two rows of crochets where only one occurs, as in *Rhescyntis meander* (Fig.40).

Crochet remnants, from what may once have been an outer row, are found in some specimens of *Citheronia regalis* and *Eacles imperialis* (Fig.39). Not all specimens have them. In the Saturniinæ and in *Citheronia, Eacles,* and *Syssphinx* of the Citheroniinæ, the crochets in the middle of the series are shortened forming a more or less C-shaped pattern (Fig.41).

The number of crochets seems to be distinctive, as the following counts for Saturniinæ show:

Antheræa, Actias, Calosaturnia	18 or more
Saturnia	15 - 18
Hyalophora, Samia	13 - 16
Rothschildia	10 - 12

Counts apply to prolegs on the third to sixth abdominal segments. A larger number of crochets always appears to the anal prolegs.

The number of crochets may be related to the size of the larva, at least in some of the New World forms. *Citheronia, Eacles,* and *Rhescyntis meander* are large and have at least 20 on each segment, while the small *Dryocampa rubicunda* has 7 to 9 crochets, and the Hemileucinæ have 6 to 9. *Attacus atlas,* however, has only 13 to 16 crochets, as do *Hyalophora* and *Samia.*

Evolution and Taxonomic Value of Larvæ

Characters in the immature stages of Lepidoptera have long been used for aid in defining taxonomic groups. First instar larvæ, in particular, show less variation within taxa than adults. Species within genera may be almost identical.

Because of the almost cataclysmic changes which take place during metamorphosis, speculation is justified as to whether larvæ, including the first instar, could diverge faster than their imagines in the course of evolution. This would seem possible, since in Lepidoptera most external structures of the imago do not develop from external larval structures but instead arise at the end of the larval period from small, previously quiescent groups of cells, the "imaginal discs." Larval-specific selective factors could not affect them nearly as much as the larval structures. Predators and parasites are examples of such selective factors. Many are particular as to the stage (egg, larval instar, pupa, or adult) which they attack but not as particular about the species (HOWARD and WILLISTON in SCUDDER, 1889). Since immature and mature stages need not occur at the same season, the effects of climate may differ. The very great mortality which occurs between oviposition and pupal eclosion and the relatively long duration of this period in most species of Lepidoptera, indicates that the brunt of natural selection (aside from courtship recognition factors) is borne by the immature stages. For example, in a quantitative study of natural populations of *Phlegethontius sextus* (Johan.) and *P. quinquemaculatus* (Haw.) (Sphingidæ) LAWSON (1959) found 98 per cent mortality in larval stages alone. Yet, species differences are usually assumed to be greater in adults than larvæ.

A model which might result in larval divergence follows. Suppose that some selective factor was focused on larvæ of several species but affected the imagines not at all. Random variation could remain the same for individuals in all stages, but since selection was concentrated on larvæ, net evolution would be greater in larval characters than in those of the adult. It is hardly to be expected that all species would adapt in the same way. Some would become more unlike as a result of selection. Meanwhile, no adaptation to this factor has been required of the adult. Thus, it seems possible that larval differences could accumulate faster than those in adult structures.

Species could not evolve solely by larval adaptation since the sexually mature stages must be reproductively isolated. Thus, for populations of the same species which were geographically isolated and had evolved different larval characters, the removal of spatial barriers would at first permit interbreeding with resulting larval polymorphism.

A behavioral difference in the imago, however, might serve to isolate reunited forms although they retained similar imaginal morphology. To a taxonomist looking at museum specimens, the adults would appear similar but the larvæ different. Eventually, the imagines would probably become more unlike as selective factors acted upon them more strongly than on the larvæ, their evolutionary divergence overtaking that of the immatures.

The following examples may make this more convincing. A favorite behavioral mechanism for isolating species in the Saturniidæ is the time of day or night during which a female will release the scent which attracts males. The time is characteristically different for each species. Fortunately for taxonomists, adults of these moths usually have conspicuous differences. But, in the Notodontidæ, the adults of the genus *Datana* are difficult to separate although mature larvæ can be identified at a glance. Sibling species such as *Erynnis lucilius* Scud. & Burg., *E. persius* Scud., and *E. baptisiæ* Forbes (Hesperiidæ) have different food-plants, but adults are difficult or impossible to determine in unlabelled dried specimens even from genitalia. A conspicuous color difference makes separation of the first instar larvæ of two of the species a simple matter. First instar larvæ of *E. baptisiæ* are orange while those of *E. lucilius* are pale greenish white.

First instar larvæ should be particularly helpful in taxonomic studies either (1) when morphology of the imagines differs greatly but the larvæ retain similar characters, or (2) when larvæ have changed and the mature stages have not diverged greatly. Each requires evolutionary conservatism in one stage and divergence in another. The majority of cases fall into the first category. However, a classic example of dissimilar larvæ but superficially similar adults is that of *Automeris* (Hemileucinæ) and the Saturniinæ. Until Mosher (1914) classed *Automeris* with the Hemileucinæ on the basis of pupal characters and Fracker (1929) reached the same conclusion on larval characters, the genus was often placed in the Saturniinæ. Characters have since been found in the adult for placing the genus correctly.

In passing, it should be noted that the setæ are quite homogeneous in the Hemileucinæ but that there is a diversity of types in the Citheroniinæ and Rhescyntidinæ. In the first group the larvæ have stinging setæ, and larval evolution may have proceeded along physiological lines. In the latter groups the product of evolution is more readily seen as the result of setal modification.

Key to First Instar Larvae of Saturniidæ

The key was constructed from the following species, from North America unless a locality is noted. All specimens are in the larval collection at Yale University. HEMILEUCINÆ: *Automeris coresus* Bdv. (Argentina), *A. io* Fabr., *A. pamina* Neum., *Coloradia pandora* Blake, *Dirphia baroma* Schaus (Brasil), *D. curitiba* Draudt (Brasil), *D. epiolina* Felder (Brasil), *Hemileuca maia* Drury, *H. neumoegeni* Hy. Edw., *H. nevadensis* Stretch, *Hylesia nigricans* Berg (Argentina), *Pseudohazis* spp; CITHERONIINÆ: *Syssphinx (Bouvierina) heiligbrodti* Harvey, *Adeloneivaia apicalis* Bouvier (Brasil), *Anisota oslari* Roths., *Dryocampa rubicunda* Fabr., *Citheronia brisottii* Bdv. (Argentina), *C. regalis* Fabr., *Eacles imperialis* Drury, *Neocarnegia basirei* Schaus; RHESCYNTIDINÆ: *Rhescyntis (Arsenura) meander* Walker (Brasil); SATURNIINÆ: *Actias luna* L., *A. selene* Hübner (India), *Antheræa polyphemus* Cramer, *Attacus atlas* L. (Borneo), *Calosaturnia walterorum* Hogue & Johnson, *Dictyoploca japonica* Moore (Japan), *Hyalophora (H.) cecropia* L., *H. (H.) euryalus* Bdv., *H. (Callosamia) angulifera* Walker, *H. (C.) carolina* Jones, *H. (C.) promethea* Drury, *Rothschildia orizaba* West., *Rhodinia fugax* Butler (Japan), *Saturnia (S.) pavonia* L. (Germany), *Samia cynthia* L.; AGLIINÆ: *Aglia tau* L. (Germany). The Brasilian larvæ were preserved by F. Plaumann, those from Argentina by J. Förster, those from Germany by J. Reichel, and those from India, Japan, Borneo by C. L. Remington. The nomenclature largely follows Michener (1952).

Notes:

1. Descriptions are for one half of the body, *i.e.* reference to two setæ would mean the larva actually possessed four, with two arranged symmetrically on each side.

2. Whenever the word "fused" is used, it applies to the chalazæ of the setæ, *i.e. "D1 fused on dorsomeson"* means that the chalazæ of the first dorsal seta from each side of the body are united so that the two setæ now arise from a common base.

3. Segments are numbered posteriorly T-1, T-2, T-3 for the three thoracic segments and A-1 to A-10 for the abdominal segments.

The Key

1. Pro- and metathorax (T-1 and T-3) with dorsal chalazæ much longer than those of mesothorax (T-2); dorsal setæ of T-2 short, bearing 4 branches with 2 of these longer than the others; chalaza of dorsal seta D1 of abdominal segment eight (A-8) fused on dorsomeson; no fusion on A-9; last abdominal segment (A-10) with a conspicuous posteriorly projecting chalaza on dorsomeson (Fig. 34); elongated chalazæ have numerous thorny projections of cuticle usually bearing a secondary seta; some secondary setæ on body, lateral plates of prolegs, and anal proleg .... Subfamily AGLIINÆ (*Aglia tau*)

Chalazæ of T-1 and T-3 never prolonged without similar extension of chalazæ of T-2; A-10 never with posteriorly projecting chalaza on dorsomeson; if cuticle of chalazæ is erupted with thorny projections, secondary setæ are usually absent from their tips; secondary setæ, if present, usually confined to the lateral plates of the prolegs (short hairlike setæ on the elongated chalazæ in *Syssphinx*) 2

2. Scoli (usually XD, SD, L, D) on thoracic and abdominal segments bear 5-12 setæ of subequal length usually attached near the top (Fig. 5); dorsal scoli on A-9 never fused on dorsomeson; second dorsal seta (D2) of A-9 often absent; scoli subequal in height or at least none several times as long as others; anal prolegs with as many as 18 setæ on lateral sclerotized plate; second lateral seta (L2) on prothorax (T-1) often not distinguishable from secondary setæ of scolus L1; on A-1 to A-8 second lateral seta (L2) is of primitive form and separated from secondary setæ of scolus L1 (Fig.9). (Subfamily SATURNIINÆ) 6

Chalazæ usually bearing only one or two primary setæ at the top; some times 4-6 shorter processes around the setæ; second dorsal seta (D2) always present on A-9, fused on dorsomeson and borne on a chalaza (Fig. 16); some chalazæ may be much longer than homologous chalazæ on different segments, particularly those on the thorax and A-8 and A-9; anal prolegs with three setæ mesad, one anterior, and five on lateral sclerotized plate (Fig. 25); primitive lateral seta (L2) on T-1 present and projecting caudad from the base or near the base of L1; L2 may rise from chalaza of L1 on A-1 to A-8 3

3. T-2 with chalaza of dorsal seta (D) several times as long as other thoracic chalazæ; no fusion on dorsomeson of A-8 (Fig.11). (Some CITHERONIINÆ) .... *Anisota, Dryocampa.*

D on T-2 not the only prolonged thoracic chalaza; D1 fused on dorsomeson of A-8 4

4. Chalazæ of dorsal (D) and subdorsal (SD) setæ of T-2 and T-3 and first dorsal seta (D1) of A-8 at least twice as long as chalazæ on A-1 to A-7, A-9 and A-10; chalazæ may have thorny cuticular projections; some setæ of suranal plate on A-10 usually borne on prominent chalazæ (Figs. 28 to 31); primitive setæ on posterior edge of cervical shield (D1, D2) on T-1 shorter than chalazæ of D on T-2; no eversible glands on A-1 and A-7 5

Chalazæ of thoracic setæ subequal to those of abdomen; all chalazæ without cuticular eruptions except at the top surrounding the primary setæ; chalazæ of setæ on suranal plate inconspicuous; primitive setæ on posterior edge of cervical shield (D1, D2) usually as long as chalazæ of D on T-2; eversible glands often visible behind spiracle on A-1 and A-7 (Fig. 46) 14

5. Chalazæ granulated without prominent cuticular thorns; many setæ barbed and flattened giving appearance of a double-edged saw; subventral (SV1 and SV2) and ventral (V1) setæ of A-3 to A-6 without this modification; only one seta on the lateral plate on A-10 has this shape; double-hooked crochets on prolegs deeply embedded in spatula giving the illusion of two rows; lateral setæ (L1 and L2) rising from separate chalazæ on A-1 to A-8. .... Subfamily RHESCYNTIDINÆ (*Rhescyntis meander*)

Chalazæ with cuticular thorns; setæ relatively smooth; crochets shallowly embedded in spatula and obviously composed of a single row with occasional remnants (3-4) of an outer row; usually three or more setæ of the suranal plate borne on one chalaza (Figs. 28 and 29); L1 and L2 with chalazæ at least partly fused on A-1 to A-8. (Subfamily CITHERONIINÆ) 20

6. Only primary setæ (SV1, SV2, V1) present on prolegs of A-3 to A-6; secondary setæ occur on the anal prolegs; D-2 usually present on A-9 (Figs. 22, 35) 7

All prolegs have secondary setæ on the lateral sclerotized plates (making a total of 9-12 setæ on prolegs of A-3 to A-6); D2 never present on A-9 (Figs. 24, 36) 10

7. Chalazæ of D1 on A-8 entirely separate; D2 a conspicuous seta on all abdominal segments 8

Chalazæ of D1 on A-8 partially or wholly fused on dorsomeson; D2 may be missing on A-9 9

8. Height of SD and D scoli less than twice width; XD-SD of T-1 present on anterior edge of cervical shield as a continuous band of setæ .... *Saturnia, Dictyoploca*

Height of SD and D scoli greater than twice width; XD-SD of T-1 are two separate groups of setæ with prominent chalazæ .... *Calosaturnia, Caligula*

9. Secondary setæ of D and T-2, T-3 and abdominal segments recurved with tips pointing caudad; width of L scolus on T-1 less than half the width of the segment; XD and SD on T-1 separate .... *Rhodinia fugax*

Secondary setæ of D and SD straight, pointing in various directions; width of L scolus on T-1 more than half the width of the segment; XD and SD on T-1 partly or entirely fused; D1 on A-8 fused on dorsomeson (Fig. 4) .... *Actias*

10. Secondary setæ on prolegs of A-3 to A-6 arranged on both proximal and distal parts of sclerotized plate (Fig. 37) .... *Attacus atlas*

Secondary setæ on prolegs of A-3 to A-6 arranged on distal part of sclerotized plate only (Fig. 36) 11

11. Scoli XD, SD of T-1 and D1 of A-8 fused at base only (Fig.3) .... *Antheræa*

Scoli XD, SD of T-1 separate; D1 on A-8 completely fused on dorsomeson 12

12. SV group on T-1 is a scolus with more than 3 setæ; on head capsule a light-colored area appears on each side of the epicranium; 10-12 crochets on A-3 to A-6 .... *Rothschildia*

SV group on T-1 with at most 3 setæ; no light colored area on epicranium of head capsule (may be light colored elsewhere); 13-19 crochets on A-3 to A-6 13

13. Body appears checkered due to dark areas between pairs of adjacent scoli (Fig. 9) .... *Samia*

Body with transverse bands of color or unicolorous but not checkered .... *Hyalophora*

a. Head and body unicolorous .... Subgenus *Hyalophora*

b. Head capsule bicolored; body with transverse dorsal stripes .... Subgenus *Callosamia*

14. Chalazæ with tiny processes (4-6) at tip which are less than one-tenth the length of primary setæ on the chalazæ (Fig. 42) 15

Chalazæ with longer processes (4-6) at tip which are one-half to one fifth as long as the primary setæ (Fig. 43) 19

15. Scoli on anterior edge of cervical shield (SD and XD) of T-1 and subdorsal scoli (SD) of T-2 and T-3 three-pronged at top with a seta on each prong .... *Pseudohazis*

SD, XD of T-1 and SD of T-2 and T-3 two-pronged bearing two setæ 16

16. SV chalazæ on A-7, A-8, and A-9 subequal in height 17

SV chalazæ on A-7, A-8, and A-9 not all subequal in height 18

17. Eversible glands behind spiracle on A-1 and A-7 conspicuous .... *Dirphia curitiba*

Eversible glands behind spiracle inconspicuous .... *D. baroma, D. epiolina*

18. Four longitudinal series of light colored dashes running from T-2 to A-9 and situated between rows of homologous groups of setæ; the dorsal and subdorsal series more conspicuous than the others; SV seta on A-7 with large chalaza while SV chalazæ on A-8 and A-9 are reduced or wanting .... *Coloradia*

Body without longitudinal light colored stripes; SV chalazæ on A-7 and A-9 of subequal height; A-8 with SV chalaza reduced or wanting (Fig.10) .. *Hemileuca*

19. Chalazæ about one half the dorsoventral diameter of the body; fused chalazæ with only a slight fork below the insertion of the primary setæ; eversible glands inconspicuous .... *Hylesia*

Chalazæ equal to or greater in length than the dorsoventral diameter of the body; fused chalazæ with conspicuous fork below the insertion of primary setæ; eversible glands prominent behind spiracle on A-1 and A-7 .... *Automeris*

20. Elongate chalazæ not swollen at top; D1 on T-1 and D2 on A-1 to A-8 short, thickened and bullet shaped; primitive lateral seta (L2) on T-1 and A-8 usually projects caudad from base of L chalaza (Fig. 13); lateral scolus (L) on T-1 with 1 to 3 secondary setæ; SV chalaza on A-9 prominent (Fig.20) 21

Elongate chalazæ swollen at apex; D1 on T-1 and D2 on A-1 to A-8 longer and bristle-shaped; L2 on T-1 and A-8 usually at top of L chalaza (Fig.12); L on T-1 with no secondary setæ; SV on A-9 relatively inconspicuous (Figs.18 and 19) 22

21. One or two secondary setæ on prolegs of A-3 to A-6; some fusion on lateral plate of proleg on A-10 (Fig. 31) .... *Neocarnegia basirei*

No secondary setæ on prolegs of A-3 to A-6; chalazæ separate on lateral plate of anal proleg (Fig. 30) .... *Eacles imperialis*

22. XD at least as large as the most prominent structures on T-2 and T-3 and moved lateral to a level between D and SD on T-2; SD on T-1 less than one-tenth as large as XD and severely crowded .... *Adeloneivaia apicalis*

XD not as large as the structures on T-2 and at nearly the same level as D on T-2; XD on T-1 may be subequal or several times as long as SD 23

23. Hairlike setæ along the entire length of elongated chalazæ (D, SD on T-2 and T-3, D1 on A-8); primary setæ on fused chalazæ parallel to each other; XD and SD on cervical plate subequal and reduced; thorny processes on D1, SD, and L of A-1 to A-7 only at base of chalazæ (Figs. 12, 18, 45) .... *Syssphinx*

Hairlike setæ lacking on all chalazæ; primary setæ on fused chalazæ widely divergent forming acute or obtuse angle; XD several times as long as SD on T-1; thorns on D1, SD, L of A-1 to A-7 along the whole length of chalazæ (Figs. 19, 44) .... *Citheronia*

Recapitulation of Similarities and Differences

There are two clearly separated groups in the family Saturniidæ. One includes the primarily Old World subfamily Saturniidæ. The first instar larvæ of this group have numerous secondary setæ on wartlike processes (scoli). Each scolus with its secondary setæ is homologous to one, two, or four primary setæ. Secondary setæ also occur on some or all of the prolegs. There are tendencies toward fusion of scoli in the middle of the dorsum of the eighth abdominal segment but never on the ninth abdominal segment where the second dorsal seta (not a scolus) tends to be lost.

The other group includes the New World subfamilies Citheroniinæ, Hemileucinæ, and Rhescyntidinæ. Scoli and secondary setæ rarely occur. Setæ and the chalazæ supporting them on the thoracic segments and abdominal segments eight and nine are often quite different in size and form from those on other segments. The first set of dorsal setæ on the eighth abdominal segment and the second set of dorsal setæ on the ninth abdominal segment are usually fused in the middle of the dorsum on both segments.

The Agliinæ have numerous secondary setæ, but many of the primary setæ can be distinguished from the secondary setæ. The first dorsal setæ are fused on the eighth abdominal segment and may tend toward fusion on the ninth. A unique large chalaza or scolus with many secondary setæ projects caudally from the middle of the tenth or last abdominal segment.

Brahmæa japonica Butler was examined for its relationship to the Saturniidæ. It has numerous scoli and secondary setæ resembling the Saturniinæ. Some scoli on the meso- and metathorax and on abdominal segments eight and ten are greatly extended, whereas they tend to be subequal in the Saturniinæ. There seems to be no compelling reason for including it in the Saturniidæ although one might wonder if larval differences between the Old World and New World subfamilies are greater than the differences between the Saturniinæ and Brahmæidæ.

In the Saturniinæ a few trends are indicated. The subfamily is divided into: a) those genera which have secondary setæ on all prolegs but lack second dorsal seta (D2) on the ninth abdominal segment, and b) those genera which have secondary setæ only on the anal prolegs and may have a separate D2 seta on the ninth abdominal segment. In the first group fall *Hyalophora, Samia, Rothschildia, Antheræa,* and *Attacus.* In the second are *Saturnia, Calosaturnia, Actias, Caligula, Rhodinia,* and *Dictyoploca. Caligula, Calosaturnia, Dictyoploca,* and *Saturnia* have the dorsal scoli on the eighth abdominal segment wholly separate while *Antheræa, Actias,* and *Rhodinia* exhibit progressive fusion of these structures on the dorsomeson. *Antheræa* and *Actias* also tend to have the two scoli on the prothorax (XD and SD) fused. *Saturnia* and *Dictyoploca* have the secondary setæ of XD-SD on the prothorax sprouting directly from the cervical plate. In *Saturnia* these setæ form a more or less ribbonlike band while in *Dictyoploca* they are separated into two clumps. In *Calosaturnia* and *Caligula* these prothoracic setæ are borne on separate well developed chalazæ.

In the New World group of subfamilies, the Hemileucinæ are rather homogeneous. There is a tendency toward lengthening of processes on chalazæ in relation to the primary setæ — *Hemileuca* and *Pseudohazis* with almost none, *Dirphia, Hylesia,* and finally *Automeris* with well developed processes. If the genera are arranged by increasing length of processes on chalazæ, then the order agrees with the order of branching in MICHENER's (1952) phylogenetic tree. Some chalazæ in *Pseudohazis* which should bear only two primary setæ had an extra seta, making a three-pronged structure. This could be dismissed as an aberration except that the structures were symmetrical, and PACKARD (text figs. 10, 11; Figs.5 and 6 on plate 24; 1914) figures three pronged setæ also. Although the eversible glands behind the spiracle on the first and seventh abdominal segments are considered "family characters", there is variation in their prominence. In some species of *Pseudohazis* none were visible. They were conspicuous in *Dirphia curitiba* but inconspicuous in *D. baroma* and *D. epiolina.*

The single available representative of the Rhescyntidinæ has specialized saw-like and finely granulated chalazæ without the cuticular eruptions which characterize many Citheroniinæ. The setæ on the suranal plate were completely separate as in the Hemileucinæ; but there is great difference in length of some thoracic and abdominal chalazæ, as in the Citheroniinæ. PACKARD mentions another species, *Rhescyntis richardsonii* Druce, having enormous armature on the pro- and metathorax.

Within the Citheroniinæ, *Dryocampa* and *Anisota* are quite unique. The armature in general is greatly reduced and the dorsal setæ are separated on the eighth abdominal segment. There seem to be more and greater differences separating these genera from the rest of the Citheroniinæ than there are separating the Citheroniinæ from the Rhescyntidinæ and the Hemileucinæ. The chalazæ on the dorsal half of the three thoracic segments are useful in characterizing genera. On each of these segments there are two pairs of fused and often enlarged chalazæ one more dorsal than the other. Each of the six structures can be indicated as very large (VL), large (L), small (S), or very small (VS) in relation to the others of the same species. In summary crude formulæ may be written which emphasize differences rather than similarities:

	Thoracic Segment		
	Pro-	*Meso-*	*Meta-*
Dryocampa and *Anisota*	VS VS	VL VL	VS VS
Eacles	S S	VL S	VL S
Neocarnegia	L S	L L	L L
Citheronia	L S	VL L	VL L
Syssphinx	VS VL	VL L	VL L
Adeloneivaia	VL VS	VL L	VL L

The order of branching in MICHENER'S phylogentic tree is, from bottom to top, *Eacles* and *Citheronia, Syssphinx, Adeloneivaia, Dryocampa* and *Anisota,* and *Neocarnegia.* Based on larval setæ, *Dryocampa* and *Anisota* are separate from the rest, but whether they represent the loss of many specialized characters or a really primitive type is not certain. At the very least, the larvæ suggest that these two genera belong either at the top or bottom of the Citheroniinæ if not in their own subfamily. *Eacles* and *Neocarnegia* have important similarities in the manner of branching and the shape of setæ. The two genera seem at least as close as *Citheronia* and *Eacles. Syssphinx* is distinct in having hairy chalazæ. *Adeloneivaia* has unique widely spread prothoracic chalazæ. The clue to the position of *Adeloneivaia* and *Syssphinx* probably lies in other species of these or allied genera.

There is a general trend toward fusion of setæ on the last abdominal segment — *Dryocampa* and *Anisota* with none, to *Adeloneivaia, Syssphinx, Citheronia, Eacles,* and *Neocarnegia.*

A complete study of the first instar larvæ of the Saturniidæ may settle phylogenetic relationships precisely. It is usually no more difficult to collect first instar larvæ than it is to collect adult female moths, since oviposition readily takes place in almost any container. Preservation in alcohol or fixative is somewhat simpler than preparing adults, and a complete collection of first instar larvæ of all the Saturniidæ would occupy the space of only three or four museum drawers. In fact, living material of species whose larvae have never been adequately described can be purchased from commercial breeders. The inescapable conclusion is that a taxonomic collection should and easily can include samples of first instar larvæ.

SUMMARY

1. First instar larvæ of the Lepidoptera have certain primary setæ which are found throughout the order. Other setæ which appear in later instars or only in more specialized forms are called secondary setæ. The variation of the setæ and their supporting structures is useful taxonomically and phylogenetically.

2. There is a general tendency toward fusion of the supporting structures (chalazæ) of certain groups of setæ followed by fusion of whole groups particuarly on the dorsum of the thorax and eighth, ninth, and tenth abdominal segments. As a rule, only the supporting structures fuse; the primary setæ remain separate although it is useful to say, for example, "the first dorsal setæ are fused on the dorsomeson."

3. The evolutionary significance of first instar larvæ and the relative effects of selection on adults and larvæ are discussed. A model is given whereby larvæ might diverge faster than adults. Several examples are mentioned where larval recognition characters are better than those of adults.

4. A series of aberrant *Hemileuca* is discussed in relation to the evolution of secondary setæ.

5. A key to the first instar larvæ is presented.

6. The Old World subfamily Saturniinæ and the New World subfamilies Citheroniinæ, Hemileucinæ, Rhescyntidinæ are clearly separated by larval differences. The Agliinæ may be a specialized offshoot of the New World group.

7. Within the Saturniinæ, the genera *Actias, Caligula, Calosaturnia, Dictyoploca, Rhodinia,* and *Saturnia* are separated from the more specialized genera *Attacus, Antheræa, Hyalophora, Rothschildia,* and *Samia.*

8. The Hemileucinæ seem rather homogeneous.

9. Within the Citheroniinæ, *Citheronia, Eacles,* and *Neocarnegia* are related while *Adeloneivaia* and *Syssphinx* are distinct. *Dryocampa* and *Anisota* are very similar. However, the differences which separate these two genera from the rest of the Citheroniinæ seem greater than those which separate the Citheroniinæ from the other New World subfamilies.

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References

Fracker, Stanley B., 1929. The classification of lepidopterous larvæ, revised. *Illinois Biol. Monographs,* vol.2, no.1: 161 pp., 10 pls.

Gerasimov, A. M., 1935. Zur Frage der Homodynamie der Borsten von Schmetterlingsraupen. *Zool. Anz.* 112: 177-194, 8 figs.

Hinton, H. E., 1946. On the homology and nomenclature of the setæ of lepidopterous larvæ, with some notes on the phylogeny of Lepidoptera. *Trans, Royal ent. Soc. London* 97: 1-37.

Lawson, F. R., 1959. The natural enemies of the Hornworms on tobacco (Lepidoptera: Sphingidæ). *Ann. ent. Soc. Amer.* 52: 741-755.

Michener, Charles D., 1952. The Saturniidæ (Lepidoptera) of the Western Hemisphere. *Bull. Amer. Mus. nat. Hist.* 98: 341-400, figs.1-420.

Mosher, Edna, 1914. A classification of the pupæ of the Ceratocampidæ and Hemileucidæ. *Ann. ent. Soc. Amer.* 7: 277-300.

Packard, A. S., 1905. Monograph of the bombycine moths of North America, Part II. *Mem. nat. Acad. Sci.* (Washington) 9: 1-151, 61 pls.

----------, 1914. Monograph of the bombycine moths of North America, Part III. *Mem. nat. Acad. Sci.* 12: pp.ix + 1-276, 503-516, pls.1-113.

Peterson, Alvah, 1948. *Larvæ of insects. Part I. Lepidoptera and Hymenoptera.* 315 pp., 70 pls.

Scudder, S. H., 1889. *Butterflies of the Eastern U. S. and Canada,* vol. 3: pp. 1869-1924, pls. 88, 89.

Schüssler, H., 1933-1936. *Lepidopterorum Catalogus,* vol.10 (partes 55, 56, 58, 65, 70, 75, 76): Saturniidæ 769 pp.; Syssphingidæ 230 pp.

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DATA ON *DECODES*, A NEW NORTH AMERICAN CNEPHASIID GENUS, WITH DESCRIPTIONS OF NEW SPECIES (TORTRICIDÆ)

by N. S. Obraztsov and J. A. Powell

In 1879, Lord Walsingham described a new North American species *Sciaphila basiplagana.* Fernald (1903) transferred it to the genus *Tortrix* Linné, but Meyrick (1912) came back to the point of view of Walsingham, and placed this species in the genus *Cnephasia* Curtis which at that time was treated as synonymous with *Sciaphila* Treitschke. Busck (1919) was the first who noticed the relationship between *basiplagana* and the Palearctic genus *Tortricodes* Guenée, placed it in this genus, and described one more North American species as *Tortricodes fragariana.* McDunnough (1939) treated *basiplagana* again as belonging to *Cnephasia,* but *fragariana* he left in the genus *Tortricodes,* in which, in accordance with Busck (1919), he also placed *horariana* Walsingham as the second North American species.

Later Busck changed his opinion about the systematic position of *basiplagana, fragariana,* and *horariana*, and treated them as members of a separate genus *Decodes,* the description of which he never published. This name of Busck is known only from his labels in the United States National Museum, and hand written or typed notes deposited in this museum. On one place in these notes, "*Decodes* gen. nov." is mentioned as including *fragariana, basiplagana,* and *horariana,* but no diagnosis of this new genus is given. In two drafts of generic keys of the Tortricidæ, based on the male genitalia and dated "May 1922" and "July 1923", a "n. gen." with *fragariana* as the type is mentioned, but not named. The keys dated "May 1929" and "July 1929" include the name "*Decodes* Busck" without any reference to the species. From these keys a comparative, genitalic diagnosis of *Decodes* is seen, but it does not give a complete idea of this genus. In a synoptic table of the Tortricid genera, based on external characters and dated "May 1929", Busck again gave only a comparative diagnosis of *Decodes,* but did not name any species of this genus. As is seen from the above, Busck did not leave any note which might be published post-humously, to secure his authorship of the genus *Decodes,* and it remained merely a manuscript name.

The name *Decodes* represents probably an arbitrary combination of letters, imitating the name *Tortricodes,* and should therefore be treated as being of masculine gender. In describing the genus, the present author does not see any objections to the application of the name *Decodes* to the new genus established below, especially because this name became familiar to the students dealing with the collections of the United States National Museum. He only regrets that there is no chance to attribute its authorship to the late August Busck who should, in fairness, be considered the real author of this name.

In its present conception, the genus *Decodes* includes two of the species named by Busck as its members, and four more new species described below. The species *horariana* should be excluded from *Decodes,* because it shows some characters justifying its generic separation. This problem will be treated by Obraztov in his revision of the Nearctic genera of the Tortricidæ, planned for publication before long.

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DECODES Obraztov, new genus

Type: *Tortricodes fragariana* Busck, 1919.

Sciaphila (in part), Walsingham, 1879, *Illustrations typical specimens Lepidoptera Heterocera* 4: 23. Fernald, 1882, *Trans. Amer. ent. soc.* 10: 17. Grote, 1882, *New check list North American moths:* 58.

Tortrix (in part), Fernald, "1902" [1903], *Bull. U. S. nat. mus.* 52: 484.

Cnephasia (in part), Meyrick, 1912, *in* Wagner, *Lepid. catalogus,* pt. 10: 45; 1913, *in* Wytsman, *Genera insectorum,* fasc. 149: 45. Barnes & McDunnough, 1917, *Check list Lepidoptera Boreal America*: 178. McDunnough, 1939, *Mem. so. California acad. sci.* 2: 58.

Tortricodes, Busck (not Guenée), 1919, *Proc. ent. soc. Washington* 21: 52. Barnes & Busck, 1920, *Contr. nat. hist. Lepid. North America* 4: pl. 32: figs. 3-4. Forbes, "1923" [1924], *Mem. Cornell univ agr. exp. sta.* 68: 488. McDunnough, 1939, *Mem. so. California acad. sci.* 2: 58.

Peronea (in part), Meyrick, 1922, *Entomologist* 55: 255 (by mistake).

Head (fig. 1) with dense, moderately long, somewhat rough or velvet-like scaling. Antenna simple, densely short ciliated, in males sometimes slightly subserrate apicad. Labial palpus ascending with scaling appressed; second joint slightly bent upward, a little dilated apicad; terminal joint rather long, obtuse. Proboscis moderate, well developed. Maxillary palpus rather long. Thorax smooth or with a slight posterior tuft. Abdomen with a moderate anal tuft in male, with a typical "floricomous" tip in female.

Forewing (fig. 2) smooth or with groups of raised scales, broad lancet-shaped; costa more or less arched; apex narrowly rounded; termen oblique, slightly convex; tornus flatly rounded; dorsum gently arched, more rounded basad. Twelve veins, all separate; S almost straight; R_1 from middle of discal cell; R_2 nearer to R_3 than to R_1; R_3 twice as remote from R_4 as R_4 is from R_5; the latter to costa; internal vein of discal cell from between R_1 and R_2, or lacking; M_1 to termen, more or less close to apex; M_2, M_3, and Cu_1 almost equidistant at origin; Cu_1 from lower angle, Cu_2 from behind middle of discal cell, but distinctly before two-thirds; A_1 distinct tornad; basal fork at A_{2+3} a quarter of entire vein.

Hind wing (fig. 2) subtrapezoidal, broader or narrower than forewing; costa gently arched; apex rotundate, sometimes slightly projected; termen below it, straight or concave; tornus broadly rounded; dorsum convex or straight externad, strongly arched basad. Seven veins; S slightly undulate, almost straight; R and M_1 long stalked; M_2 and Cu_1 closely approximated toward lower angle of discal cell; M_3 lacking; Cu_2 from slightly behind three-quarters of discal cell. Cubitus without pecten.

Male genitalia (figs. 3-8). Tegumen moderately broad with more or less oblique shoulders; pedunculi rather long and narrow; saccus complete. Valva elongate, weak, narrowed apicad; length larger than width; costa more or less sclerotized, often strong; sacculus either developed as a rather weak fold, or long with a free point bent downwardly; upper basal angle of valva more or less produced; no pulvinus and processus basales. Uncus slender, tapering, spinulate; gnathos rather long with a spoon-like dilated middle process; socii weak, drooping, dilated, rather large. Fultura superior sclerotized, forming a dilated, shield-like middle plate over ædœagus. Fultura inferior sclerotized, more or less high, subtrapezoidal with two apical points; caulis moderate, joined to or close to cæcum penis; two weak, haired papillæ on diaphragma dorsolaterad from fultura inferior. Ædœagus slender, more or less long bent or elbowed, slightly tapering apicad; cæcum penis elongate; no cornuti.

Female genitalia (figs. 9-14). Papillæ anales floricomous with caudal lobes more or less broad and cephalary parts narrow. Sinus vaginalis wide; lamella antevaginalis narrow, fused with a sclerotized, more or less long antrum; lamella postvaginalis dilated with cephalary angles rotundate. Ductus bursæ moderate or rather short, sometimes slightly sclerotized on certain places; no cestum. Corpus bursæ rotundate or slightly elongate, finely punctate or smooth; signum stellate or ribbon-like, scobinate. Ductus seminalis merging with corpus bursæ caudad, sometimes through its slightly produced caudal part.

Remarks. In the venation of hind wing this new genus approaches the Palearctic genera *Tortricodes* Guenée, *Oxypteron* Staudinger, and *Oporopsamma* Gozmány, but differs from all of them in having the subcostal area of the forewings distinctly broader and all branches of the vein R correspondingly longer. Moreover, in *Decodes,* R_5 of the forewing terminates distinctly at the costa, while in the above Palearctic genera it reaches the termen or at least *(Oporopsamma)* the apex. All of the latter genera have the antenna in the male more or less fasciculate-ciliated, the proboscis greatly reduced, and the maxillary palpus rudimentary or absent. All of them have the socii much narrower, and the middle process of the gnathos is never spoon-like. In addition, *Tortricodes* has no fultura superior, and in *Oxypteron* the gnathos is semimembranous, fused with anal tube. A dilated sterigma is typical of the females of the above Palearctic genera. The venation of hind wings of the Neotropical genus *Rhythmologa* Meyrick is also similar to that of *Decodes,* but in *Rhythmologa* the forewing vein R_5 terminates below the wing apex, and the sterigma of the female is underdeveloped.

The six known species of the genus *Decodes,* according to their male genitalia, might be distributed among two groups. In one of them (*johnstoni, aneuretus,* and *bicolor*) the sacculus is strongly sclerotized and ends in a free tip; in the other group (*montanus, basiplaganus,* and *fragarianus*) it is weak, developed merely as a fold at the lower margin of the valva. For the present time it would seem imprudent to treat these groups as separate subgenera, especially with regard to a similar specific modification of the sacculus in the genus *Cnephasia* Curtis where it cannot be valued as a subgeneric character.

At our present knowledge, the genus *Decodes* is exclusively Nearctic. All of the six known species are recorded in California, but two of them (*basiplaganus* and *fragarianus*) have a wider distribution in North America.

North American *Decodes* Species

Group I

Decodes fragarianus (Busck), new combination

Tortricodes fragariana Busck, 1919, *Proc. ent. soc. Washington* 21: 52 Barnes & Busck, 1920, *Contr. nat. hist. Lepid. North America* 4: pl.32: fig 5. Blackmore, 1920, *Rept. Brit. Columbia prov. mus.* for 1919: 19; 1921, *ibid.* for 1920: 24; Forbes, "1923" [1924], *Mem. Cornell univ. agr. exp. sta.* 68: 488. McDunnough, 1939, *Mem. so. California acad. sci.* 2: 58, no.7456.

Peronea elapsa Meyrick, 1922, *Entomologist* 55: 255 (substitute name, by mistake).

A gray species having the color of the forewings variable from nearly a uniform mouse gray to having a distinct antemedian whitish band preceded by a dark band and followed by an ill-defined dark area, a pale area, and a pale subterminal spot.

Male. – Forewing length 6.3 to 8.0 mm. *Head*: labial palpus, second segment narrow, about six times longer than wide, not expanded apically, about as long as vertical diameter of eye; gray exteriorly, the scales tipped with whitish, white to grayish interiorly; terminal segment less than half the length of second, slightly narrower, dark gray exteriorly, paler interiorly. Antenna gray, annulated paler above, scape whitish below. Head with tufts of dense, prominent, dark gray scales tipped with whitish. *Thorax*: gray above including tegula, mottled indistinctly with paler, brownish white scales; metanotum unscaled except for weak whitish tufts at sides posteriorly; a tuft of elongate brownish gray scales, minutely tipped with white projecting from below base of tegula posteriorly under wings; underside scales large, whitish. Pro- and mesothoracic legs gray exteriorly, each marked with whitish on the coxa, lower margin of femur, median and terminal band on tibia, and terminal bands on tarsal segments, whitish exteriorly; metathoracic legs whitish throughout. *Forewing*: about 2.75 times longer than greatest width, costa curve slightly flattened at about middle; ground color mouse gray, usually with markings indistinct, consisting of a broad, dark fascia in costal half of wing at basal one fifth, bordered internally and externally by more or less distinct black lines, sometimes preceded by some red brown overscaling in basal area, followed by a broad pale fascia bordered outwardly by an incomplete narrow band of upraised black scales which are followed by a few brownish scales; outer half of wing usually showing almost no markings; sometimes an indistinct, irregular row of upraised black scales from near end of cell, curving downwards toward tornus. Cilia gray, tipped with whitish. Underside pale gray, darker along costa; costa whitish at middle, marked in outer half with five indistinct whitish blotches. *Hindwing*: pale silver-gray throughout, cilia margined basally by a row of short, darker scales, underside similar *Abdomen*: shining silver-gray above and below including prominent, dorsal tuft on eighth segment. Genitalia as in fig.3 (drawn from plesiotype, San Francisco, JAP slide No.488, 20 slides examined); fultura superior rounded apically with lateral margins straight; socii small, rounded; shape of valva variable, depending upon mounting technique; ædœagus evenly curved, more strongly so than in *montanus* or *basiplaganus*.

Female. – Length of forewing 6.5 to 8.4 mm. *Head*: essentially as described for male; color, especially of labial palpus tending to be whiter. *Forewing*: more distinctly marked than male; less distinctly marked specimens show some brownish scaling at base, borders of dark fascia indicated by upturned black scales at least in middle of wing, outer border of pale submedian fascia, when the latter is not evident, indicated by central tuft of upraised red-brown scales; specimens vary through successive degrees to a distinctly banded form as follows: basal patch red-brown, dark fascia at one-fifth, distinctly bordered with a black band outwardly and inwardly on costal half of wing, blending with basal patch towards dorsum; broad whitish submedian band across wing, expanding on dorsum, indistinct outwardly, bordered outwardly below cell by a row of upturned black scales; outer half of wing mouse gray with suggestion of a second white postmedian band blending into ground color, most evident on dorsal half, with whitish in the terminal area and along margin towards tornus. Underside as described for male, with more distinct costal spots in heavily marked specimens. *Hindwing*: as in male, darker towards apex; underside as in male. *Abdomen*: dull gray above, paler below; genital tuft gray to brownish, prominent. Genitalia as in fig.9, (drawn from plesiotype, Redwood City, JAP slide No.518, 17 slides examined); plate of antrum very short, broadly emarginate at junction of ductus bursæ; ductus bursæ longer than corpus bursæ, with a sclerotized curvature at about middle, corpus bursæ very weak (frequently broken or lost in dissections) without any signum, with only some minute spicules along the central portion.

Known range: British Columbia; Oregon; California; Utah; Colorado; New Mexico.

Type: HOLOTYPE male (genitalia on slide, prepared by C. HEINRICH on February 25, 1919), Victoria, British Columbia; deposited in the United States National Museum, and examined by the present authors.

Other material examined: BRITISH COLUMBIA: 1♂ (genitalia on slide prepared by A. BUSCK on November 16, 1922), Kaslo (Dyar, 39013); 5♂♂, 8♀♀ (genitalia on slides, prepared by C. HEINRICH on January 29, 1919, by A. BUSCK on October 3, 1925, and April 1929, and JAP slide Nos. 466♂, 493♀), Victoria, September 1, 1903, August 17, 1918, September 14-16, 1920 (E. H. BLACKMORE), August 21 and September 9, 1921, August 30, 1922 (W. R. CARTER), deposited in U. S. National Museum; 1♀ (genitalia on slide no. 105-Obr.), Victoria (A. J. CRAKER), deposited in American Museum of Natural History. OREGON: 1♂ (genitalia on slide, prepared by A. BUSCK on April 8, 1929), "Oregon". CALIFORNIA: 2♂♂ (one has the genitalia on slide no.341-Obr.), Berkeley, June, deposited in American Museum of Natural History and U. S. National Museum; 92♂♂, 78♀♀ from various localities, Sonoma County south to San Diego County, data to be given in detail elsewhere. COLORADO: 1♂ (genitalia on slide no. 1-Obr. 3/9 1960), Glenwood Springs, August 1893. NEW MEXICO: 5♂♂, 2♀♀ (genitalia on slides, prepared by C. HEINRICH on January 29, 1919, and A. BUSCK on September 30, 1919—figured in BARNES & Busck, 1920, *Contr. nat. hist. Lepid. North America* 4: pl.32, fig.5—, January 15, 1923; and January 11 and October 2, 1925; and JAP slide No. 479), Hell Canyon, September 10, 1916 (C. HEINRICH), deposited in U. S. National Museum; 1♂ (genitalia on slide no.344-Obr.), Galisteo, September 4, 1916 (C. HEINRICH), deposited in American Museum of Natural History. UTAH: 4♀♀ (genitalia of two of them on slides, prepared by A. BUSCK on October 10, 1923, and May 9, 1925), Provo, August 20, 1911, October 1-2, 1912 (T. SPALDING), deposited in U. S. National Museum.

Decodes basiplaganus (Walsingham), NEW COMBINATION

Sciaphila basiplagana Walsingham, 1879, *Illustrations typical specimens Lepidoptera Heterocera* 4: 23, pl.65: fig.8. Fernald, 1882, *Trans. Amer. ent. soc.* 10: 17. Grote, 1882, *New check list North American moths*: 58, no.69.

Tortrix basiplagana, Fernald, "1902" [1903], *Bull. U. S. nat. mus.* 52: 484, no. 5412.

Cnephasia basiplagana, Meyrick, 1912, *in* Wagner, *Lepid. catalogus,* pt.10: 45; 1913, *in* Wytsman, *Genera insectorum,* fasc 149: 45. Barnes & McDunnough, 1917, *Check list Lepidoptera Boreal America*: 178, no.7406. McDunnough, 1939, *Mem. so. California acad. sci.* 2: 58, no.7464.

Tortricodes basiplagana, Busck, *Proc. ent. soc. Washington* 21: 52. Barnes & Busck, 1920, *Contr. nat. hist. Lepid. North America* 4: pl.32: fig.4.

A dark and light banded species, superficially indistinguishable from certain distinctly marked individuals of *fragarianus.*

Female. – Forewing length 8.5 to 8.8 mm. Essentially as described for the extreme distinct marked form of *fragarianus. Forewing*: about 2.65 times the greatest width, costa evenly curved. Basal patch brownish; a transverse band at basal one-fifth bending outward at middle, margined with black; submedian band whitish, expanding towards dorsum to a round projection along dorsum, bordered below cell and above dorsal projection by upraised black scales; mouse gray in outer half of wing, interrupted by an incomplete, whitish band on dorsal half at outer third and an ill-defined subterminal whitish band and subapical blotch. *Genitalia*: as in fig.10 (drawn from plesiotype, Petaluma, JAP slide No.470, eight slides examined); plate of antrum well defined, short without emargination; ductus bursæ short, without sclerotized area; corpus bursæ strong, round, with patch-like signum and dense comb-like scobination, most pronounced around signum.

Male. - Length of forewing 8.0 mm. The one dry specimen available for study is damaged, but superficially appears essentially as described for female, although not so distinctly banded, with the pale antemedian area grayish. *Genitalia*: as in fig.4 (drawn from plesiotype, Pleasant Hill, JAP slide No.496, two slides examined); fultura superior short, the basal width of dilated portion shorter than the length; produced slightly apically, the lateral margins showing a slight sigmoid curvature.

Known range: California; Arizona; Texas; Illinois; New York; Pennsylvania; Massachusetts.

Type: HOLOTYPE, male (genitalia on slide no.5356), Bosque Co., Texas, October 12, 1874 (BELFRAGE); deposited in the British Museum, and examined by OBRAZTSOV.

Other material examined: CALIFORNIA: 1 ♀ (JAP slide No.508), Cotati, Sonoma Co. X-7-36; 1 ♀ (JAP Slide No. 470), Petaluma, Sonoma Co. IX-20-39 (E. C. JOHNSTON) deposited in Canadian National Collection; 1 ♂, 3 ♀ ♀ (JAP Slides, Nos.504, 510, 521), Pleasant Hill, Contra Costa Co., IX-(15, 20)-58, X-2-59 (W. E. FERGUSON); 1 ♀ (JAP Slide No.517), Redwood City, San Mateo Co., X-13-59 (P. H. ARNAUD, JR.) deposited in California Academy of Sciences. ARIZONA: 2 ♂ ♂, 1 ♀ (genitalia on slides, prepared by A. BUSCK on September 21, 1925, and April 20, 1929; slide no. 3-Obr. 2/25 1960), Prescott, October 1-7; 2 ♂ ♂, 1 ♀ (genitalia on slides, prepared by A. BUSCK on September 1, 5, and 22, 1925), Mohave Co., September 8-15, and October 16-23; 1 ♂, 6 ♀ ♀ (genitalia of 1 ♀ on slide no.1-Obr. 2/25 1960), Paradise, Cochise Co., August 24-31, and September 8-30; 1 ♂ (genitalia on slide no.2-Obr. 2/25 1960), South Arizona. TEXAS: 1 ♀ (genitalia on slide no.4-Obr. 2/25 1960), Kerrville, October 1908. ILLINOIS: 1 ♀ (genitalia on slide, prepared by A. BUSCK on December 5, 1938), Putnam Co., September 22, 1937 (M. O. GLENN). NEW YORK: 2 ♂ ♂, 2 ♀ ♀ (genitalia on slides, prepared by A. BUSCK on September 20 and 21, and October 1, 1925), Ithaca, September 9-26, 1924 (Cornell University Expedition); 2♂♂, 2♀♀ Six Mile Creek, Ithaca, August 29 and September 9, 1923 (J. G. FRANCLEMONT), all of the above specimens deposited in U. S. National Museum; 7♂♂, 19♀♀ (genitalia of 1♂ and 1♀ on slides nos.343-Obr. and 104-Obr., correspondingly), Pelham, Westchester Co., September 2 and 24, and October 2, 1954 (A. B. KLOTS), deposited in American Museum of Natural History. PENNSYLVANIA: 1♂ (genitalia on slide, prepared by A. BUSCK on September 30, 1919; figured in Barnes & Busck, 1920, *Contr. nat. hist. Lepid. North America* 4: pl.32, fig.4), New Brighton, September 23, 1905 (H. D. MERRICK). MASSACHUSETTS: 1♂ (genitalia on slide, prepared by A. BUSCK on April 18, 1929), Cohasset, September 28, 1907 (O. BRYAN); these specimens deposited in U. S. National Museum.

DECODES MONTANUS Powell, NEW SPECIES

Superficially resembling *fragarianus* but with a strongly contrasting, well defined basal patch; usually the remainder of the markings diffuse and pale. Female with a conspicuous band of dark scales on the seventh abdominal sternite.

Male. — Length of forewing 8.7 mm. *Head*: labial palpus, second segment nearly clyindrical slightly expanded distally, three times longer than maximum width, slightly longer than vertical eye diameter; gray exteriorly, the scales tipped with white, less broadly so distally, whitish interiorly with a few brownish scales apically; terminal segment about half the length of second, brownish, the scales tipped with white, more broadly so interiorly. Head tufts prominent, not appressed, the scales whitish below, dark brown on outer half, tipped with white deeply notched; loose tuft of whitish scales under eye. Antenna brown, annulated paler; scape white below. *Thorax*: tegula dark brown at base, lighter brown distally, apical scales broadly tipped with white. Thorax above banded as follows: dark at base, followed posteriorly by a pale brownish white band and a narrow dark brown band; posterior half of mesonotum light brown, the scales tipped with white, less broadly so posteriorly; metanotum unscaled except for thin white hair brush on each side posteriorly. Thorax below white; pro- and mesothoracic legs brown exteriorly, marked with white as follows: coxæ irregularly speckled, femora below, tibiæ banded above at middle, tarsal segments apically banded; whitish interiorly (described from paratopotype; holotype lacks both mesothoracic and one metathoracic legs). Metathoracic leg whitish tibia and tarsus faintly tinged with brown exteriorly. *Forewing*: length about 2.8 times greatest width; costa evenly curved, slightly bowed at base. Upperside with basic arrangement of markings as in *fragarianus*. Basal area tan, blending to darker brown on dorsum. Transverse band at basal one-fifth dark chocolate brown, well defined by marginal darker lines, blending dorsally with darker part of basal area: remainder of wing essentially brownish white; outer margin of antemedian white band indicated by a short row of dark scales above the fold; costal area beyond narrow costal portion of antemedian band brownish, slightly darker than remainder of wing, the shading extending towards dorsum in a blunt spur outside the median row of dark scales; costa with about eight short, obscure, dark, oblique dashes in shaded area; a vertical, well defined dark line in terminal area; dorsal margin with about six irregular, dark spurs between basal band and terminal line. Fringe long, pale brownish, scales white tipped, extending conspicuously above apex. Underside pale brownish, lighter towards dorsum, costa with ill-defined but contrasting whitish area along middle third. *Hindwing*: shining whitish, pale brownish towards apex; fringe with basal pale brown band; underside similar. *Abdomen*: holotype abdomen treated in caustic solution and placed on slide; genitalia as in fig.5 (drawn from paratype, Donner Summit, JAP slide No.460, three specimens examined); socii large; arms of gnathos bowed at middle, short; fultura superior elongate, produced and narrowed apically; valva with membranous projection at end of sacculus, costal margin strongly bowed; ædœagus only slightly curved, longer than in *basiplaganus*.

Female. — Length of forewing 9.1 mm. Essentially as described for male. Labial palpus more extensively marked with white. Thorax above rubbed on allotype but appears to be darker and less conspicuously banded than in male. Allotype lacks one meso- and one metathoracic leg. *Forewing*: more contrastingly marked than in male. Basal band darker, well defined with some brown scales in middle; antemedian band well defined, pale gray, margined outwardly by nearly complete row of dark scales; costal area and spur above dorsal expansion of antemedian band darker gray, well defined. Subterminal line not so well defined as in male. *Abdomen*: tan or pale brown (although this may be due to artificial discoloring); underside of seventh segment with a conspicuous posterior margin of large purple-black scales which expands laterally into huge tufts (these are very noticeable on the whole specimen). Genitalia as in fig. 11 (drawn from paratype, Donner Summit, JFGC slide No.4385: four slides examined); plate of antrum more elongate than in *basiplaganus*, longer than its median width, tapering at junction with ductus bursæ, not emarginate; ductus bursæ short; corpus bursæ strong, round with a stellate, patch-like signum and tiny comb-like scobination most pronounced around signum.

The specimens from Donner Summit are larger (length of forewing 9.8-9.9 mm.) and apparently have the markings paler and less well defined, although both are somewhat rubbed. However, the genitalia of both sexes match the remainder of the widely distributed type series, and the dark scale band of the seventh abdominal sternite on the female is quite distinctive.

HOLOTYPE male, Mt. Lowe, Los Angeles Co., California, Sept. 18, 1925 (E. Piazza) deposited in California Academy of Sciences. ALLOTYPE female, Mt. Shasta, Siskiyou Co., Calif., Aug. 19, 1939 (E. C. Johnston) deposited in Canadian National Collection. Six PARATYPES, all California: 1♂, 1♀ Donner Summit, Nevada Co., VIII-7-35 (E. C. Johnston); 1♀ Mill Valley, Marin Co., IX-9-48 (H. B. Leech); 2♂♂ Mt. Hermon, Santa Cruz Co., IX-(5-8)-31 (H. H. Keifer); 1♂ with same data as holotype (abdomen lost), deposited in collections of American Museum of Natural History, Canadian National Collection, California State Department of Agriculture, U. S. National Museum, and author. Three additional female specimens examined in alcohol: 2♀♀ Soquel, Santa Cruz Co., IX-24-43; 1♀ Calimesa, Riverside Co., IX-14-43, not designated as paratypes, in California Department of Agriculture collection.

Additional material examined by Obraztsov: 2♂♂ (genitalia on slides, prepared by A. Busck on January 12 and 14, 1925), San Diego, California, October 6, 1919 (K. R. Coolidge); 4♂♂, Mt. Hermon, Santa Cruz Co., California, September 5-8, 1931 (H, H. Keifer) all deposited in U. S. National Museum.

Group II

DECODES JOHNSTONI Powell, new species

A gray species with elongate, narrow forewings which are quite variable in color, ranging from uniform pale gray through a darker form with basal third of wing inside oblique line and terminal area flushed with white to a distinctly marked form having a crescent-shaped black spot in the basal white area and the dividing line and outwardly adjoining area black.

Male. – Length of forewing 10.2 mm. *Head*: labial palpus narrow, second segment slightly longer than vertical eye diameter, narrow at base, expanding gradually to apex, length about 3.5 times greater than apical width, gray exteriorly, the scales dark, tipped with white, whitish interiorly; terminal segment slightly longer than half the length of second, rounded at apex, dark gray exteriorly, the scales only narrowly margined with white, lighter interiorly. Antenna gray, segments obscurely annulate with whitish basally; underside of scape white. Head with tufts prominent, compact, dark gray, the scales only shallowly notched in the narrow whitish apical band. *Thorax*: tegula and mesonotum dark gray, not banded; metanotum unscaled, with small lateral tufts. Underside whitish. Pro- and mesothoracic legs dark gray exteriorly, the tarsal segments with narrow white apical bands; whitish interiorly; metathoracic leg whitish, suffused with grayish exteriorly, tibial spurs and tarsal segments except apical bands, gray. (The holotype lacks the meso- and metathoracic legs on one side.) *Forewing*: costa evenly but only slightly curved from base to apex; apex rounded acute, termen very oblique; length about three times greatest width. Gray, basal area whitish, its outer margin indicated by an obscure line from inside basal one-third of costa towards anal angle, notched inwardly just above fold and disappearing below fold; terminal area outside cell diffused by whitish blending into darker gray of outer costal area towards apex. Fringe short, whitish with a basal row of short gray scales. Underside uniform gray; costa indistinctly marked with several whitish spots on outer half. *Hindwing*: grayish, paler basally. Fringe whitish with a basal row of short brownish scales from before apex to first anal vein. Underside paler. *Abdomen*: gray, darker below; tufts of eighth segment conspicuous, silvery, shaded with purplish below. Genitalia as in fig.6 (drawn from paratype, Alpine Lake, JAP slide No.369; three slides examined); socii small; costal margin of valva heavily sclerotized, produced apically into expanded portion; sacculus heavily sclerotized, free end longer than in other known *Decodes*.

Female. - Length of forewing 9.8 mm. Essentially as described for male but more heavily marked with white. Head, labial palpus, antenna, thorax paler. *Forewing*: more distinctly marked due to the heavy white overscaling. Basal one-third whitish, more distinctly so costally and outwardly; outer margin of whitish area, a line from inside basal one third of costa obliquely outward, broadly notched inward above fold and just above dorsum, ending a little before anal angle; area outside this dark gray, shading gradually to whitish in terminal area; indication of two vertical black lines in terminal area. Underside, hindwing and abdomen as in male. Genitalia as in fig. 13 (drawn from paratopotype, JAP slide No.485, three slides examined); plate of antrum small but heavily sclerotized, joining ductus bursæ without emargination; ductus bursæ with light sclerotized curvature just before corpus bursæ; signum ribbon-like, weakly formed to base of ductus seminalis, not expanding towards center of bursa.

HOLOTYPE male and ALLOTYPE female, Mt. St. Helena, Napa Co., California, March 7, 1940 and March 24, 1939, respectively, (E. C. JOHNSTON), deposited in Canadian National Collection. Fourteen PARATYPES, all California, as follows: 1♂, The Geysers, Sonoma Co., III-19-39 (E. C. JOHNSTON); 1♀ same data as holotype, 1♀ same data except III-26-46; 1♂, Spring Mt., Napa Co., III-25-46 (E. C. JOHNSTON), 1♀ same data except IV-2-40; 5♀♀ Mill Valley, Marin Co., III-12-20 (E. P. VAN DUZEE); 1♂, Alpine Lake, Marin Co., III-30-56 (J. POWELL), 1♀ same locality, IV-1-59 (J. M. BURNS); 1♀ Mt. Tamalpais, Marin Co., IV-3-07 (F. X. WILLIAMS); 1♂ San Francisco, "V" (F. X. WILLIAMS), deposited in American Museum, California Insect Survey, California Academy of Sciences, Canadian National Collection, U. S. National Museum, and author's collection.

Length of forewing of paratypes, 9.2 to 11.0 mm. The variation in color of the forewings is remarkable. A less distinctly marked form exists (♂, ♀ Marin Co.) in which the wing is uniform whitish gray with a few scattered small groups of black scales in areas of black on the marked varieties. The variation is gradual, and more distinctly marked forms than in the above description have the basal white area interrupted by a black crescent spot, which varies in development, and a blackish suffusion outward from the margin of the light basal area. In extreme forms the crescent spot is shaped like the neck of a swan, which begins at the base of the dorsal margin, the head of which is in the middle of the basal area with the beak extending outward on the fold.

The species is dedicated to the late EDWARD C. JOHNSTON, formerly of Petaluma, California, who, in building probably the largest collection of California Microlepidoptera ever assembled, provided many valuable records for the present study, including nearly half of the known specimens of the endemic California *Decodes* species.

DECODES ANEURETUS Powell, NEW SPECIES

A dark gray species having the forewing marked only by an indistinct, oblique, pale grayish antemedian band and an indication of pale banding in the terminal area, the pale areas margined by dark, upraised scales.

Female. - Length of forewing 10.2 mm. *Head*: labial palpus cylindrical, narrow; second segment about one-fifth longer than vertical diameter, about four times longer than wide, very little expanded apically, dark gray above and exteriorly towards apex, the scales only narrowly tipped with white, blending to whitish basally exteriorly and below, white interiorly; terminal segment about one-half the length of second, rounded apically, dark gray, interior whitish basally. Antenna gray, scape and first twelve segments below white. Head with tufts of prominent, dense, dark gray scales which are only minutely tipped with whitish. *Thorax*: tegula and mesonotum dark gray showing no color pattern, metanotum unscaled, lateral posterior tufts short, dense; ventral side of thorax whitish. Pro- and mesothoracic legs gray exteriorly with indication of whitish at tibial and tarsal segment apices, whitish interiorly; metathoracic leg whitish, tibia and tarsal segments obscurely mottled with pale brown exteriorly, spurs brown below. *Forewing*: costa nearly straight for about basal third, sharply curved there, then nearly straight to apex. Length about three times greatest width. Dark gray, only indistinctly marked. Three antemedian, incomplete transverse lines of upraised, dark scales: first at basal one-sixth of costa, angling outward, bending inward in cell, disappearing below fold; second parallel, obscure at costa, more distinct in cell, bending slightly at fold, disappearing below fold; third at bend in costa, the most distinct of the three, angling outward towards dorsum just before anal angle, disappearing below cell. Area inside first line pale grayish; between first and second darker, blending into pale of base at dorsum; area between second and third lines whitish, forming an oblique pale band, the most distinct marking on the wing. Ground color uninterrupted between third line and end of cell; apical area paler, gray to whitish, marked by three parallel, outward curving lines of dark scales in middle. Area between the first two lines slightly darker. Fringe long, pale gray, scales with subterminal darker bands, the rows forming three more or less distinct bands. Underside gray; base of cell with a patch of upraised white scales; outer half of costa indistinct but broadly marked with whitish, surrounding three rather distinct gray subcrescentic spots bordering costa; submarginal area and fringe mottled whitish. *Hindwing*: whitish basally, brownish marginally, darkest at apex; veins brown towards margin. Fringe white with a basal brown band around apex disappearing before anal area. Underside similar, costa and veins brownish throughout. *Abdomen*: the abdomen of the unique female has been treated in caustic solution and is on a slide. No unusual external features were noted. Genitalia as in fig.12 (drawn from allotype, JAP slide No.481; one specimen examined); plate of antrum weakly sclerotized, narrowly emarginate at junction of ductus bursæ; ductus sclerotized and folded just before corpus bursæ; signum gradually becoming broader towards center of corpus bursæ.

Male. - Length of forewing about 9.9 mm. Essentially as described for female. The unique male appears to be an older, somewhat more worn specimen, and the markings are only faintly indicated. *Forewing*: almost unicolorous gray, with an indication of the broad submedian pale band; white markings on underside of costa restricted to four rather distinct, oblique dashes. *Abdomen*: on slide, genitalia as in fig. 7 (drawn from holotype, JAP slide No.463, one specimen examined); socii moderately long, reaching over half the length of the short gnathos; costal margin of valva weakly sclerotized but with an expanded base and definite apex; sacculus heavily sclerotized, free end narrow, short.

HOLOTYPE male and ALLOTYPE female, Carmel, Monterey Co., California, April ("IV") (A. H. VACHELL), deposited in American Museum of Natural History.

The types, which were recently discovered among unworked Kearfott Collection material at the American Museum, have at some time in the past become moldy, and the appendages are somewhat obscured by dry fungal parts which remain despite an attempted cleaning.

DECODES BICOLOR Powell, NEW SPECIES

A large species having the costal half of the forewing white, the dorsal half dark gray.

Female. - Length of forewing 11.9 mm. *Head*: labial palpus cylindrical, the segments not expanded apically; second segment about as long as vertical eye diameter, four times longer than wide; gray exteriorly, the scales tipped with white, less broadly so apically on the segment; basally white interiorly; terminal segment about one-half the length of second; gray with scattered whitish interiorly. Antenna gray, annulated paler, basal ten or twelve segments white anteriorly and below. Head tufts conspicuous, loose, dark brown, the scales moderately notched at tips, very contrastingly and distinctly tipped with white. *Thorax*: tegula whitish; mesonotum pale gray (probably showing two paler transverse bands, but specimens available mostly rubbed); metanotum unscaled except having rather dense, flat, lateral, white tufts. Ventral side of thorax pale brownish-white. Pro- and mesothoracic legs nearly uniform gray-brown exteriorly, showing only faint banding on tarsal segment apices; paler interiorly. Metathoracic leg whitish, coxa exteriorly, tibial spurs, and last four tarsal segments brown. *Forewing*: three times longer than greatest width; costa evenly bowed in basal half, less so apically; apex acute. Color pattern divided by a longitudinal line beginning just below fold at base crossing fold in an oblique line near base to near costal margin of cell at basal one-fifth of wing, angling downward slightly through middle of cell, turned upward just basad of end of cell to costal margin of cell, then straight to apex of wing. Area above this line white, more completely so adjacent to line end basally; outer half of costa and apex blending to dark grayish. Area immediately below the line dark brown, darkest in cell, shading gradually to lighter gray-brown along dorsal margin, palest at tornus. Fringe short, pale brownish white. Underside uniform brown, an elongate pale spot at base in middle. *Hindwing*: brownish white, paler basally; fringe long, white, with a brown band on base around apex of wing. Underside similar, the veins brown. *Abdomen*: shining brownish white, darker below. Genitalia as in fig.14 (drawn from paratopotype, JFGC slide No. 4375, two slides examined); plate of antrum large, heavily sclerotized; ductus bursæ without sclerotized band; signum ribbon-like, not extending beyond base of ductus seminalis.

Male. - Length of forewing about 11.6 mm. External characteristics as described for female. (Only two males available for study, both badly damaged.) Head and thorax (mostly lacking scales) apparently not differing from female. *Wings*: (one pair of wings of allotype removed and bleached for study of venation; JFGC slide No.4374) marked as female. *Genitalia*: as in fig.8 (drawn from paratype. Mill Valley, JAP slide No.477; two slides examined); socii long, reaching to apex of short gnathos; costal margin of valva and the sacculus heavily sclerotized; tip of sacculus free, flared, rounded.

HOLOTYPE female and ALLOTYPE male, Mt. St. Helena, Napa County, California, April 18, 1939 (E. C. JOHNSTON) deposited in U. S. National Museum. Fifteen PARATYPES, all California, as follows: 1 ♀ same data as holotype; 1 ♀ McCloud, Siskiyou County, VI-5-35 (E. C. JOHNSTON); 1 ♀ Foresthill, Placer Co., VIII-31-37 (W. R. BAUER); 1 ♀ The Geysers, Sonoma Co., V-9-39 (W. R. BAUER); 1 ♀ same locality, IV-28-40 (E. C. JOHNSTON); 1 ♀ Pope Creek, Napa Co., IV-6-57, at light (J. POWELL); 1 ♀ Mill Valley, Marin Co., V-3-24 (E. P. VAN DUZEE); 1 ♀ same locality, III-17-26; 2 ♀ ♀ same locality, IV-19-50 (H. B. LEECH); 1 ♀ same locality, IV-29-58, light trap; 1 ♀ Descanso, San Diego Co., "1914" (W. S. WRIGHT); 4 ♀ ♀ Pine Valley, San Diego Co., IV-17-50 (E. C. JOHNSTON), deposited in collections of American Museum of Natural History, British Museum, Canadian National Collection, California Insect Survey, California Academy of Sciences, San Diego Museum of Natural History, U. S. National Museum, and author.

Forewing length range of paratypes, 10.1 to 11.6 mm. All of the paratypes from the northern part of the range match the holotype description well. The San Diego County specimens show considerable variation in replacement of the costal white by gray, especially apically. One specimen is nearly entirely gray, showing the characteristic contrasting white and dark above and below the line only in the cell.

ACKNOWLEDGEMENT

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Literature Cited

Busck, A, 1919. Two microlepidoptera injurious to strawberry. *Proc. ent. soc. Washington* 21: 52-53.

Fernald, C. H., 1903. Tortricidæ. *in*: Dyar, A List of North American Lepidoptera. *Bull. U. S. nat. mus.* 52: 448-489.

McDunnough, J., 1939. Checklist of the Lepidoptera of Canada and the United States of America. Part II, Microlepidoptera. *Mem. so. California acad. sci.* 2: 1-171.

Meyrick, E., 1912. Tortricidæ. *in*: Wagner, *Lepid. catalogus,* Pars 10: 1-86.

Walsingham, Lord Thos. de Grey, 1879. North American Tortricidæ. *Ill. typical spec. Lep. Het., British mus.* 4. xi + 84 pp., 17 pls.

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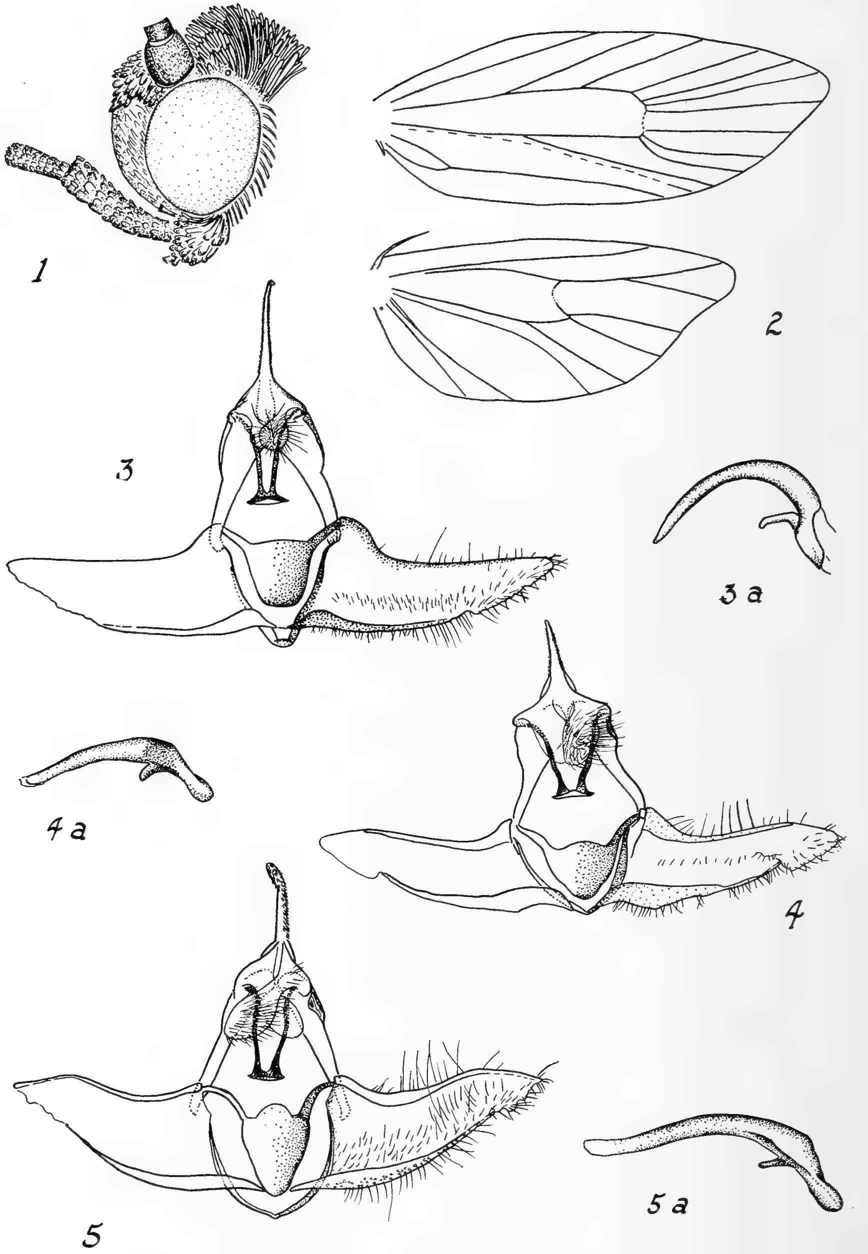
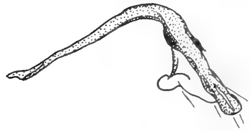


Fig.1. *Decodes,* head, lateral aspect: fig.2. *Decodes,* wing venation; figs.3-5, male genitalia of *Decodes* spp., ventral aspect, spread, ædœagus and fultura inferior removed, *a* = ædœagus, lateral aspect: fig.3. *D. fragarianus* (Busck); fig.4. *D. basiplaganus* (Walsingham); fig.5. *D. montanus* Powell.



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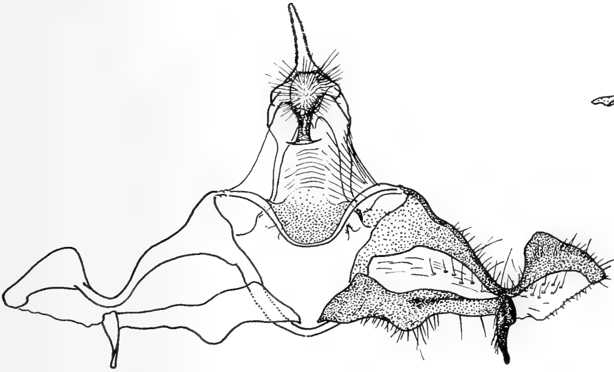

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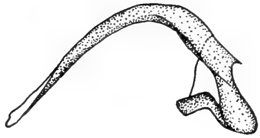

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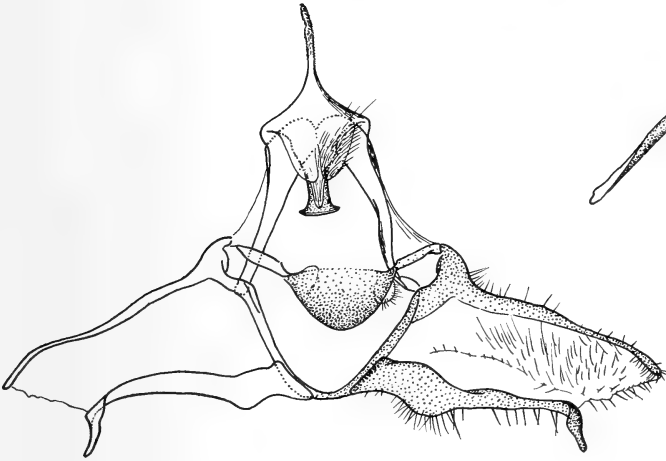

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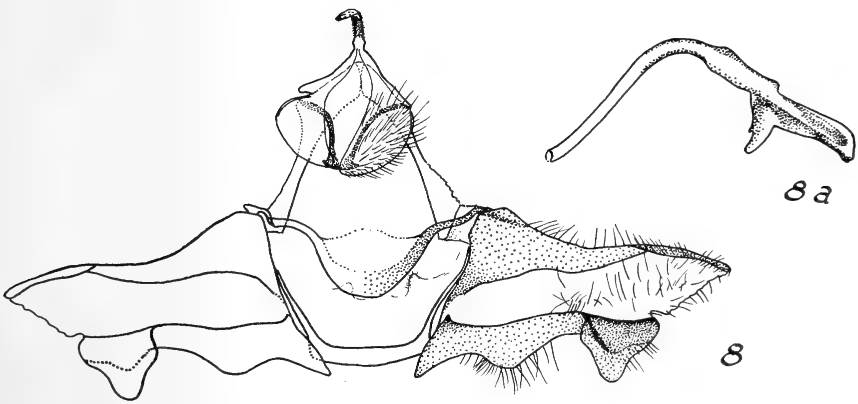

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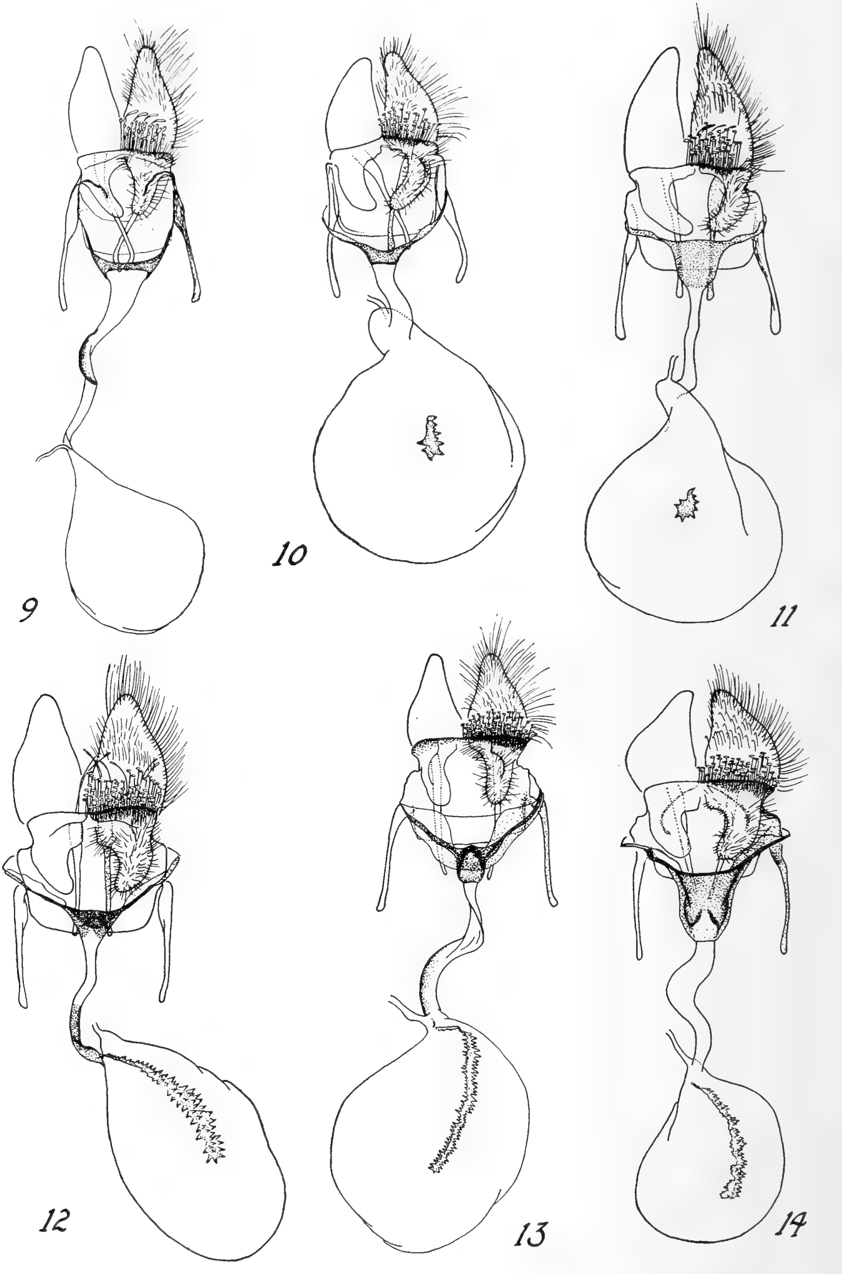
Male genitalia of *Decodes* spp., ventral aspect, spread, ædœagus and fultura inferior removed, *a* = ædœagus, lateral aspect: fig.6. *D. johnstoni* Powell; fig.7. *D. aneuretus* Powell; fig.8. *D. bicolor* Powell.



Female genitalia of *Decodes* spp., ventral aspect: fig.9. *D. fragarianus* (Busck); fig.10. *D. basiplaganus* (Walsingham); fig.11. *D. montanus* Powell; fig.12. *D. aneuretus* Powell; fig.13. *D. johnstoni* Powell; fig.14. *D. bicolor* Powell.

STUDIES OF THE CHROMOSOMES OF NORTH AMERICAN RHOPALOCERA. 3. LYCÆNIDÆ, DANAINÆ, SATYRINÆ, MORPHINÆ

by KODO MAEKI and CHARLES L. REMINGTON

This paper is a continuation of our first two, which gave the sources of most of our material, our techniques, and an account of the chromosomes of Papilionidæ, Pieridæ, Hesperiidæ, and Megathymidæ (Maeki & Remington, 1960a, 1960b). The subject of the fourth, concluding, paper of this series will be the remaining groups of the family Nymphalidæ. In general, EHRLICH's reclassification (1958a, 1958b) of the Rhopalocera is accepted, and we follow him in placing the Riodinids in the Lycænidæ and the Danaids, Satyrids, and Morphids as subfamilies of the huge family Nymphalidæ. The inclusion of the Lycænidæ in the present paper is not meant to suggest close phylogenetic affinity with the other groups but is merely for convenience in fitting the size requirements of this *Journal*. Similarly, the Pieridæ were paired with the Hesperioidea in our preceding paper only for convenience.

Most of the specimens for which the chromosomes are reported here were taken in 1959. We now are processing many additional species from North America, for which counts will be published in a supplementary paper, and there are 4 Danainæ and 1 Satyrinæ in our forthcoming report on S. A. Hessel's 1960 African material.

As before, the numbers in square brackets are the designations of individuals studied and can be found on the specimens and slides preserved for permanent reference in the Peabody Museum of Yale University. In the following lists "*n*" represents the haploid chromosome number, "I" refers to the primary spermatocyte division and "II" to the secondary spermatocyte division. No female meiosis was investigated in these groups.

Fixed testes of several species not listed below were sectioned and examined but did not show any meiotic divisions. For some of these species we have studied enough testes to conclude that divisions are rare or absent after eclosion of the imago (or barely possibly that divisions are limited to a brief time of day when we would not normally be dissecting and fixing material, such as 5:00 a.m.). The numbers of specimens of these species are as follows: several *Incisalia augustinus* (Westwood), *I. polios* Cook & Watson, and *I. irus* (Godart) from Connecticut and New Jersey, 6 Florida *Satyrium favonius* (J. E. Smith), 7 Colorado *Œneis chryxus* Doubleday, 4 Colorado *Erebia callias* Edwards, 3 Colorado *E. epipsodea* Butler, 11 Florida *Euptychia hermes* (Fabricius), and 3 Florida *E. areolata* (J. E. Smith). Fewer testes were examined but all gave negative results for the following: 1 Colorado *Plebejus sæpiolus* (Boisduval), 1 Colorado *Chrysophanus titus* (Fabricius), 2 New Mexico *Sandia macfarlandi* Ehrlich & Clench, 1 Colorado *Œneis uhleri* Reakirt, 1 Colorado *Cœnonympha ochracea* Edwards.

A. LYCÆNIDÆ:

1. *Calephelis virginiensis* (Guérin). $N = 45$. Counts were made in 3 nuclei (I) and 4 nuclei (II) in testes of one male [F81] taken in the Corkscrew Swamp, near Immokalee, Collier Co., Florida, 19 April 1960, *leg.* K. Maeki. There are 9 chromosomes distinctly larger than the remainder. This is the first Riodinid species to be studied cytologically.

2. *Lycæna helloides* (Boisduval). $N = 24$. Counts were made in 28 nuclei (I) and 18 nuclei (II) in testes of one male [63] taken at Gothic, el. 9500′, Gunnison Co., Colorado, 20 July 1959. About 7 chromosomes are large, about 12 are medium, and about 5 are smaller in size. There is some uncertainty about the placement of this Colorado form in *L. helloides* or *L. dorcas* (Kirby) (see Clench, 1958: p.59).

3. *Lycæna nivalis* (Boisduval). $N = 24$. Counts were made in 106 nuclei (I) and 68 nuclei (II) in testes of 11 males [9, 29-1, 29-2, 29-3, 34-1, 34-2, 34-3, 34-5, 99, 101, 102] all taken at Gothic in July 1959. Six other males showed no meiotic metaphases. The size relations of the chromosomes are similar or identical to those of *L. helloides.* One anomalous metaphase plate at the second division in male No. 99 shows 25 elements, instead of 24; the other nuclei have 24 elements in this individual. There is a possibility that this male is a hybrid.

4. *Lycæna snowi* (Edwards). $N = 24$. Counts were made in 12 nuclei (I) in the testes of one male [183] taken at Copper Lake, el. 11,000′, Gunnison Co., Colorado, 1 Aug. 1959. No suitable secondary spermatocyte divisions were found. As with *L. helloides,* there are 7 large chromosomes. Probably *L. snowi* is a race of *L. cupreus* (Edwards), but for the present we list it as distinct.

5. *Lycæna hypophleas* (Boisduval). $N = 24$. Counts were made in 31 nuclei (I) and 28 nuclei (II) in the testes of 3 males [331, 333, 381] taken in New Haven, Connecticut, September 1959. Two chromosomes are distinctly smaller than the remainder; the others are uniform in size and are rather large. We classify *hypophleas* as a full species until its genetic relations with Palearctic forms are better known.

6. *Lycæna rubidus* (Edwards). $N = 38$. Counts were made in 87 nuclei (I) and 52 nuclei (II) in testes of 5 males [175, 190-1, 190-2, 190-3, 190-4] taken at Gothic, 31 July and 2 Aug. 1959. There are 6 or 7 large and 5 or 6 small chromosomes.

7. *Lycæna heteronea* (Boisduval). $N = 68$. Counts were made in 106 nuclei (1) and 93 nuclei (II) in the testes of 9 males [64-1, 64-3, 64-4, 64-5, 77-1, 77-2, 77-3, 71-1, 92-1] taken at Gothic on 20 and 22 July 1959. Two chromosomes are very large, 5 or 6 medium, and the others small.

8. *Icaricia icarioides* (Boisduval). $N = 24$. Counts were made in 23 nuclei (I) in testes of one male [106-2] taken at Gothic, 23 July 1959. There are 7 large, 13 medium, and 4 small chromosomes. Two other males showed no countable nuclei.

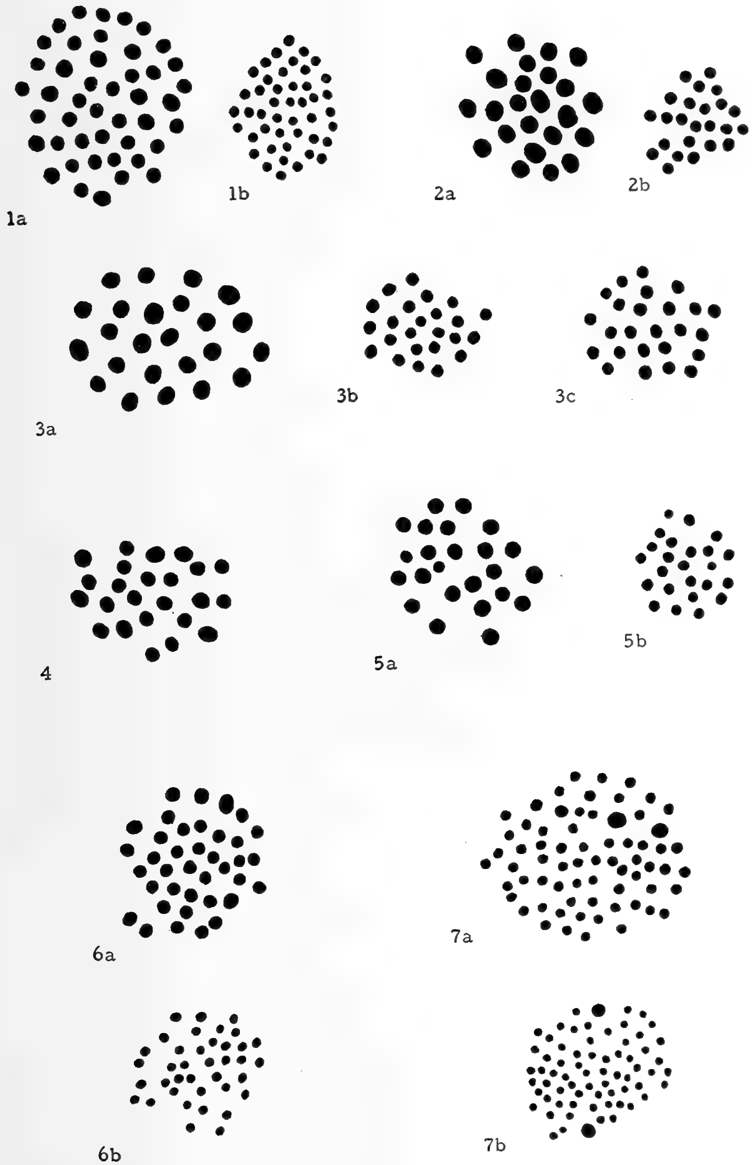


Fig. 1a — *Calephelis virginiensis* (I) ; fig. 1b — same (II) ; fig. 2a — *Lycæna helloides* (I) ; fig. 2b — same (II) ; fig. 3a — *L. nivalis* (I) ; fig. 3b — same (II; $n = 24$) ; fig. 3c — same (II; $n = 25$) ; fig. 4 — *L. snowi* (I); fig. 5a — *L. hypophleas* (I) ; fig. 5b — same (II) ; fig. 6a — *L. rubidus* (I) ; fig. 6b — same (II); fig. 7a — *L. heteronea* (I) ; fig. 7b — same (II).

9. *Lycæides melissa* (Edwards). $N = 24$. Counts were made in 18 nuclei (I) in testes of one male [114] taken at Gothic, 24 July 1959. No suitable metaphase nuclei in the secondary division were found. The size relations of the chromosomes appear to be exactly like those of *I. icarioides* and *A. glandon.*

10. *Agriades glandon* (de Prunner). $N = 24$. Counts were made in 13 nuclei (II) in testes of one male [93] taken at Gothic, 22 July 1959. No countable nuclei in the primary division were found. A second male showed no meiotic divisions. This is *rusticus* (Edwards), presumed to be a race of the holarctic *A. glandon.*

11. *Everes amyntula* (Boisduval). $N = 24$. Counts were made in 26 nuclei (I) and 17 nuclei (II) in testes of 2 males [109, 110] taken at Gothic, 23 July 1959. There are 5 chromosomes distinctly larger than the other 19; the latter are rather uniform in size. A third male showed no meiotic divisions.

12. *Everes comyntas* (Godart). $N = 24$. Counts were made in 11 nuclei (II) in testes of 2 males taken in New Haven, Connecticut, 3 Sept. [319-2] and 19 Sept. [395] 1959. No suitable primary divisions were found. No countable nuclei were found in testes of 4 other males taken with No. 319-2. There appear to be 4 large, 18 medium, and 2 small chromosomes, and this seems to be a significant distance from the 5-19-0 size relations of *E. amyntula.* The species distinctness of these two *Everes* has been questioned by several authors (*e.g.,* Clench, 1958: pp. 59-60).

13. *Eumæus debora* (Hübner). $N = 24$. Counts were made in 66 nuclei (I) and 22 nuclei (II) in the testes of one male [M16] taken at Ciudad Victoria, Tamaulipas, Mexico, 1 Aug. 1959. The caryotype includes 8 or 9 larger, 11 or 12 medium, and 4 smaller chromosomes.

14. *Satyrium sylvinus* (Boisduval). $N = 41$. Counts were made in 10 nuclei (I) and 14 nuclei (II) in the testes of one male [282] taken near Somerset, Gunnison Co., Colorado, 15 Aug. 1959. There appear to be about 10 chromosomes distinctly larger than the others, but all are large.

15. *Calycopis cecrops* (Fabricius). $N = 24$. Counts were made in 15 nuclei (I) and 7 nuclei (II) in testes of 2 males [F154, F192] taken at the Archbold Biological Station, Highlands Co., Florida, 21 and 22 April 1960, *leg.* K. Maeki. Many additional suitable nuclei were present and could have been counted. There are 20 large and 4 small chromosomes. A third male taken at the same time had no meiotic divisions, only maturing sperms.

16. *Strymon melinus* Hübner. $N = 24$. Counts were made in 16 nuclei (I) and 34 nuclei (II) in testes of 3 males taken on West Rock, New Haven, Connecticut, 23 Aug. [393] and 3 Sept. [318-1, 318-2]. All the chromosomes are large, but 12 are slightly smaller than the others.

B. NYMPHALIDÆ — DANAINÆ:

1. *Danaus gilippus* (Cramer). $N = 29$. Counts were made in 181 nuclei (I) and 96 nuclei (II) in testes of 3 males [M31, M32-1, M32-3] taken at Ciudad Victoria, 2 Aug. 1959. All nuclei show 4 large chromo-

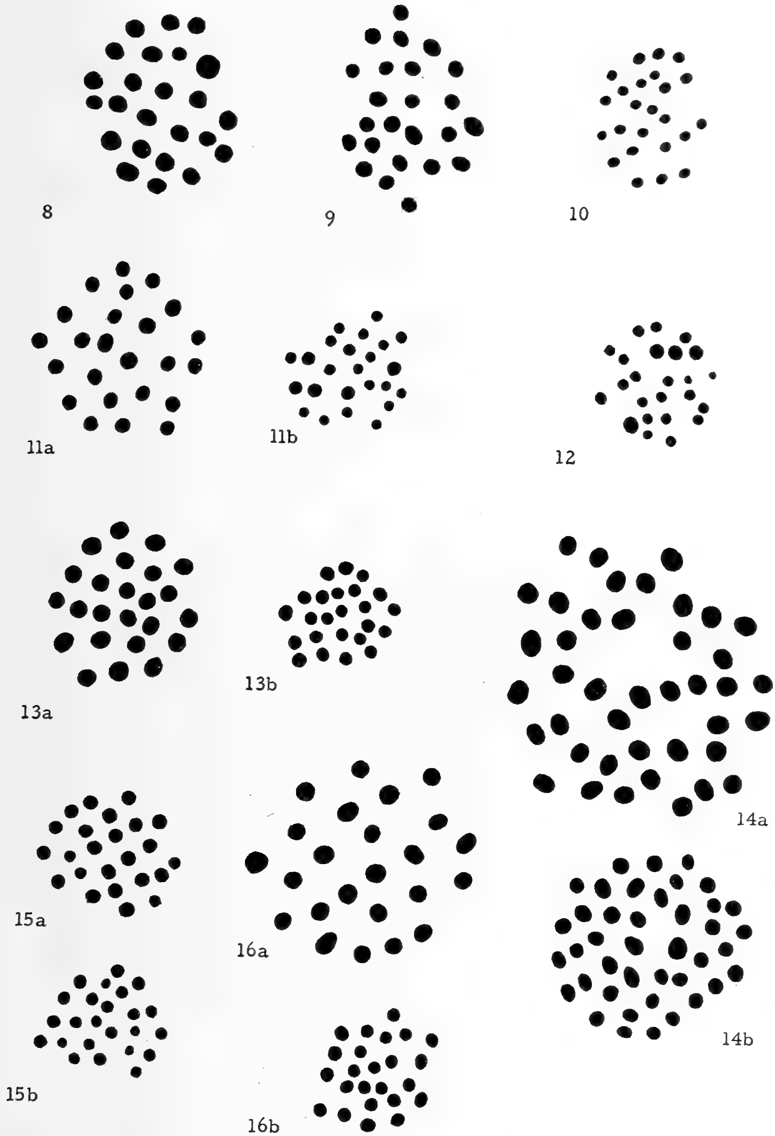


Fig. 8 — *Icaricia icarioides* (I) ; fig. 9 — *Lycæides melissa* (I) ; fig. 10 — *Agriades glandon rusticus* (II) ; fig. 11a — *Everes amyntula* (I) ; fig. 11b — same (II) ; fig. 12 — *E. comyntas* (II) ; fig. 13a — *Eumæus debora* (I) ; fig. 13b — same (II) ; fig. 14a — *Satyrium sylvinus* (I) ; fig. 14b — same (II) ; fig. 15a — *Calycopis cecrops* (I) ; fig. 15b — same (II) ; fig. 16a — *Strymon melinus* (I) ; fig. 16b — same (II).

somes, 21 of medium size, and 4 small elements. One male *D. eresimus* was taken with the 3 *D. gilippus* (see next species), and there is a possibility of a mix-up of the testes, because at first the *eresimus* was not noticed as different, and its testes were dissected into the same fixative vial as were those of the true *gilippus*. We had too few vials available on the Mexican trip and were sometimes forced to combine into single vials several testes of what appeared to be all the same species. Since 3 of the 4 *Danaus* testes gave counts of 29 in all of the numerous nuclei, and the 35 countable nuclei in the other testis all showed 30 elements, there can be little doubt that the present listing is correct. These are the first Danaid caryotypes to be reported. One male of race *berenice* (Cramer), from Highlands Co., Florida, showed no meiotic divisions.

2. *Danaus eresimus* (Cramer). $N = 30$. Counts were made in 15 nuclei (I) and 20 nuclei (II) in the testes of one male [M32-2] taken at Ciudad Victoria, 2 Aug. 1959. There are 4 large and 5 small chromosomes.

C. NYMPHALIDÆ — SATYRINÆ:

1. *Erebia magdalena* Strecker. $N = 29$. Counts were made in 19 nuclei (I) and 22 nuclei (II) in testes of one male [179] taken at Copper Lake, el. 11,000′, Gunnison Co., Colorado, 1 Aug. 1959. There are 10 large, 11 medium, and 8 small chromosomes. Three other males taken at Copper Lake on 1 and 16 Aug. contained no meiotic divisions.

2. *Cercyonis pegala* (Fabricius). $N = 27$. Counts were made in 10 nuclei (I) and 22 nuclei (II) in testes of one male [292] taken at the north rim of the Black Canyon of the Gunnison River, Montrose Co., Colorado, 19 Aug. 1959. There are 25 large and 2 smaller chromosomes. Three other males taken at the same time showed no meiotic divisions. This population goes under the subspecific name *boopis* (Behr).

3. *Cercyonis œtus* (Boisduval). $N = 27$. Counts were made in 41 nuclei (I) and 27 nuclei (II) in testes of 5 males [81, 105, 123a, 123b, 123c] taken at Gothic, 22-24 July 1959. Size relations are as in *C. boopis*. Two other males, taken at Gothic, 22 Aug. 1959, showed no meiotic divisions.

4. *Œneis lucilla* Barnes & McDunnough. $N = 29$. Counts were made in 34 nuclei (I) in testes of one male [223] taken above Cumberland Pass, el. 12,500′, Gunnison Co., Colorado, 11 Aug. 1959. No suitable nuclei in the secondary division were found. There are 27 large chromosomes, and 2 very large with somewhat elongate form.

D. NYMPHALIDÆ — MORPHINÆ:

1. *Morpho peleides* Kollar. $N = 28$. Counts were made in 15 nuclei (I) and 10 nuclei (II) in testes of 3 males [M52-1, M52-2, M52-3] taken at El Salto, S. L. P., Mexico, 4 Aug. 1959. All the chromosomes are large, but 4 are somewhat smaller than the others. This is the first Morphid to be studied cytologically.

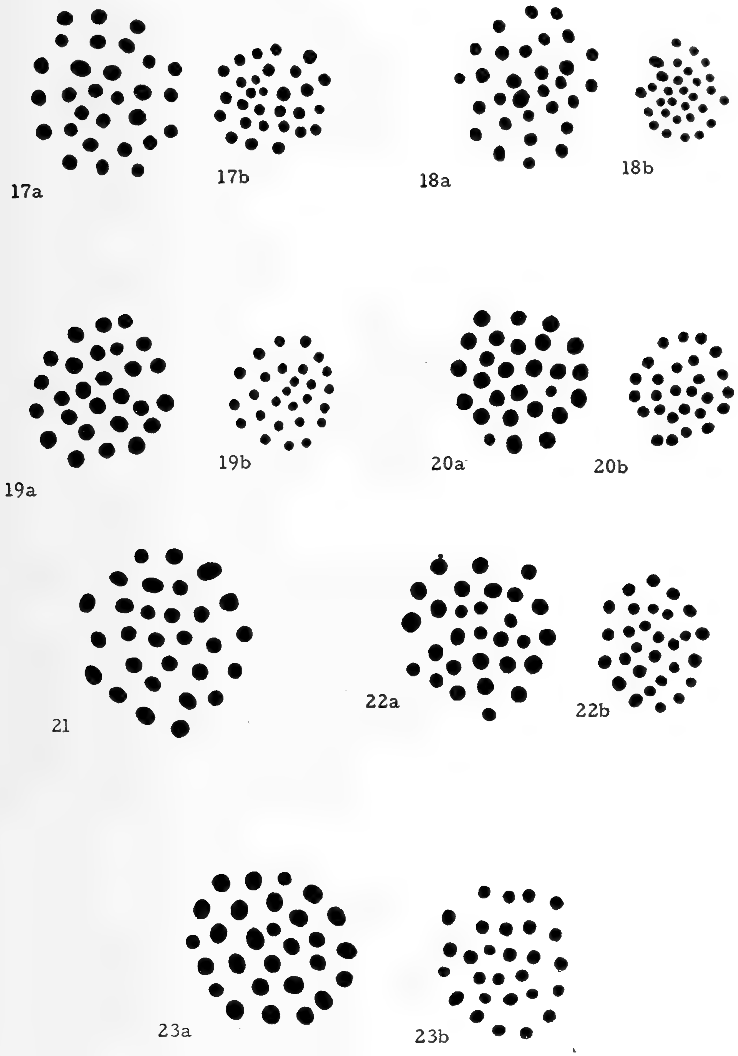


Fig. 17a — *Danaus gilippus* (I) ; fig. 17b — same (II) ; fig. 18a — *D. eresimus* (I) ; fig. 18b — same (II) ; fig. 19a — *Cercyonis pegala* (I) ; fig. 19b — same (II) ; fig. 20a — *C. œtus* (I) ; fig. 20b — same (II) ; fig. 21 — *Œneis lucilla* (I) ; fig. 22a — *Erebia magdalena* (I) ; fig. 22b — same (II) ; fig. 23a — *Morpho peleides* (I) ; fig. 23b — same (II).

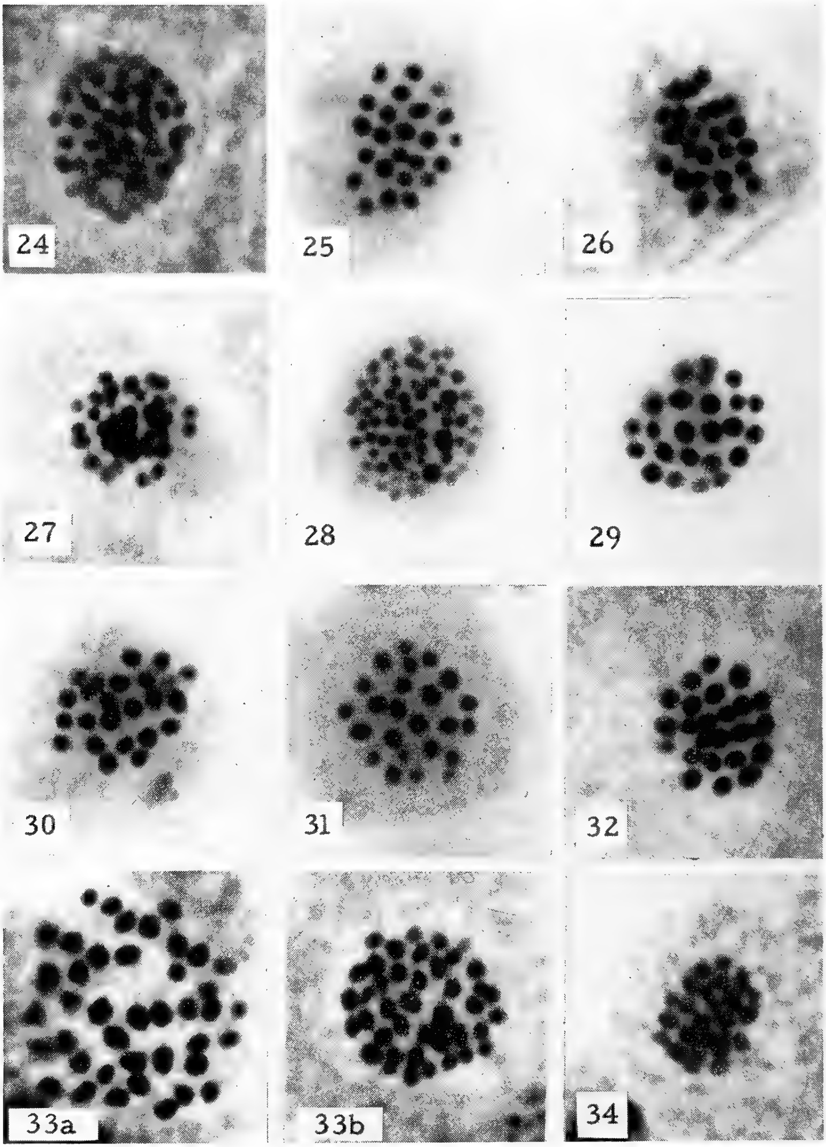


Fig. 24 — *Calephelis virginiensis* (I) ; fig. 25 — *Lycæna nivalis* (I) ; fig. 26 — *L. snowi* (I) ; fig. 27 — *L. rubidus* (I) ; fig. 28 — *L. heteronea* (I) ; fig. 29 — *Icaricia icarioides* (I) ; fig. 30 — *Lycæides melissa* (I) ; fig. 31 — *Everes amyntula* (I) ; fig. 32 — *Eumæus debora* (I) ; fig. 33a — *Satyrium sylvinus* (I) ; fig. 33b — same (II) ; fig. 34 — *Calycopis cecrops* (I).

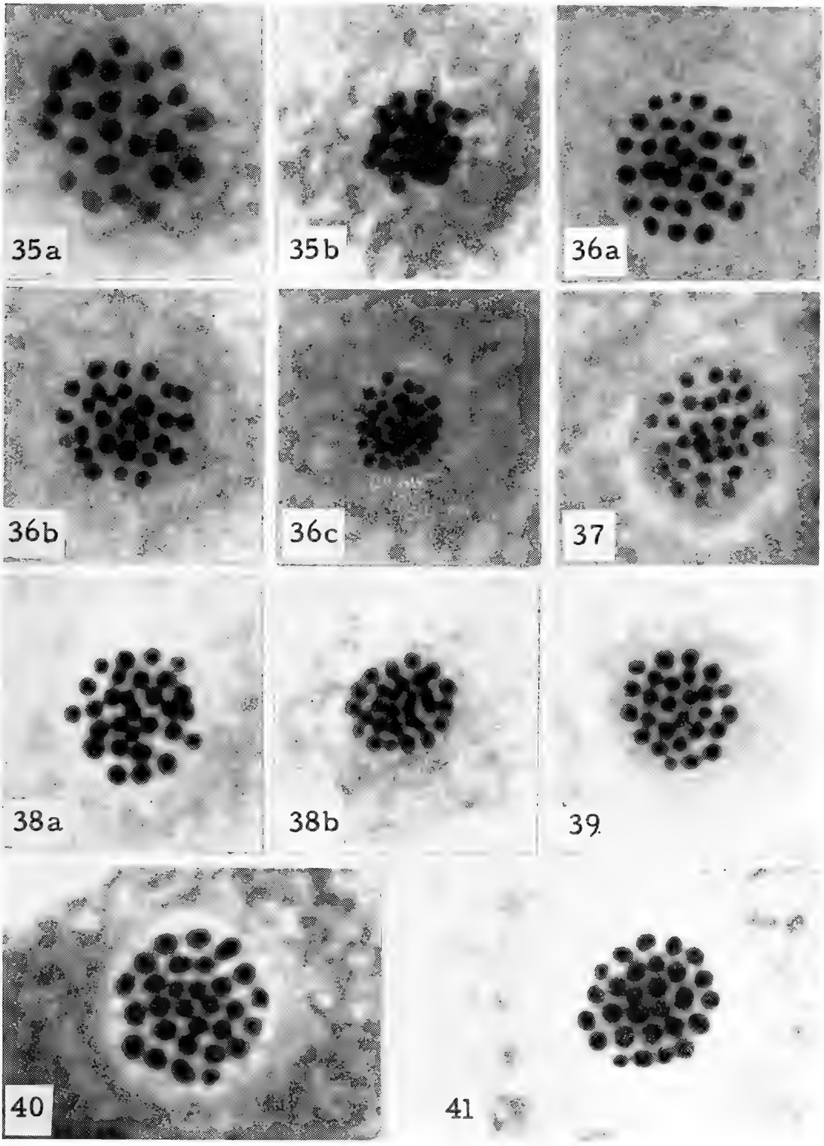


Fig. 35a — *Strymon melinus* (I) ; fig. 35b — same (II) ; fig. 36a — *Danaus gilippus* (I) ; fig. 36b — same (I — from another individual) ; fig. 36c — same (II) ; fig. 37 — *D. eresimus* (I) ; fig. 38a — *Erebia magdalena* (I) ; fig. 38b — same (II) ; fig. 39 — *Cercyonis œtus* (I) ; fig. 40 — *Œneis lucilla* (I) ; fig. 41 — *Morpho peleides* (I).

Table 4.[1] CHROMOSOME NUMBERS OF THE LYCÆNIDÆ.

Species	Number (n)	Division	Reference
A. Riodininæ:			
CALEPHELIS VIRGINIENSIS (Guérin)	45	♂ (I, II)	Present paper
B. Lycæninæ:			
LYCÆNA HELLOIDES (Bdv.)	24	♂ (I, II)	Present paper
LYCÆNA NIVALIS (Bdv.)	24	♂ (I, II)	Present paper
LYCÆNA SNOWI (Edw.)	24	♂ (I)	Present paper
LYCÆNA HYPOPHLEAS (Bdv.)	24	♂ (I, II)	Present paper
Lycæna phleas (Linné) (2 sspp.)	24	♂ (I, II), ♀ (I)	Federley, 1938 Lorkovič, 1941 Maeki & Makino, 1953 Maeki, 1953b
Lycæna virgaureæ (Linné)	24	♂ (I, II), ♀ (I)	Federley, 1938
Lycæna tityrus (Poda) (=*dorilis*)	24	♂ (I, II)	Lorkovič, 1941
Lycæna hippothoe (Linné)	24	♂ (I), ♀ (I)	Federley, 1938 de Lesse, 1952
LYCÆNA RUBIDUS (Edw.)	38	♂ (I, II)	Present paper
LYCÆNA HETERONEA (Bdv.)	68	♂ (I, II)	Present paper
Lampides bœticus (Linné)	24	♀ (I)	Federley, 1942
Syntarucus telicanus (Lang)	24	♂ (I)	Lorkovič, 1941
Celastrina argiolus (Linné) (2 sspp.)	25	♂ (I, II), ♀ (I)	Federley, 1938 Lorkovič, 1941 Maeki, 1953a, b Maeki & Makino, 1953
EVERES COMYNTAS (Gdt.)	24	♂ (II)	Present paper
EVERES AMYNTULA (Bdv.)	24	♂ (I, II)	Present paper
Everes argiades (Pallas) (2 sspp.)	24	♂ (I, II)	Lorkovič, 1938, 41 Maeki & Makino, 1953 Maeki, 1953b
Everes decolorata (Staud.)	25	♂ (I, II)	Lorkovič, 1938, 41
Everes alcetas (Hoff.) [France]	25	♂ (I, II)	Lorkovič, 1941
[Yugoslavia]	26	♂ (I, II)	Lorkovič, 1938, 41
Cupido minimus (Fuessly)	24	♂ (I, II)	Lorkovič, 1941
Cupido sebrus (Ochs.)	24	♂ (I)	Lorkovič, 1941
Zizeeria maha (Kollar)	24	♂ (I)	Maeki & Makino, 1953 Maeki, 1953b
Lycæides argyrognomon (Bergstr.)	24	♂ (I, II), ♀ (I)	Federley, 1938 Lorkovič, 1941

[1]Tables 1 (Papilionidæ), 2 (Hesperioidea), and 3 (Pieridæ) are in Parts 1 and 2 of this series of papers (*Journ. lepid. soc.* 13: 199; 14: 51-53; 1960).

Table 4 — continued.

Lycæides idas (Linné) (2 sspp.)	24	♂ (I, II)	Lorkovič, 1941
Lycæides idas "argellus" (*laps. cal.*?)	19-24	♂ (I, II)	Valle, 1948
LYCÆIDES MELISSA (Edw.)	24	♂ (I)	Present paper
Plebejus argus (Linné)	23	♂ (I, II), ♀ (I)	Federley, 1938 Lorkovič, 1941
Aricia agestis (Schiff.) (= *astrarche, medon*)			
[Finland]	23 ♂ (I, II) ; 24 ♀ (I)		Federley, 1938
[Yugoslavia]	24	♂ (I, II)	Lorkovič, 1941
Aricia nicias (Meigen)	23	♂ (I)	de Lesse, 1952
ICARICIA ICARIOIDES (Bdv.)	24	♂ (I)	Present paper
Eumedonia chiron (Rott.) (= *eumedon*)	24	♂ (I, II), ♀ (I)	Federley, 1938 Lorkovič, 1941
Agriades glandon (de Prun.) [France]	24	♂ (I)	de Lesse, 1954a
AGRIADES GLANDON RUSTICUS (Edw.)	24	♂ (II)	Present paper
Cyaniris semiargus (Rott.)	24	♂ (I, II), ♀ (I)	Federley, 1938 Lorkovič, 1941
Meleageria daphnis (Schiff.)	24	♂ (I, II)	Lorkovič, 1941
Vacciniina optilete (Knoch)	24	♂ (I), ♀ (I)	Federley, 1938
Polyommatus icarus (Rott.)	22, 23	♂ (I, II) ♀ (I)	Federley, 1938 Lorkovič, 1941
Agrodiætus phyllis (Chr.)	10	♂ (I)	de Lesse, 1958
Agrodiætus araratensis de Lesse	13	♂ (I)	de Lesse, 1958
Agrodiætus hopfferi (H.-S.)	15	♂ (I, II)	de Lesse, 1959a, 59b
Agrodiætus iphigenia (H.-S.)	21	♂ (I)	de Lesse, 1958
Agrodiætus hamadensis de Lesse	21, 22	♂ (I)	de Lesse, 1959b
Agrodiætus eros (Ochs.)	23	♂ (I, II)	Lorkovič, 1941
Agrodiætus escheri (Hbn.)	23	♂ (I)	de Lesse, 1954a
Agrodiætus amandus (Schn.)			
[Finland]	23	♂ (I), ♀ (I)	Federley, 1938
[France]	24	♂ (I, II)	Lorkovič, 1941
Agrodiætus thersites (Cant.)	24	♂ (I, II)	Lorkovič, 1941
Agrodiætus hylas (Esper)	24	♂ (I, II)	Lorkovič, 1941
Agrodiætus sennanensis de Lesse	28-30	♂ (I, II)	de Lesse, 1959a, 59b
Agrodiætus dama (Staud.)	41, 42	♂ (I)	de Lesse, 1959b
Agrodiætus bellargus (Rott.)	45	♂ (I, II)	Lorkovič, 1941
Agrodiætus damon (Schiff.)	45	♂ (I)	de Lesse, 1952
Agrodiætus vanensis de Lesse	78	♂ (I)	de Lesse, 1958
Agrodiætus albicans (H.-S.)	82	♂ (I, II)	de Lesse, 1954a

Table 4 — continued

Agrodiætus hispana (H.-S.)	84, 85	♂ (I)	de Lesse, 1952, 56a
Agrodiætus coridon (Poda)			
[France]	88	♂ (I)	de Lesse, 1952, 54a, 56a
[Yugoslavia]	90	♂ (I, II)	Lorkovič, 1941
Agrodiætus rippertii (Freyer)	90	♂ (I, II)	de Lesse, 1954b
Agrodiætus dolus (Hbn.)	124-125	♂ (I)	de Lesse, 1954b
Agrodiætus argester (Bergstr.)			
[S. W. Spain]	131-134	♂ (I)	de Lesse, 1954b
[S. E. Spain, S. France]	147-151	♂ (I)	de Lesse, 1954b
Agrodiætus nivescens (Kef.)	190-191	♂ (I)	de Lesse, 1954b
Maculinea nausithous (Brg.)	24	♂ (I)	de Lesse, 1954a
Maculinea arion (Linné)	23	♂ (I), ♀ (I)	Federley, 1938 Lorkovič, 1941
Glaucopsyche alexis (Poda) (= *cyllarus*)	23	♂ (I)	Lorkovič, 1941
Glaucopsyche melanops (Bdv.)	23	♂ (I)	de Lesse, 1953b
Scolitantides orion (Pallas)	23	♂ (I, II)	Lorkovič, 1941
Philotes vicrama (Moore)	24	♂ (I)	Lorkovič, 1941
TARAKA HAMADA (Druce) [Japan]	15	♂ (I)	Maeki, unpubl.
SATYRIUM SYLVINUS (Bdv)	41	♂ (I, II)	Present paper
CALYCOPIS CECROPS (Fabr.)	24	♂ (I, II)	Present paper
STRYMON MELINUS (Hbn.)	24	♂ (I, II)	Present paper
Strymonidia pruni (Linné)	23	♂ (I)	Beliajeff, 1930 de Lesse, 1952
Callophrys rubi (Linné)	23	♀ (I)	Federley, 1938
Narathura japonica (Murray)	24	♂ (I)	Maeki & Makino, 1953
Thecla betulæ (Linné)	16?	♀ (I)	Federley, 1938
ANTIGIUS ATTILIA (Bremer) [Japan]	25	♂ (I)	Maeki, unpubl.
CHRYSOZEPHYRUS AURORINUS (Obth.) [Japan]	24	♂ (I)	Maeki, unpubl.
FAVONIUS COGNATUS (Staud.) [Japan]	24	♂ (I)	Maeki, unpubl.
JAPONICA SÆPESTRIATA (Hew.) [Japan]	25	♂ (I)	Maeki, unpubl.
Neozephyrus taxila (Bremer)	24	♂ (I)	Maeki, 1953a, b Maeki & Makino, 1953
USSURIANA STYGIANA (Butler) [Japan]	47	♂ (I)	Maeki, unpubl.
EUMÆUS DEBORA (Hbn.)	24	♂ (I, II)	Present paper
C. Curetinæ:			
Curetis acuta Moore	29	♂ (I)	Maeki & Makino, 1953 Maeki, 1953b

Table 5. CHROMOSOME NUMBERS OF THE NYMPHALIDÆ: DANAINÆ, SATYRINÆ, MORPHINÆ.

Species	Number (n)	Division	Reference
A. Danainæ:			
DANAUS GILIPPUS (Cramer)	29	♂ (I, II)	Present paper
DANAUS ERESIMUS (Cramer)	30	♂ (I, II)	Present paper
CADUGA SITA (Kollar) [Japan]	47	♂ (I, II)	Maeki, unpubl.
B. Satyrinæ:			
Melanitis phedima (Stoll)	28-30	♂ (I, II)	Maeki, 1953b
Mycalesis gotama Moore	28	♂ (I, II)	Maeki & Makino, 1953
Mycalesis francisca (Stoll)	29	♂ (I)	Maeki & Makino, 1953 Maeki, 1953b
Lethe diana (Butler)	29	♂ (I)	Maeki, 1953a, b Maeki & Makino, 1953
Kirrodesa sicelis (Hew.)	29	♂ (I)	Maeki & Makino, 1953
Neope goschkevitschii (Mén.)	28	♂ (I)	Maeki, 1953a, b Maeki & Makino, 1953
Pararge ægeria (Linné)	28	♂ (I), ♀ (I)	Federley, 1938
Pararge mæra (Linné) (3 sspp.)	28	♂ (I, II), ♀ (I)	Federley, 1938 Lorkovič, 1941
Pararge megæra (Linné) (2 sspp.)	29	♂ (I, II)	Lorkovič, 1941
Pararge petropolitana (Fab.) (= *hiera*)	29	♂ (II), ♀ (I)	Federley, 1938
PARARGE DEIDAMIA (Evers.) [Japan]	29	♂ (I, II)	Maeki, unpubl.
Melanargia galathea (Linné)	24	♂ (I)	Lorkovič, 1941
Melanargia lachesis (Hbn.)	24	♂ (II)	Lorkovič, 1941
Cœnonympha arcania (Linné)	32	♂ (I, II)	Lorkovič, 1941
Cœnonympha pamphilus (Linné)	28, 29	♂ (I), ♀ (I)	Federley, 1938
Cœnonympha iphis (Schiff.)	29	♀ (I)	Federley, 1938
Cœnonympha tiphon Rebel	29	♂ (I, II), ♀ (I)	Federley, 1938 Lorkovič, 1941
Cœnonympha œdippus (Fab.)	29	♂ (I)	Maeki & Makino, 1953
Ypthima argus Butler	29	♂ (II)	Maeki, 1953a, b Maeki & Makino, 1953
YPTHIMA MOTSCHULSKYI (Br. & Grey) [Japan]	27	♂ (I, II)	Maeki, unpubl.
Erebia calcarius Lork.	8	♂ (I, spg.)	Lorkovič, 1949, 53 de Lesse, 1955a
Erebia cassioides (R. & Hohen.) (sev. sspp.)	10	♂ (I)	Lorkovič, 1953 de Lesse, 1953a, 55a Lork. & de Lesse, 1955
Erebia tyndarus (Esper) (sev. sspp.)	10	♂ (I, II, spg.)	de Lesse, 1953c, 55a Lorkovič, 1953 Lork. & de Lesse, 1955

Table 5 — continued.

Erebia medusa (Schiff.) (2 sspp.)	11	♂ (spg.), ♀ (I)	Federley, 1938 Lorkovič, 1941
Erebia nivalis Lork. & de L.	11	♂ (I, spg.)	de Lesse, 1955a, c Lork. & de Lesse, 1955
Erebia epipsodea Butler	11	♂ (spg.)	de Lesse, 1956b
Erebia mnestra (Hbn.)	12	♂ (I, II)	de Lesse, 1953c
Erebia gorgone Bdv.	12	♂ (I, II)	de Lesse, 1953a
Erebia œme (Hbn.)	14	♂ (I, II)	Lorkovič, 1941
Erebia meolans (de Prun.)	14	♂ (I)	de Lesse, 1953a
Erebia callias Edw.	15	♂ (I, spg.)	de Lesse, 1955a, c
Erebia epiphron (Knoch)	17	♂ (I)	Lorkovič, 1941
Erebia glacialis (Esper)	19	♂ (I, II)	Lorkovič, 1941
Erebia pharte (Hbn.)	19	♂ (I)	Lorkovič, 1941
Erebia pronoe (Esper)	19	♂ (spg.)	Lorkovič, 1941
Erebia æthiops (Esper)	21	♂ (II)	Lorkovič, 1941
Erebia gorge (Hbn.)	21	♂ (I, II)	Lorkovič, 1941
Erebia melas (Herbst)	21	♂ (I, II)	Lorkovič, 1941
Erebia stirius (Godt.) (= *nerine*)	22	♂ (I, II)	Lorkovič, 1941, 52
Erebia scipio Bdv.	22	♂ (I, II)	de Lesse, 1953c
Erebia lefebvrei (Bdv.)	22	♂ (I, II)	de Lesse, 1953a
Erebia styx (Freyer)	23	♂ (I)	Lorkovič, 1952
Erebia hispania rondoui Obth.	24	♂ (I, II)	de Lesse, 1953a, c
Erebia hispania hispania Butler	25	♂ (I)	Lorkovič, 1953 de Lesse, 1953a
Erebia pandrose (Bork.) (= *lappona*) (sev. sspp.)	28	♂ (I, II), ♀ (I)	Federley, 1938 de Lesse, 1953a
Erebia ligea (Linné)	29	♀ (I)	Federley, 1938
Erebia disa (Thunb.)	29	♀ (I)	Federley, 1938
Erebia manto (Schiff.)	29	♂ (I, II)	de Lesse, 1953a
EREBIA MAGDALENA Stkr.	29	♂ (I, II)	Present paper
Erebia ottomana (H.-S.)	40	♂ (I, II)	Lorkovič, 1941, 49
Erebia iranica Grum-Gr.	51	♂ (I, spg.)	de Lesse, 1955c
Erebia dromulus Staud.	51 (52?)	♂ (I)	de Lesse, 1955c
Maniola jurtina (Linné)	29	♂ (I, II), ♀ (I)	Federley, 1938 Lorkovič, 1941
Hyponephele lycaon (Rott.)	29	♂ (I, II)	de Lesse, 1953b
Kanetisa circe (Fab.)	29	♂ (I, II)	de Lesse, 1953b
Hipparchia fagi (Scop.) (= *hermione*)	29	♂ (I, II)	Lorkovič, 1941
Hipparchia semele (Linné)	29	♂ (I, II), ♀ (I)	Federley, 1938
Minois dryas (Scop.) [Japan]	28	♂ (I)	Maeki & Makino, 1953 Maeki, 1953b
[Yugoslavia]	27	♂ (spg.)	Lorkovič, 1941

Table 5 — continued.

CERCYONIS PEGALA (Fab.)	27	♂ (I, II)	Present paper
CERCYONIS ŒTUS (Bdv.)	27	♂ (I, II)	Present paper
Aphantopus hyperantus (Linné)	29	♀ (I)	Federley, 1938
Œneis jutta (Hbn.)	32	♀ (I)	Federley, 1938
ŒNEIS LUCILLA B. & McD.	29	♂ (I)	Present paper
ŒNEIS ASAMANA Mats. [Japan]	29	♂ (I)	Maeki, unpubl.
ŒNEIS DAISETSUZANA Mats. [Japan]	29	♂ (I)	Maeki, unpubl.
C. Morphinæ:			
MORPHO PELEIDES Kollar	28	♂ (I, II)	Present paper

Discussion

Tables 4 and 5 show the chromosome numbers of the 75 species of Lycænidæ and 69 of Nymphalidæ (except for Nymphalinæ and Libytheinæ) for which counts have now been recorded. Of the 23 species described in the present paper, 22 are new to cytology and are shown in capitals in the Tables. Also in capitals are 11 other species, from Japan, here recorded for the first time; Maeki will report more fully on these elsewhere. For these Tables we had to adopt classificatory systems applicable to Nearctic as well as Palearctic species. Our compromise with several current systems undoubtedly has inconsistencies and outright errors but is convenient for the present. The genera of the Blues are mainly those of Nabokov (1945) based on Stempffer's (1937-38) system. The Hairstreak classification is a conglomeration of the proposals of Shirozu and Yamamoto (1956), Riley (1958), Ziegler (1960), and Clench (in press). The arrangement of the Satyrids is most influenced by generic revisions by de Lesse (*e.g.,* 1951). For simplicity the sequence of species in the genera for which very many chromosome counts are available (*Lycæna, Agrodiætus,* and *Erebia*) is by chromosome number, not necessarily phylogenetic affinity.

As with the Hesperioidea, Pieridæ, and Papilionidæ, certain units in the Lycænidæ and Nymphalidæ tend to have a distinctive chromosome number. In the Lycæninæ the characteristic number is about 24, in the Satyrinæ about 29. There are many interesting individual variants from these basic types, especially in the large genera *Agrodiætus* and *Erebia.* Too few counts are known for similar generalizations concerning Riodinæ, Curetinæ, Danainæ, and Morphinæ.

The count for *Curetis acuta* is very unusual for a Lycænid; not only is the exact number unique, but the caryotype does not seem to be derivable from the basic type of the Lycæninæ by easy fission of chromosomes. This is tentative but perhaps significant evidence for the extreme distinctness of *Curetis,* already well documented by means of other criteria by SHIROZU and YAMAMOTO (1958). These authors made this a monogeneric family, but in line with the reduction of the Riodinids to subfamily status, we also rank Curetinæ as a subfamily rather than a full family. The significance of the haploid number of *C. acuta* cannot be seen until chromosome counts have been made for other species of *Curetis.*

The high number for *Calephelis virginiensis* also cannot be evaluated until other members of the genus and other Riodininæ are studied. We hope soon to determine the numbers for the two eastern American sibling species, *C. muticum* McAlpine and *C. borealis* (Grote & Robinson), and of several presumed subspecies of *Apodemia mormo* Felder & Felder.

The haploid number of 28 for the first known *Morpho* points to affinity with the Satyrinæ. Here, too, several species must be studied before confident generalizations are possible.

Our two widely different *Cercyonis* both have $n = 27$. This dims the hope that chromosome counts will help to resolve the badly confused status of several other members of this genus, such as *meadii* (Edw.), *masoni* (Cross), and *silvestris* (Edw.), and some so-called subspecies of *pegala.*

Many more species of the Holarctic genus *Erebia* have been studied cytologically than of any other genus of Lepidoptera, mainly through the efforts of Z. LORKOVIC and H. DE LESSE. Fortunately, there is also a recent and comprehensive monograph of the entire genus (Warren, 1936). This makes it possible to compare the chromosome findings with a sophisticated taxonomic analysis based largely on several structures of the male genitalia and androconial wing-scales. WARREN arranged the 69 species of *Erebia* in 15 groups. Chromosome counts are now available for 32 species (and semispecies) in 10 of WARREN's 15 groups. The following list shows all the counts known for each group. As an indication of relative group size, the total number of full species accepted by WARREN, in each group is shown in parentheses.

I. Ligea Group (5) - 29, 29.
II. Epiphron Group (8) - 17, 19.
IV. Æthiops Group (4) - 21.
VI. Embla Group (3) - 29.
VIII. Magdalena Group (3) - 29.
IX. Medusa Group (2) - 11.
XI. Alberganus Group (7) - 11.
XII. Pluto Group (10) - 19, 21, 12, 12, 40, 8, 10, 10, 11, 24, 25, 51, 15, 51.
XIII. Pronoe Group (9) - 19, 22, 22, 22, 23, 21.
XIV. Pandrose Group (5) - 14, 14, 28.

Several taxa ranked by WARREN as subspecies, particularly in the Pluto Group, have since been shown cytologically to be full species. Among these is *iranica* ($n = 57$) which WARREN placed as one of the Palearctic subspecies of the Nearctic *callias;* it is not *callias* ($n = 15$) but belongs to the *tyndarus* complex and apparently has the same number as its own geographic neighbor, *dromulus* ($n = 51$ or 52). Two new species with distinctive chromosome numbers have been named by LORKOVIC and DE LESSE since WARREN'S monograph was completed.

LORKOVIC (1949) and WHITE (1954) have discussed the possibility that chromosomal evolution in *Erebia* has included polyploidy. The above check list helps in reviewing this point, since it is to be expected that a series of autopolyploids would be taxonomically similar. The best known polyploid Lepidoptera (*Solenobia*) are autopolyploids. A suggestive instance in *Erebia* is *E. pandrose* ($n = 28$); both of its known near relatives, *E. œme* and *E. meolans,* have $n = 14$. In the Pluto Group *E. calcarius* has $n = 8$, and *E. tyndarus* and *cassioides* have $n = 10$; *E. ottomana* has $n = 40$, and is possibly to be explained as a case of decaploidy or octoploidy. The numbers 8, 12, 24 (and 25), and 51 also might suggest polyploidy in this group. But perhaps more probable is the occurrence of fusions with increased and fissions with decreased polyteny, as mentioned in our first paper (1960a: pp.199-200). Quantitative measurements of DNA might give conclusive evidence of the mechanism of numerical increase.

Aside from the extremely derived caryotypes among species of *Erebia,* most Satyrinæ have haploid numbers between 27 and 32. *Melanargia* is an oddity; both known species have $n = 24$. This is further evidence of the isolated position of this genus among the Satyrinæ.

Among the Lycænidæ, *Agrodiætus* shows interesting multiples and near-multiples, such as 12, 23, 45, 90, 134, 190. The last, for *A. nivescens,* is the highest haploid number known in the Metazoa. Our own counts for *Lycæna rubidus* ($n = 38$) and *L. heteronea* ($n = 68$) are major divergences from the otherwise highly stereotyped number ($n = 24$) for the Coppers. Our new record of *Ussuriana stygiana* ($n = 47$) might be explained by doubling of the 23 ancestral autosomes, plus the intact X-chromosome, but our count for *Satyrium sylvinus* ($n = 41$) is not so simply explainable and dictates caution in interpreting unusual haploid numbers. *S. sylvinus* is also remarkable in having chromosomes as large as those of cytologically "typical" Lycænids with $n = 24$, such as *Strymon melinus.* All the other species of Lycænids with more than 30 chromosomes have the size of most individual elements small, suggesting some form of fission in their history. Consistently with this hypothesis, the species with very small numbers, such as *Taraka hamada* and *Thecla betulæ,* have very large chromosomes, pointing to 1 + 1 fusion of ancestral chromosomes.

We found only one instance of variation in chromosome number — a nucleus of *Lycæna nivalis* showed 25 elements rather than the normal 24. This species is very closely related to *L. helloides,* flies with it at Gothic, and may well hybridize with it occasionally. Possibly the one anomalous metaphase is due to this being a hybrid with occasional failure of synapsis of one pair of chromosomes. FEDERLEY (1938) counted 24 chromosomes in each of 17 nuclei in four males of *L. virgaureæ* from Finland, but 2 other nuclei had 25 and 26 elements. He did not note whether these 2 nuclei were in a single male. But he did report that they had some abnormally small chromosomes, and he attributed this to fragmentation. However, it is at least as reasonable to suppose that the small elements were non-pairing univalents in a hybrid male. Other Finnish *Lycæna* which might hybridize with *L. virgaureæ* are *L. hippothoe, L. phleas,* and *L. helle* (Schiffermüller).

Some of the species in the Tables have two supposed subspecies whose chromosome numbers are reported to be different. Chromosome differences in Lepidoptera usually are correlated with species distinctness, as was found for *Papilio hippocrates* (see, *e. g.,* Maeki & Remington, 1960a). The reverse is often not the case, of course. The reported geographic differences for Lycænidæ and Satyrinæ are:

Aricia agestis (Finland) — $n = 23$ (♀ $n = 24$)
(Yugoslavia) — $n = 24$
Agrodiætus amandus (Finland) — $n = 23$
(France) — $n = 24$
Agrodiætus coridon (France) — $n = 88$
(Yugoslavia) — $n = 90$
Agrodiætus argester (SW. Spain) — $n = 131$-134
(SE. Spain, S. France) — $n = 147$-151
Minois dryas (Yugoslavia) — $2n = 54$
(Japan) — $n = 28$
Erebia hispania (Pyrenees) — $n = 24$
(Sierra Nevada, Spain) — $n = 25$.

SUMMARY

1. The chromosome numbers and some size relations are reported for 16 species of Lycænidæ and 7 species of the first three subfamilies of the Nymphalidæ *(sensu lato)*. Of these, 22 are species new to cytology, and the other (*Agriades glandon rusticus*) is the Nearctic race of a species known previously only from European material. No counts had previously been recorded for any Riodinids, Danaids, or Morphids. The cytologically new species are: *Calephelis virginiensis* (Florida), *Lycæna helloides, nivalis, snowi, rubidus, heteronea* (all Colorado), *L. hypophleas* (Connecticut), *Icaricia icarioides, Lycæides melissa, Everes amyntula* (all Colorado), *E. comyntas* (Connecticut), *Eumæus debora* (Mexico), *Satyrium sylvinus* (Colorado), *Calycopis cecrops* (Florida), *Strymon melinus* (Connecticut), *Danaus gilip-*

pus and *eresimus* (Mexico), *Erebia magdalena, Cercyonis pegala, C. œtus, Œneis lucilla* (all Colorado), and *Morpho peleides* (Mexico). All these counts are from spermatocyte divisions.

2. Meiotic divisions are numerous in many adult, flying males of Lycænidæ, Danainæ, and Morphinæ, but 5 species of Theclini with early spring flight periods showed no divisions. Meiosis has usually been completed before eclosion in males of Satyrinæ.

3. The haploid number tends to be 24 for the Lycæninæ and 29 for the Satyrinæ. There are two principal exceptions: in the Lycænines, many species of *Agrodiætus* have more than 24 (up to 190-191); in the Satyrids, many species of *Erebia* have far fewer than 29 haploid chromosomes.

4. The suggestion of polyploidy in butterflies is not strongly supported, partly because exact multiples of the typical haploid number are not usual among species with high numbers. Fission, with reduced polyteny, is more likely. Some form of fusion is the probable cause of deviants with very low numbers.

5. The haploid number is only mentioned for 11 Japanese species: *Taraka hamada, Antigius attilia, Chrysozephyrus aurorinus, Favonius cognatus, Japonica sæpestriata, Ussuriana stygiana* (all Lycænidæ); and *Caduga sita, Pararge deidamia, Ypthima motschulskyi, Œneis asamana,* and *Œ. daisetsuzana* (all Nymphalidæ, *sensu lato*). Descriptions and full records will be reported in later papers.

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References

Beliajeff, N. K., 1930. Die Chromosomenkomplexe und ihre Beziehung zur Phylogenie bei den Schmetterlingen. *Zeitschr. induk. Abstamm.-und Vererbungsl.* 54: 369-399, 3 pls.

Clench, H. K., 1958. [Review of *Colorado Butterflies, Part III.*] *Lepid. news* 11: 57-60.

-----------, in press. Theclini - hairstreaks *in* Ehrlich, P. R., *How to know the butterflies.*

Ehrlich, P. R., 1958a. The higher systematics of the butterflies. *Lepid. news* 11: 103-106, 1 fig.

-----------, 1958b. The comparative morphology, phylogeny and higher classification of the butterflies (Lepidoptera: Papilionoidea). *Univ. Kansas sci. bull.* 39: 305-370, 64 figs.

Federley, H., 1938. Chromosomenzahlen finnländischer Lepidopteren. I. Rhopalocera. *Hereditas* 24: 397-464, 47 figs.

............., 1942. Chromosomenzahlen von vier Tagfaltern von oceanischen Inseln. *Hereditas* 28: 493-495.

de Lesse, H., 1951. Divisions génériques et subgénériques des anciens genres *Satyrus* et *Eumenis* (sensu lato). *Rev. franç. lépid.* 13: 39-42.

............., 1952. Quelques formules chromosomiques chez les Lycænidæ (Lépidoptères Rhopalocères). *C. R. acad. sci.* (Paris) 235: 1692-1694, 3 figs.

............., 1953a. Formules chromosomiques nouvelles du genre *Erebia* (Lep. Rhopal.) et séparation d'une espèce méconnue. *C. R. acad. sci.* (Paris) 236: 630-632, 7 figs.

............., 1953b. Formules chromosomiques de *Boloria aquilonaris* Stichel, *B. pales* D. et Schiff., *B. napæa* Hoffm. et quelques autres Lépidoptères Rhopalocères. *Rev. franç. lépid.* 14: 24-26, 1 pl., 5 figs.

............., 1953c. Formules chromosomiques nouvelles du genre *Erebia* (Lépid. Rhopal.). *C. R. acad. sci.* (Paris) 237: 758-759, 3 figs.

............., 1954a. Formules chromosomiques nouvelles chez les Lycænidæ (Lépid. Rhopal.). *C. R. acad. sci.* (Paris) 237: 1781-1783.

............., 1954b. Formules chromosomiques nouvelles chez les Lycænidæ (Lépidoptères Rhopalocères). *C. R. acad. sci.* (Paris) 238: 514-516, 5 figs.

............., 1955a. Nouvelles formules chromosomiques dans le groupe d'*Erebia tyndarus* Esp. (Lépidoptères, Satyrinæ). *C. R. acad. sci.* (Paris) 240: 347-349.

............., 1955b. État actuel de la systématique du groupe d'*Erebia tyndarus* Esp. (s. l.). Note complémentaire. *Rev. franç. lépid.* 14: 258-259.

............., 1955c. Une nouvelle formule chromosomique dans le groupe d'*Erebia tyndarus* Esp. (Lépidoptères Satyrinæ). *C. R. acad. sci.* (Paris) 241: 1505-1507, 3 figs.

............., 1956a. Étude cytologique des *Lysandra* fixés par M. H. Beuret. *Mitt. ent. Ges. Basel* (n. F.) 6: 77-80.

............., 1956b. Notes on the species-groups in the genus *Erebia*: a reply. *Entomologist* 89: 278-282.

............., 1958. Description de deux nouvelles espèces d'*Agrodiætus* (Lép. Lycænidæ) séparées à la suite de la découverte de leurs formules chromosomiques. *Lambillionea* 57: 65-71, 4 figs.

............., 1959a. Description d'une nouvelle sous-espèce d'*Agrodiætus hopfferi* H. S. (Lep. Lycænidæ) et de sa formule chromosomique particulière. *Bull. mens. soc. linn. Lyon* 28: 149-151.

............., 1959b. Sur la valeur spécifique de deux sous-espèces d'*Agrodiætus* (Lep. Lycænidæ) récemment décrites. *Bull. mens. soc. linn. Lyon* 28: 312-315, 5 figs.

Lorkovič, Z., 1938. Studien über den Speziesbegriff. II. Artberechtigung von *Everes argiades* Pall., *E. alcetas* Hffgg. und *E. decolorata* Stgr. *Mitt. münchener ent. Ges.* 28: 215-246, 8 figs.

............., 1941. Die Chromosomenzahlen in der Spermatogenese der Tagfalter. *Chromosoma* 2: 155-191, 13 figs.

............., 1949. Chromosomenzahlen-Vielfachung bei Schmetterlingen und ein neuer Fall fünffacher Zahl. *Rev. suisse zool.* 56: 243-249, 4 figs.

............., 1952. Beiträge zum Studium der Semispecies. Spezifität von *Erebia stirius* Godt. und *E. styx* Frr. (Satyridæ). *Zeitschr. Lepid.* 2: 159-176, 2 pls., 4 figs.

............., 1953. Spezifische, semispezifische und rassische Differenzierung bei *Erebia tyndarus* Esp. I, II. *Bull. int. acad. sci. Yougoslavie* (Zagreb) 294: 269-358, 8 pls.

............., 1958. Some pecularities of spatially and sexually restricted gene exchange in the *Erebia tyndarus* group. *Symp. quant. biol.* (Cold Spring Harbor) 23: 319-325, 4 figs.

Lorkovič Z., & H. de Lesse, 1955. Note supplémentaire sur le groupe d'*Erebia tyndarus* Esp. *Lambillionea* 55: 55-58.

Maeki, K., 1953a. Chromosome numbers of some butterflies (Lepidoptera-Rhopalocera). *Japanese journ. genetics* 28: 6-7, 5 figs.

............., 1953b. A chromosome study of Japanese butterflies (Lepidoptera-Rhopalocera). *Kwansei Gakuin Univ., annual studies* 1: 67-70.

Maeki, K., & S. Makino, 1953. Chromosome numbers of some Japanese Rhopalocera. *Lepid. news* 7: 36-38.

Maeki, K., & C. L. Remington, 1960a. Studies of the chromosomes of North American Rhopalocera. 1. Papilionidæ. *Journ. lepid. soc.* 13: 193-203, 2 pls, 7 figs.

-----------, 1960b. *Idem.* 2 Hesperiidæ, Megathymidæ, and Pieridæ. *Journ. lepid. soc.* 14: 37-57, 7 pls.

Nabokov, V., 1945. Notes on Neotropical Plebejinæ (Lycænidæ, Lepidoptera). *Psyche* 52: 1-61, 8 pls.

Riley, N. D., 1958. The genera of Holarctic Theclinæ: a tentative revision. *Proc. X. int. congress ent.* 1: 281-288.

Shirozu, T., & H. Yamamoto, 1956. A generic revision and the phylogeny of the tribe Theclini (Lepidoptera; Lycænidæ). *Sieboldia* 1: 329-421, pls 35-85.

-----------, 1958. Systematic position of the genus *Curetis* (Lepidoptera; Rhopalocera). *Sieboldia* 2: 43-51, 15 figs.

Stempffer, H., 1937-38. Contribution à l'étude des Plebeiinæ palæarctiques. *Bull. soc. ent. France* 42: 211-218, 296-301, 28 figs.

Valle, A., 1948. Preliminary data on the chromosome cycle of *Lycæides idas* L. *Experientia* 5: 388-389, 3 figs.

Warren, B. C. S., 1936. *Monograph of the genus* Erebia. 407 pp, 104 pls. British Museum (Nat. Hist.), London.

White, M. J. D., 1954. *Animal cytology and evolution,* 2nd ed. 454 pp, 147 figs. Univ. Press, Cambridge.

Ziegler, J. B., 1960. Preliminary contribution to a redefinition of the genera of North American hairstreaks north of Mexico (Lycænidæ). *Journ. lepid. soc.* 14: 19-23.

Postscript

After the manuscript for this paper had gone to the printer, we received a major new work on Rhopalocera chromosomes by H. de Lesse (Spéciation et variation chromosomique chez les Lépidoptères, Rhopalocères, *Ann. sci. nat., zool. biol. anim.* (12) 2: 1-223, 222 figs.). The de Lesse manuscript was finished in May, 1958, but was not published until 1960 (received at Yale 21 Oct. 1960). We expect to summarize some of the many important findings from this paper later, but it is not possible to include the relevant data on Satyrinæ and Lycæninæ in this postscript. The haploid number is listed for the first time for 48 species of Lycæninæ and 33 of Satyrinæ, and counts are confirmed with new material for many previously recorded species. There are also 13 new counts for Hesperiidæ and 9 for Pieridæ, as well as many for Nymphalinæ which we will add to the table in our concluding paper of this series. There is a summary list of all the 174 species for which de Lesse has made counts, and the caryotype findings are painstakingly compared with those from genitalic characters. The results are considered in terms of geographic distribution of the taxa and of the sympatry and sterility relations of several of the most interesting complexes. There is also a discussion of variation of chromosome number and its interpretation. All the species are European and Middle Eastern, except *Erebia callias* from Colorado.

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DESCRIPTIONS OF TWO NEW *CHLOSYNE* (NYMPHALIDÆ) FROM MEXICO, WITH A DISCUSSION OF RELATED FORMS

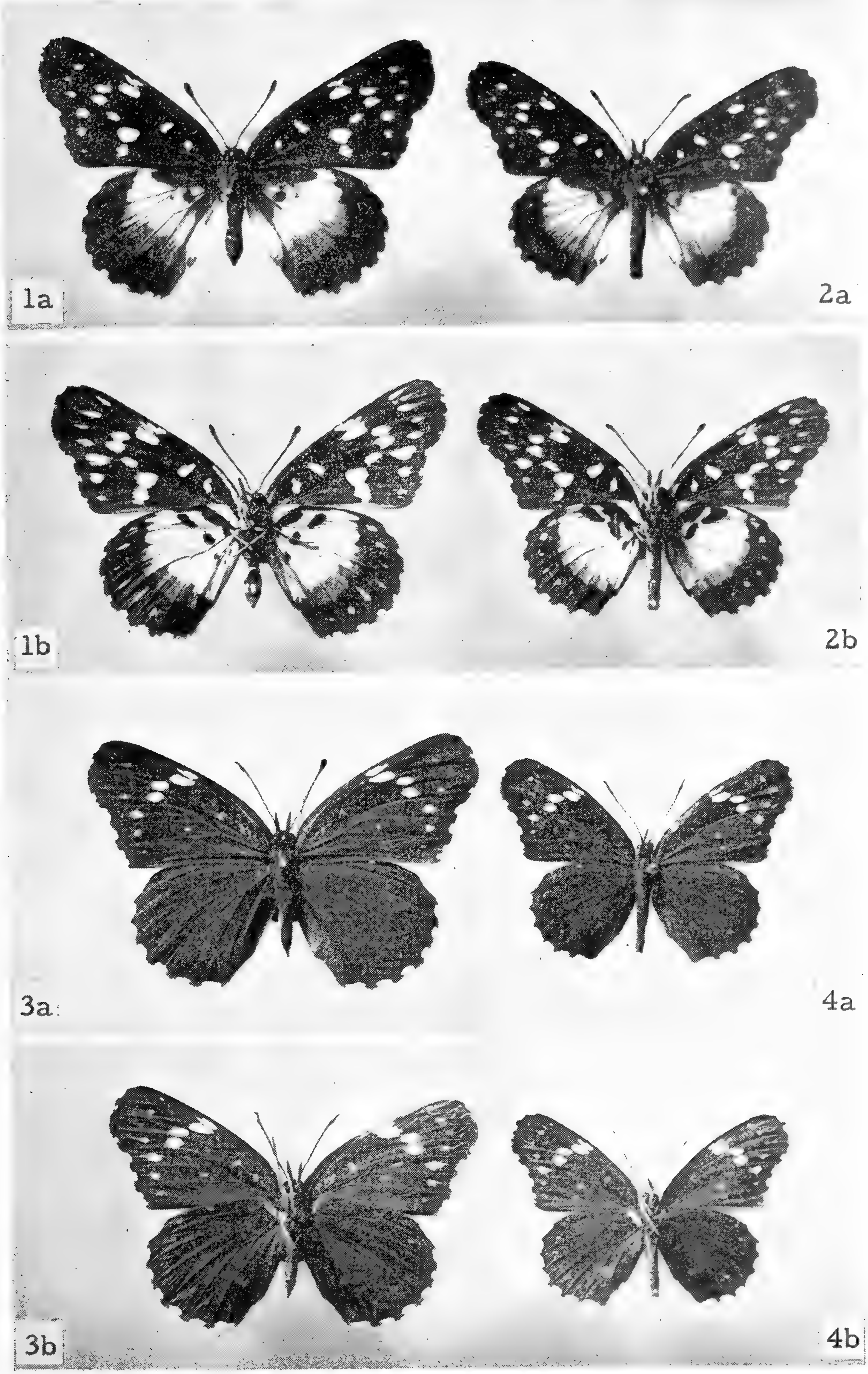
by David L. Bauer

Some years ago while examining the series of *Chlosyne lacinia* Geyer in the collection of F. M. Brown, I noticed five specimens without marginal or submarginal spots on the wings. These specimens were all from northeastern Mexico and this along with their other peculiarities interested me, so I set them aside and continued to examine the series. Later among the specimens of *Chlosyne lacinia quehtala* Reakirt, I found five more specimens which also did not have a trace of the marginal or submarginal spots on their wings. These last specimens were from southwestern Mexico. As soon as possible I examined the genitalia of these two insects to see if they were just another variation of the protean *C. lacinia,* of which I had already checked many forms, or something new. I was both surprised and delighted to find the genitalia were definitely not like those of true *lacinia.* Comparison with the genitalia of other species of *Chlosyne* showed them to be most like those of *C. janais* Drury.

The next summer, 1954, a trip was taken to Mexico and several colonies of the first insect were found, its habits were observed, and a good series was collected, but only one specimen of the second insect was captured. However, that same year, and also two years later, Kent H. Wilson was collecting *Papilio* in Mexico, and knowing of my interest in the *Chlosyne* he collected as many as he could and sent them to me for study. In the lot was a good series of the second insect, collected by him in the state of Guerrero. In the meantime a search through the *Zoological Record* and the extensive entomological literature at the University of Washington Library brought to light Hall's (1924) description of two *Chlosyne* which also lacked the submarginal spots on the wings. He named these two insects *C. rosita,* from western Guatemala, and *C. montana,* from Mexico, and gave excellent figures of the types. In his description of *C. rosita* he wrote: "I first met with this interesting species nearly twenty years ago, but hesitated to describe it owing to its similarity to certain forms of *C. lacinia.* Mr. Talbot, however, has now been good enough to dissect a specimen, and informs me that it is quite clear that it is distinct, and that it seems to come nearer to *C. janais* Drury than to *C. lacinia.*" I now had adequate series and information for a serious study of these insects.

This past year M. Spelman sent me specimens of *C. rosita* from Catamaca, Vera Cruz, Mexico, and Tuxtla Gutierrez, Chiapas, Mexico, and also San Salvador, El Salvador. Comparison of my specimens from northeastern Mexico with Hall's description and figures and with the specimens from Mr. Spelman, showed that they are a northern subspecies of *C. rosita.*

I take pleasure in naming this hitherto unnamed insect for F. Martin Brown of Colorado Springs, Colorado, in whose collection the first specimens were discovered.


1a
2a
1b
2b
3a
4a
3b
4b

CHLOSYNE ROSITA BROWNI Bauer, NEW SUBSPECIES

HOLOTYPE male. Upper surface of the primaries, jet black; two small white spots in discal cell; median series of spots large, prominent, and white in color, not confluent; postmedian series composed of seven small white dots, which are variable in size and shape; no trace of marginal or submarginal spots.

Under surface of the primaries glossy charcoal black in color; markings of upper surface repeated below, but all spots are larger and pale yellow in color; basal quarter of costa yellow tinged with rufous.

Upper surface of the secondaries with large orange-yellow discal patch shaded or margined with rufous along its edges; one deep rufous or black spot in discal cell; base and costa black; one yellow spot along costa and confluent with discal patch; area between vein 2A and inner margin pale yellow; a broad black band along outer margin, through center of which runs a partial series of white dots; no marginal or submarginal spots.

Under surface of secondaries predominantly pale yellow, with broad outer margin of glossy charcoal black in which is central row of white spots, these spots largest near costa and becoming smaller near anal angle; in basal area is diagonal black band from costa to inner margin; narrow row of black spots across postbasal area; series of five deep rufous spots included along outer edge of yellow area; no marginal or submarginal spots.

Fringes: alternately black and white.

Head: black marked with white middorsally.

Palpus: black above and white beneath.

Antenna: black banded with white at juncture of segments; club black, shading to white ventrolaterally.

Thorax: black marked with white ventrally.

Legs: femur largely black but with some pale orange scaling along inner side; tarsus and tibia of forelegs white, those of other legs pale orange.

Abdomen: charcoal black with each segment edged with white; a pale yellow ventral stripe along each side.

ALLOTYPE female. On upper surface pattern and coloring are as in male Holotype, but discal patch on secondaries paler; under surface same in pattern and coloring, but all white spots larger and the postmedian spots elongated into dashes.

HOLOTYPE male: El Salto, 1,600 feet elevation, San Luis Potosi, Mexico, 29 July 1954, *leg.* DAVID L. BAUER. Length of forewing base to apex 23 mm., apex to outer angle 15 mm., outer angle to base 15 mm.; range in type series: base to apex 20-24 mm., apex to outer angle 12-15 mm., outer angle to base 13-15 mm. Length of hindwing base to outer margin 15 mm.; range of type series 13-16 mm.

ALLOTYPE female: same locality as Holotype, 27 July 1954, *leg.* D. L. BAUER. Length of forewing base to apex 28 mm., apex to outer angle 19 mm., outer angle to base 17 mm.; range in type series: base to apex 24-28 mm., apex to outer angle 14-17 mm., base to outer angle 16-19. Length of hind wing base to outer margin 20 mm.; range in type series 18-20 mm.

PARATYPES: 26 ♂♂ and 10 ♀♀, all from Mexico, as follows: 7 ♂♂ and 1 ♀, same data as Holotype; 3 ♂♂ and 2 ♀♀, same data as Allo-

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Fig. 1a — *Chlosyne rosita browni*, Allotype ♀, upperside; fig. 1b — same, underside; fig. 2a — *C. rosita browni*, Holotype ♂, upperside; fig. 2b — same, underside; fig. 3a — *C. riobalsensis*, Allotype ♀, upperside; fig. 3b — same, underside; fig. 4a — *C. riobalsensis*, Holotype ♂, upperside; fig. 4b — same, underside.

type; 6 ♂♂ and 1 ♀, same locality and collector as Holotype, 26 July 1954; 6 ♂♂ and 2 ♀♀, same locality and collector as Holotype, 28 July 1954; 1 ♂, same locality as Holotype, 25 August 1954, *leg.* P. R. Ehrlich; 1 ♀, Rio Purification, Tamps., 26 July 1954, *leg.* D. L. Bauer; 1 ♂ and 1 ♀, El Bonito Valles, S. L. Potosi, 28 June 1940, *leg.* Hoogstraal & Knight; 1 ♂ and 1 ♀, 60 mi. S. of Ciudad Victoria, Tamps., 6 July 1936, *leg.* H. D. Thomas; 1 ♂, Galena, Nuevo Leon, 29 April 1941, *leg.* J. & R. Potts; 1 ♀, 24 mi. S. of Montemorelos, Nuevo Leon, 19 July 1954, *leg.* P. R. Ehrlich.

The Holotype and Allotype are deposited in the Peabody Museum of Natural History, Yale University. One paratype is deposited at the Instituto de Biologia, Mexico City; one at the American Museum of Natural History, New York; five (3 ♂♂, 2 ♀♀) to be returned to F. M. Brown; two (1 ♂, 1 ♀) to Paul R. Ehrlich; the rest remain in the author's collection for the present.

This northern subspecies is remarkably constant in coloring and pattern. Its main differences from *C. r. rosita* are shown in the following list.

1. Upper surface of the forewing (the pattern is the same in both):
   r. rosita - all white spots small;
   rosita browni - median series of white spots larger than other spots.
2. Upper surface of the hindwing (the pattern is similar):
   a. *r. rosita* - discal patch occupies basal half of wing;
   rosita browni - discal patch occupies basal two-thirds of wing.
   b. *r. rosita* - area from vein 2A to inner margin black;
   rosita browni - area from vein 2A to inner margin pale yellow.
3. Under surface of the primaries (the pattern is similar):
   a. *r. rosita* - base of costa black;
   rosita browni - base of the costa yellow tinged with orange.
   b. *r. rosita* - all white spots small;
   rosita browni - all white spots larger, particularly the median series.
4. Under surface of the secondaries (the pattern is similar):
   a. *r. rosita* - area from vein 2A to inner margin black with small yellow spot in middle;
   rosita browni - area from vein 2A to inner margin yellow except at anal angle.
   b. *r. rosita* - series of rufous spots separated from discal patch by black scaling;
   rosita browni - series of rufous spots not definitely separated by black from discal yellow patch, at most a few black scales along inner edge.

Both *C. r. rosita* and *rosita browni* may easily be separated from all other *Chlosyne* which may have similar color patterns, by the complete absence of marginal and submarginal spots. For separation of *C. rosita browni* from *C. montana* I believe quoting from Hall's description concerning the discal patch will enable easy recognition of *montana*: "Hindwings with the red area of a pale pinkish tone, not reaching the base, but taking the form of a broad transverse band crossing the wing and becoming whitish at the inner margin."

As already mentioned, the *quehtala*-like *Chlosyne* from the state of Guerrero does not have marginal or submarginal spots on the wings, and the male genitalia are nearer those of *C. janais* than *C. lacinia*. The genitalia of this insect were found to be almost identical with those of *C. rosita*. However, it is impossible with our present information to know whether this insect is a very distinct subspecies of *rosita* or a closely related full species. But because of the different shape of the primaries, the considerably different ratio of the length of the primaries to the length of the secondaries, and the very different maculation and coloration of the wings, it is described below as a separate species. The name is taken from that of the river in whose basin most of the specimens have been collected.

CHLOSYNE RIOBALSENSIS Bauer, NEW SPECIES

HOLOTYPE male. Upper surface of the primaries jet black; the most prominent markings on this surface are the four large median white spots from costa to vein M_3; rest of median series to inner margin much smaller or obsolete; postmedian white dots small and becoming obsolete toward costa and inner margin.

Under surface of the primaries glossy charcoal black; maculation same as on upper surface with addition of a small white spot at end of discal cell; costa pale orange at base.

Upper surface of the secondaries jet black, with only a trace of the postmedian white dots.

Under surface of the secondaries glossy charcoal black; a dash of yellow at base of costa; small postmedian red spots in cells Cu_1 and Cu_2; postmedian series of white dots mere points of white and in almost submarginal position.

Fringes: white interrupted by black at ends of veins.

Palpus: black dorsally and white ventrally.

Antenna: black with each segment narrowly edged with white; club black above and white beneath.

Head: black with dash of white between eyes.

Thorax: entirely black.

Legs: femur black; tibia and tarsus of foreleg white, those of other legs pale orange.

Abdomen: black with ventral whitish stripes.

ALLOTYPE female. Upper and under surfaces of the wings marked as in male, as are all other markings.

HOLOTYPE male: Mexcala, 2,000 feet elevation, Guerrero, Mexico, 17 July 1956, *leg.* KENT H. WILSON. Length of forewing base to apex 20 mm.; variation in length of forewing in type series 18.5-22 mm. Expanse of forewings 36 mm. Length of hindwing base to outer margin 15 mm.; variation of length of hindwing in type series 13-15 mm.

ALLOTYPE female: Milpillas, 2,300 feet elevation, Guerrero, Mexico, 4 July 1956, *leg.* KENT H. WILSON. Length of forewing base to apex 25 mm.; variation in length of forewing in type series 22-25 mm. Expanse of forewings 48 mm. Length of hindwing base to outer margin 19 mm.; variation in length of hindwing in type series 17 - 19 mm.

PARATYPES: 19 ♂♂ and 4 ♀♀ all from Mexico as follows: 2 ♂♂, same data as Holotype; 1 ♂, same data as Allotype; 4 ♂♂, same locality and collector as Holotype, 13-15 July 1956; 6 ♂♂ and 1 ♀, same locality and collector as Holotype, 29-30 July 1954; 3 ♂♂, same locality and collector as Allotype, 5-6 July 1956; 1 ♂, Alpuyeca, Morelos, Mexico, 10 August 1954, *leg.* D. L. Bauer; 2 ♂♂ and 3 ♀♀, Rio de las Balsas, 2,400 feet elevation, Guerrero, Mexico, 26 June 1941, *leg.* J. & R. Potts.

The Holotype and Allotype are deposited in the Peabody Museum of Natural History, Yale University. One paratype is at the Instituto de Biologia, Mexico City; one at the American Museum of Natural History, New York; four will be returned to F. M. Brown; the remainder will be distributed between the collections of Kent H. Wilson and the author.

Fig. 5. Male clasps: a) *Chlosyne lacinia;* b) *C. riobalsensis.*

The naming of this insect adds to the genus *Chlosyne* one more member with a strictly black-and-white upper surface of the wings. *C. riobalsensis* need not be confused with any of the previously described members of the genus, for it may be separated from all of them by the complete absence of marginal and submarginal spots on both surfaces of all the wings. If there is ever any doubt as to the specimens being *C. riobalsensis* or *C. lacinia quehtala* (with which *C. riobalsensis* flies), a check of the male gentitalia will unquestionably decide the matter - see figure 5b.

Summary

It may be helpful to review the various named species and subspecies, which have been described to date, as not having any trace of the marginal or submarginal spots on the wings, and give the references to original descriptions and type localities.

Hall (1924) named two members of this group. The first in order of pages was *Chlosyne rosita,* described from a series of specimens collected at Moran, Palin, and Escuintla in western Guatemala during the months of August, September, and October. The second, named as *lacinia montana,* was described from a series of twenty specimens collected on Mount Popocatepetl at 10,000 feet elevation. Although Hall placed this insect as a member of *lacinia,* a careful study of his description and his excellent figures of the type shows that there is no trace of the submarginal or marginal spots. This, together with its general appearance, places it in the *rosita* group.

Two more members of the group are now described: *C. rosita browni* and *C. riobalsensis.* At present the systematics of the group is as follows:

Chlosyne rosita rosita Hall — El Salvador to Gulf coast of Mexico

Chlosyne rosita browni Bauer — northeastern Mexico; possibly southern Texas

Chlosyne montana Hall — Mt. Popocatepetl, Mexico

Chlosyne riobalsensis Bauer — southwestern Mexico.

HALL noted that the two he described were fairly constant, not variable as are the populations of *C. lacinia.* He also stated that the forewings are elongated, "narrower and more produced" than in the forms of *lacinia,* and "almost as in *gaudialis* Bates". This more elongated forewing is very characteristic of *C. rosita rosita* and *C. rosita browni,* but it is not prominent in HALL's figure of *C. montana* nor is it mentioned in the description. In *C. riobalsensis* the wings are of typical *Chlosyne* shape with only a few specimens showing a slight tendency to be produced at the apex. *C. riobalsensis* is the only member of the group which shows some variation in the pattern. This variation takes the form of remnants of the discal patch appearing on the under surface of the secondaries.

I have in my possession two more Mexican specimens of this group, which differ from any of the named members. But since I have only one specimen of each I am hoping to get more before describing or discussing them. One is from the state of Guerrero and the other from Lake Chapala, in the state of Jalisco. I would be interested in examining any *Chlosyne* which do not have marginal or submarginal spots on the wings, but their possessors should write before sending specimens.

ACKNOWLEDGEMENTS

Thanks are expressed to Mr. KENT H. WILSON and Mr. M. SPELMAN for making material available for study. I am much indebted to Dr. C. L. REMINGTON and Mr. F. M. BROWN for reading the manuscript and making helpful suggestions, and also for the loan of specimens.

References

Bauer, David L., 1960. A new species of *Chlosyne* (Nymphalidæ) from western Mexico. *Journ. lepid. soc.* 13: 165-169, 2 figs.

Forbes, W. T. M., 1928. A key to the forms of the genus *Chlosyne* (Lepidoptera, Nymphalidæ). *Ann. ent. soc. Amer.* 21: 98-100.

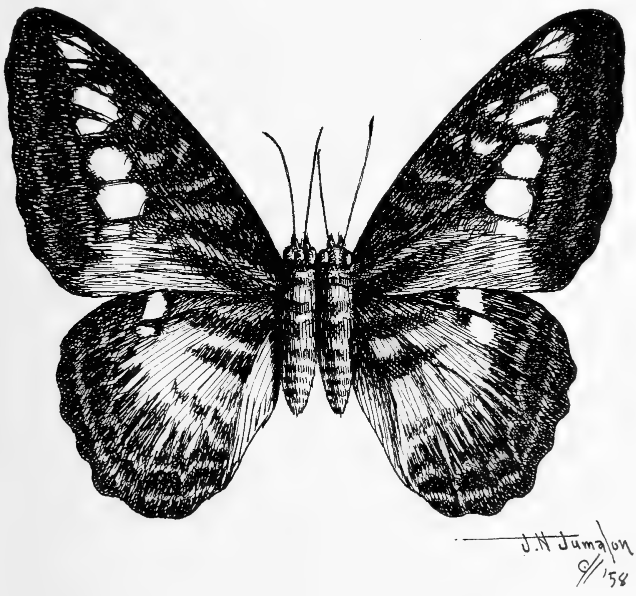
Hall, Arthur, 1924. Descriptions of two new forms of *Chlosyne* (Lep. Nymphalidæ). *Entomologist* 57: 241-242, 4 figs.

General Delivery, Heppner, Oreg., U. S. A.

NOTES ON SIAMESE TWINS OF *PARTHENOS* (NYMPHALIDÆ)

by Julian N. Jumalon

Parthenos salentia Hopffer is a vigorous, active nymphalid always identified with the swampy places, or areas near streams. Fairly large, stout-bodied and conspicuous, it can easily be detected from the distance, due to a characteristic jerky, swift glide. Conspicuous too during its flight are the rows of large, close white spots banding the forewings from below the apex running downward toward the middle of the inner margins where the bands end with a large blotch of greenish-brown, which develops into a wider, black-smeared daub toward the center of the hind-wings, fusing with a broad black margin.



The writer had developed acquaintance with *Parthenos salentia* in Leyte, Samar, Zamboanga del Norte and Lanao in Mindanao, and also in Mindoro. During the University of San Carlos scientific expedition to Agusan-Surigao in 1958, our party found the swamps around Lake Mainit to be the metropolis of this lively nymph. Hundreds of them could be observed on sunny mornings romping from their abode in the pandanus grove toward the nearby wooded hills where we encountered them gamboling in twos or more, and more often, traveling alone up and down the slopes with great energy.

This butterfly was rather rare in Cebu before the war. A few years after liberation, a trickle of reports indicated that *P. salentia* had been seen at several places in Cebu. Finally, an enthusiastic newcomer stumbled onto a swampy area about twelve kilometers north of the city where the butterfly found ideal conditions to thrive in abundance. Here, in one of his frequent visits, ALBERT LIAO spied what appeared to be a couple of *Parthenos salentia* flying *in coitu*. The pair appeared to find it easiest to glide against gravity. Their flight from branch to branch was exceedingly taxing. With little effort, he took it on the wing, and found, to his amazement, that he was pinching two bodies joined at the thorax.

The specimen has two normal bodies with their usual complements of antennæ and legs, but each body possesses only one fore- and one hind-wing, both of normal size. The bodies are joined by the sides of the thoraxes. The color of wings and markings are normal except for one of the two spots in the left hind-wing which is much smaller. The specimen when offered to the writer was mounted in a Riker frame. This was relaxed and set again to assume correct position of wings, and in so doing, one of the antennæ was broken and glued back. The insect appeared to be several days old when caught. That, in its utter clumsiness in its flight it escaped predators, is surprising.

It was learned recently from observers that the place by the swamp had almost been depleted of its *Parthenos* by high school children who frequented it in the past three years. This butterfly is however spreading over a wide area in this island-province, and its foothold here is undoubtedly permanent.

University of San Carlos, Cebu City, PHILIPPINES

ANTEOS CLORINDE NIVIFERA (PIERIDÆ) IN COLORADO

On the first of September, 1960, Mr. JOHN JUSTICE of Denver wrote to me and reported the capture of a second specimen of this tropical pierid in the Denver region. The first capture is referred to on p.388 of *Colorado Butterflies* (Brown, Eff, Rotger, 1957).

I quote here from Mr. JUSTICE's letter: "On August 29, 1960 I captured a white angled sulphur butterfly. The location was near the place where the highway to Boulder leaves the Valley Highway, just north of Denver, in Adams County [Westminster, Adams Co.]. I found the butterfly in a bed of zinnias and caught it while it was sipping nectar from a red zinnia . . . The wing span is just over 3½ inches [the earlier specimen measured 3⅜ inches]. . . . The wings are only slightly rubbed, but they are chipped in four places . . . "

This summer I have noticed subtropical nomads several times in Colorado. During July *Phœbis eubule* was seen twice during the second week near Ouray, Ouray Co. During August both *Phœbis eubule* and *Ascia monuste* were in our garden at Fountain Valley School, near Colorado Springs, El Paso Co. The former has been seen two or three times a week and the latter on August 27th.

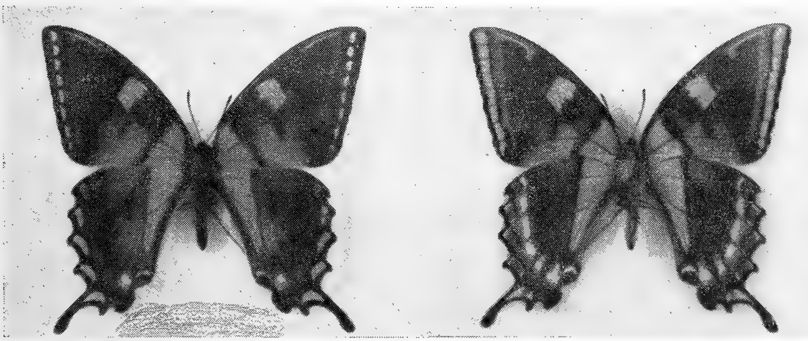
F. MARTIN BROWN, Fountain Valley School, Colorado Springs, Colo., U. S. A.

A STRIKING MELANIC MALE OF *PAPILIO GLAUCUS*

by JAMES A. EBNER

In northern Wisconsin *Papilio glaucus canadensis* Rothschild & Jordan is normally an abundant and attractive species, freely roaming the forest trails and roadsides alike. During the first three weeks of June it is often encountered in great numbers, eagerly visiting flowers, mud puddles and fresh manure. Despite its great abundance and extensive range, the species apparently varies little. It is easily understandable to imagine the writer's shock upon finding a melanic male *canadensis* in exquisite condition. The specimen happened to be discovered among an accumulation of normal Canadian Tigers collected by LOUIS ALLEN, of Milwaukee, while vacationing in Forest County. His account of this amazing capture follows:

"On June 16, 1958, I found *P. canadensis* fairly swarming in the vicinity of Crandon, Forest County, Wisconsin. Since the species is comparatively easy to take when occupied at feeding itself, I decided to collect them leisurely upon fresh manure piles in the area. At approximately 2:00 p.m. (CDT) a likely spot for collecting them was found alongside MacArthur Trail, an asphalt road intersecting with U. S. Highway 8 about two miles east of Crandon. Here, several hundred yards south of the main highway, a score or so of *canadensis* were enjoying themselves in this rather foul environment. In looking over the assembled group busily dining, I couldn't help but notice one individual considerably darker than its other male companions. I netted it easily and ushered it quickly into the cyanide bottle. The temperature at this time was in the upper sixties and the wind was out of the northwest at about ten miles per hour."



Papilio glaucus melanic ♂, upper surface at left, lower surface at right.

The more noteworthy features regarding the coloration of this melanic are enumerated below:

Upper surfaces of primaries: marginal yellow spots distinct and typical; black submarginal border greatly enlarged, extending and obliterating the apical and discal stripes of normal *canadensis*; prominent clear yellow patch in the postmedian discal area; larger more nebulous patch of suffused yellow in the median portions of cells Cu_1 and Cu_2; yellow in the basal areas unaffected and bright.

Upper surfaces of secondaries: yellow lunules normal; black submarginal border enlarged and radiating inwardly to the mid point of the disc where it terminates abruptly with the usual discal stripe; central surfaces a granulated smoky black; basad of the discal stripe the average yellow of *canadensis* predominates.

Under surfaces: generally primaries and secondaries but modified extensions of upper surfaces; irridescent blue scaling of the secondaries superbly developed when contrasted to the orange marginal lunules and the exaggerated smudgy black portions inwardly.

The head, thorax, and abdomen do not vary noticeably from normal *canadensis.*

Although the genetical complexities regarding this specimen or other similar melanic forms are little understood by the writer, it is clearly evident that this particular individual should be announced to fellow butterfly enthusiasts. For this reason the specimen is figured as a matter of permanent scientific record. The plated specimen is contained within the private collection of its captor, L. ALLEN of Milwaukee, Wisconsin.

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A RECORD OF *BOLORIA SELENE* IN OREGON

In so far as I can ascertain from searching the literature, *Boloria epithore* (Edwards) is the only *Boloria* recorded from the state of Oregon. It is taken generally throughout western Oregon and through the mountain areas of eastern Oregon. Although considerable searching has been done in the Mt. Hood area, to my knowledge *Boloria rainieri* (Barnes & McDunnough) never has been taken on the Oregon side of the Columbia river. I have, however, taken it in numbers on the eastern slopes of Mt. Adams only 35 miles north of the Columbia river.

Three years ago while collecting in the Big Summit Prairie section of the Ochoco Mountains in central Oregon HAROLD RICE collected a good series of a *Boloria* entirely different which proved to be *Boloria selene tollandensis* (Barnes & Benjamin) upon identification by L. PAUL GREY. The range of *tollandensis* has been described as Colorado and north through the Rockies, extending into portions of Idaho and Washington. It is possible that it could be taken in the Wallawa and Blue Mountains of eastern Oregon although there are no records of its capture from that area.

On 14 June, 1958, accompanied by Mr. RICE, JAMES H. BAKER, and STANLEY G. JEWETT, I made a special trip to the Big Summit Prairie for two days' collecting but we were plagued with inclement weather for all but two hours on the morning of the 15th. Although the Prairie has a total length of about twenty-five miles, and a width of approximately ten miles, *tollandensis* was taken only in one small, marshy ravine that was open and grassy and of not over ten acres. BROWN, EFF, and ROTGER (*Colorado Butterflies*: p. 64; 1957) report similar local and restricted habitats for *tollandensis* in Colorado. In a brief period of sunshine approximately twenty specimens were taken. Although similar habitats occur and collecting has been done, no other part of the Prairie has been productive. Since collections from this area have been made three years in a row it is safe to assume that the colony is well established.

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ESPECIALLY FOR FIELD COLLECTORS

(Under the supervision of FRED T. THORNE, 1360 Merritt Dr., El Cajon, Calif., U.S.A.)

CONTAINERS FOR REARING LARVÆ, CONSTRUCTED EASILY AND QUICKLY

by JOSEPH MULLER

In my leisure time I often browse through the older issues of *The Lepidopterists' News*. Doing just that, I came upon the article "Some Simple Equipment for Rearing Larvæ" by RICHARD GUPPY (*Lepid. news* 11: 227-229; 1958). Comparing his methods with mine gave me the idea to describe my own home-made containers, being used successfully for many years.

Before arriving at the containers I presently use I worked with large-mouthed gallon jars. An ink bottle filled with water containing food plant was placed on the bottom of the jars. The top was covered with cloth, held in place with rubber band or string. Finding that many young larvæ, once they left the food plant or fell to bottom of jar, had a tough time to find their way back or died in doing so, I eliminated the ink bottle. Instead, I had a hole drilled in the bottom of the jars, the size of a quarter-dollar, making it easier for wandering larvæ to get back to it, as food plant now was touching the bottom of the jar. Still, these were not the desired containers. In using these glass jars I had to stick to certain sizes of jars, while smaller glass jars collected moisture on the sides so fast and thick that a large percentage of larvæ stuck there and drowned.

After more experimenting I stumbled on plastic. Now, at last, I was able to make my own containers in any size I wished quickly, moisture free, neat-looking, and I have been using them for the last ten years. The small plastic containers are especially handy for freshly merged larvæ, as almost anything will do to raise full grown larvæ in.

The average sized and most easily made container I build out of an empty coffee can which I cut to about half of its height. Plastic, usually bought in sheets or rolls, is available in different thicknesses. It is better not to use it too heavy as it is much easier to fit together, but it should stand up by itself. Plastic must be cut straight to prevent larvæ to escape on bottom or top of container. After it is cut to the desired height, averaging 6-12 inches, it is fitted very tightly in inside of the can, overlapping about one inch on a side and held together with "Mistik Tape". One strip I tape to the inside and one to the outside of the plastic, overlapping one inch on bottom and top which then I bend to the inside of the cylinder. Plastic glue, in my experience, is messy to handle, and plastic when not heavy enough will bulge either inward of outward, making openings for larvæ to escape. "Mistik Tape" makes a neat, job, besides it can be taken off again, to use the cylinder to make different sizes. Around tops of coffee cans one finds a metal band which is easily taken off. This ring fits perfectly over cloth on top of the cylinder and holds the same in place so that no larvæ can escape. Food plant comes through a role on the bottom of the can which itself stands on top of a container filled with water. The bottom of the can is covered with white paper to absorb moisture and is exchanged when the receptacle is cleaned. I prefer white paper because the fine dust-like frass will be detected immediately, before any chewing on food plant by caterpillars can be found. This is very important, especially when the food plant of larvæ is not known, enabling one to present a different bouquet in time before larvæ die.

When having only a few larvæ to feed, I make of course smaller containers. Looking closely around the house, one always will find some kind of a can or even a hard paper container for the bottom part of the receptacle. When food plant has to be changed I have a second one handy with fresh food in which I drop larvæ. For growing larvæ I use larger containers. I have just finished building four containers 12 inches high and a diameter of 10 inches. For the bottom part I used a very hard paper drum. These drums are available in all sizes. The only difficulty is to hold close in place a top, as no rubber band or string can be used. Thinking of the perfect job the ring of a coffee can does, I make a similar ring out of soft metal bands riveted together with "Speedy Rivets", the whole job taking only minutes. Every hardware store will handle both metal bands and rivets. Plastic cylinders are also nicely used over potted food plants in flower pots or tin cans.

Larvæ too large for these containers I feed in wider, hard paper drums or wooden barrels. One or two bottles, depending on the size of the barrels, contain food plant. Burlap bags are used for covering, fastened with strings. Barrels must be kept in a cool place, and in hot spells during summer, bags are soaked in water, keeping leaves fresh longer. More than one hundred larvæ of *Catocala* I fed and had pupated in one barrel without losing a single one at one time. For full grown Sphingidæ larvæ, which are best raised to the last stage in sleeves outdoors, I prepare a heavy layer of sphagnum moss on the bottom for them to pupate in. Larvæ which are still feeding after three days (most will have disappeared in the moss) I transfer to a different receptacle to prevent them from squashing already pupating larvæ.

I get a lot of pleasure out of chasing butterflies in the field, sugaring and light collecting, but the greatest satisfaction I get rearing scarce and interesting species from the egg to the adult stage. Describing my home made containers, I hope to encourage some beginners to do more rearing with the help of these easily and quickly constructed plastic receptacles.

Early this spring (1960), I have almost one thousand larvæ (mostly *Catocala*) hatching, and I can hardly wait until the time comes to transfer the tiny larvæ to my already prepared containers.

R. D. 1, Lebanon, N. J., U. S. A.

RECENT LITERATURE ON LEPIDOPTERA

(Under the supervision of PETER F. BELLINGER)

F. BIOLOGY AND IMMATURE STAGES

Comstock, John Adams, "Notes on metamorphoses of the Giant Skippers (Lepidoptera: Megathyminæ) and the life history of an Arizona species." *Bull. southern Calif. Acad. Sci.*, vol.55: pp.19-27, 3 figs. 1956. Describes mature larva & pupa of *Megathymus evansi*. [P B.]

Comstock, John Adams, "Notes on the life history of a rare Arizona sphinx moth, *Xylophanes falco* Walker." *Bull. southern Calif. Acad. Sci.*, vol.55: pp.102-106, 5 figs. 1956. Describes mature larva & pupa; foodplant *Bouvardia glaberrima*. [P.B.]

Comstock, John A., "Brief notes on the life histories of two Arizona geometrid moths." *Bull. southern Calif. Acad. Sci.*, vol.56: pp.99-100 1957. Describes larva & pupa of *Philobia aspirata* (from Black Walnut), & egg & young larva of *Pero modestus*. [P.B.]

Comstock, John Adams, "Life histories of two southern Arizona moths of the genus *Caripeta*." *Bull. southern Calif. Acad. Sci.*, vol.56: pp.88-96, 4 pls. 1957. Describes & figures early stages of *C. hilumaria* (reared on willow, probably not the normal foodplant) & *C. macularia* (reared on oak). [P. B.]

Comstock, John Adams, "Notes on the early stages of two western American moths." *Bull. southern Calif. Acad. Sci.*, vol.56: pp.42-47, 6 figs. 1957. Describes mature larvæ & pupæ of *Cisthene nexa* & *Agriopodes viridata;* both feed on the lichen *Ramalina combeoides*. [P. B]

Comstock, John Adams, "Notes on the metamorphosis of an *Agave*-boring butterfly from Baja California, Mexico." *Trans. San Diego Soc. nat. Hist.*, vol.12: pp.263-276, 1 pl. 1957. Describes mature larva & pupa of *Megathymus comstocki* & compares them with those of *M. stephensi*. Foodplant *Agave orcuttiana*. [P. B.]

Coombs, C. W., "The insect fauna of an empty granary." *Bull. ent. Res.*, vol.46: pp.399-417, 2 pls., 2 figs. 1955. Reports survival in unused warehouse of some stored products pests, including 4 Lepidoptera [P. B.]

Coppel, H. C., & M. G. Maw, "Studies on dipterous parasites of the Spruce budworm, *Choristoneura fumiferana* (Clem.) (Lepidoptera: Tortricidæ). III. *Ceromasia auricaudata* Tns. (Diptera: Tachinidæ)." *Canad. Journ. Zool.*, vol.32: pp.144-156, 16 figs. 1954. Describes parasite & biology. Eggs are laid on leaves & ingested by larvæ; parasites develop during pupal stage of host. *Hyphantria cunea* is another host. [P. B.]

Coppel, H. C., & M. G. Maw, "Studies on dipterous parasites of the Spruce Budworm, *Choristoneura fumiferana* (Clem.) (Lepidoptera: Tortricidæ). IV. *Madremyia saundersii* (Will.) (Diptera: Tachinidæ)." *Canad. Journ. Zool.*, vol.32: pp.314-323, 16 figs. 1954. Describes parasite attacking larvæ of many Lepidoptera. [P. B.]

Coppel, H. C., & B. C. Smith, "Studies on dipterous parasites of the Spruce Budworm, *Choristoneura fumiferana* (Clem.) (Lepidoptera: Tortricidæ). V. *Omotoma fumiferanæ* (Tot.) (Diptera: Tachinidæ)." *Canad. Journ. Zool.*, vol.35: pp.581-592, 15 figs. 1957. Describes morphology & biology. [P. B.]

Cornwell, P. B., L. J. Crook, & J. O. Bull, "Lethal and sterilizing effects of gamma radiation on insects infesting cereal commodities." *Nature*, vol.179: pp.670-672, 2 figs. 1957. Including *Ephestia* spp. & *Sitotroga cerealella*.

Cowley, J., "*Pararge ægeria* captured by a dragon fly." *Entomologist*, vol.86: p.151. 1953.

Cox, H. C., "Feeding habits of European Corn Borer larvæ on selected field corn inbreds and single cross hybrids." *Iowa State Coll. Journ. Sci.*, vol.30: pp.343-344. 1956. Abstract.

Cretschmar, Max, "Ein Gartenschläfer als Konkurrent beim Lichtfang" [in German]. *Zeitschr. Lepid.*, vol.1: p.30. 1950. Dormouse *Eliomys quercinus* taking moths at light. [P. B.]

Crooke, Myles, "An outbreak of the Pine Looper Moth (*Bupalus piniarius*, L.) at Cannock Chase in Staffordshire, and some notes on the biology of this pest." *Irish Forestry*, vol.10: pp.60-63, 3 figs. 1953. Figures larva & adults. [P. B.]

Crooke, Myles, "The Pine Looper Moth." *Quart. Journ. Forestry,* vol.48: pp.36-38, 1 pl. 1954. Biology of *Bupalus piniarius.* [P. B.]

Crooke, Myles, "Host of the overwintering generation of *Trichogramma evanescens* Westw. (Hym., Trichogrammatidæ)." *Ent. mo. Mag.,* vol.92: p.368. 1956. Recorded from eggs of *Bupalus piniarius.* [P. B.]

Cumber, R. A., "Injury to *Phormium* caused by insects, mites, and molluscs." *N. Z. Journ. Sci. Tech., Sect.A,* vol.36: pp.60-74, 20 figs. 1953. Lepidoptera attacking the plant are *Oxycanus signata, Stathmopoda phlegyra, Tortrix postivittana, Cnephasia jactatana, Œceticus omnivorus, Orthoclydon præfectata,* & *Persectania steropastis.* [P. B.]

Cunningham, J. R, "A note on the Ghost Moths — family Hepialidæ. *Abantiades hyalinatus* (Herrick Schaeffer)." *Pap. Roy. Soc. Tasmania,* vol.89: p.151. 1955. Life history notes: larvæ occur in silken tunnels in the ground, leading to the roots of *Eucalyptus amygdalina* upon which they feed. [I. C.]

Curtis, W. Parkinson, "*Epischnia bankesella* Rich. (Lep. Phycitidæ)." *Journ. Soc. Brit. Ent.,* vol.3: pp.278-279. 1951. Larvæ fed successfully on *Inula crithmoides* from cliff edge (normal habitat of moth) but rejected same plant sp. from salt marsh. [P. B.]

Curtis, W. Parkinson, "The Robin (*Erithacus rubecula melophilus* Hartert) attacking insects." *Ent. mo. Mag.,* vol.92: p.10. 1956. Including Noctuidæ, *Pieris, Aglais, Vanessa* (adults). [P. B.]

Daniel, F., "Beobachtung über die Lebensweise hochalpiner Vertreter der Gattung *Hepialus* (Lep.-Hepialidæ)" [in German]. *Mitt. münchner ent. Ges.,* vol.40: pp.203-206. 1950. On the flight periods of 2 alpine spp. *H. carna* ♂♂ fly in the morning, while ♀♀ are emerging; latter fly & deposit eggs in afternoon; ♂♂ probably live only 1 day. *H. fusconebulosus* ♂♂ fly for about 20 minutes at dusk; ♀♀ fly & deposit eggs at night. [P. B.]

Daniel, Franz, "Beiträge zur Lebensweise von *Selenephora lunigera* f. *lobulina* Esp. (Lep. Lasiocamp.)" [in German]. *Mitt. münchner ent. Ges.,* vol.41: pp.251-257. 1951. Spring & summer 'generations' in Bavarian lowlands are actually 2 races, each with an annual cycle. [P. B.]

Darlington, Emlen P., "Notes on blueberry Lepidoptera in New Jersey." *Trans. Amer. ent. Soc.,* vol.78: pp.33-57. 1952. Records (some from literature) of nearly 100 spp. of Lepidoptera feeding on *Vaccinium* or *Gaylussacia;* notes on habits of some. [P. B.]

Darlow, H. M., "*Callophrys rubi* L., a new foodplant." *Ent. Rec. & Journ. Var.,* vol.65: p.19. 1953. Mature larva on *Hieracium pilosella.* [P. B.]

Darlow, H. M., "Stridulation in *Laphygma exigua* Hüb. and *Agrotis segetum* Schf." *Ent. Rec. & Journ. Var.,* vol.65: p.20. 1953. Adults; mechanism unknown. [P. B.]

Darteville, E., "Nouveau cas de transport de pseudoscorpion par un papillon" [in French]. *Lambillionea,* vol.54: pp.34-35. 1954. Pseudoscorpion attached to leg of *Sterrha aversata.* [P. B.]

Das, G. M., "Insects and mite pests of jute." *Science & Culture,* vol.14: pp.186-190. 1948. Records *Diacrisia abliqua, Anomis sabulifera, Laphygma exigua, Prodenia litura, Tarache crocala,* & *Scopula emmissaria* feeding on *Corchorus* spp [P. B.]

Daviault, Lionel, "La tordeuse à tête verte de l'épinette: *Tortrix packardiana* Fern." [in French]. *Ann. de l'ACFAS,* vol.16: pp.147-151, 1 fig. 1950. Describes all stages & records parasites & predators. [P. B.]

Davis, C. J., "New host and insect records from the island of Hawaii." *Proc. Hawaiian ent. Soc.,* vol.15: pp.85-86. 1953. Including spp. feeding on *Acacia koaia*: *Amorbia emigratella* & *Lycæna blackburni* (leaves), *Argyroploce illepida* (seeds), *Orthomycena* sp., *Enarmonia walshinghami,* & *Decadarchis minuscula* (twigs). [P. B.]

Davis, C. J., "Some recent lepidopterous outbreaks on the island of Hawaii." *Proc. Hawaiian ent. Soc.,* vol.15: pp.401-403. 1955. Including *Pseudaletia unipuncta* & *Laphygma exempta,* with lists of grasses attacked & parasites reared. [P. B.]

Delamare Debouteville, C., & R. Paulian, "Cycle evolutif d'un peuplement nidicole en Basse Cote d'Ivoire" [in French]. *Bull. Mus. nat. Hist. nat.,* Paris, vol.19: pp.453-455. 1947. Records *Monopis megalodelta* larvæ from nests of weaver birds. [P. B.]

Delucchi, Vittorio, & Jean Verbeke, "*Habrocytus milleri* n. sp., ectoparasite de *Coleophora frischella* L." [in French]. *Bull. Inst. Roy. Sci. nat. Belg.,* vol.29, no.3: 14 pp., 19 figs. 1953. Describes biology of this hymenopteran. [P. B.]

Demuth, R. P., "Birds and moths." *Ent. Rec. & Journ. Var.,* vol.67: pp.157-158. 1955. Notes on birds feeding on moths remaining near light trap in morning [P. B.]

Dever, D. A., "Identification of the larvæ of the more important insect pests of sour cherry in Wisconsin." *Trans. Wisconsin Acad. Sci.*, vol 43: pp.83-88, 1 pl. 1954. Brief descriptions and setal maps for *Grapholitha packardi, Mineola scitulella, Archips argyrospila,* & *Spilonota ocellana.* [P. B.]

Diadechko, N. P., "Parasites and predators of the American White Moth" [in Russian]. *Nauchn. Trudy Inst. Ent. Fitopatol. Akad. Nauk URSR,* vol.5: pp.106-109. 1954. *Hyphantria cunea.* [Not seen].

Diakonoff, A., "Case bearing Lepidoptera IV." *Ent. Berichten,* vol.14: pp.134-137, 5 figs. 1952. Describes 3 cases belonging to undetermined spp. of Lepidoptera, collected at Tjibodas, Java. [P. B.]

Dickson, C. G. C., "The life history of *Phasis pyrœis* Trim (Lepidoptera: Lycænidæ)." *Journ. ent. Soc. southern Africa,* vol.11: pp.50-62, 1 pl., 1 fig. 1948. Detailed descriptions of all stages. Foodplant *Zygophyllum flexuosum;* larvæ 'milked' by ants. [P. B.]

Dickson, C. G. C., "The larva and pupa of *Pseudonympha trimenii* Butl. (Lep.: Satyridæ)." *Journ. ent. Soc. southern Africa,* vol.12: pp.173-174. 1949. Describes adult larva and pupa; foodplant *Danthonia stricta.* [P. B.]

Dickson, C. G. C., "The life-history of *Charaxes pelias pelias* Cram. (Lepidoptera: Nymphalidæ)." *Journ. ent. Soc. southern Africa,* vol.12: pp.109-117, 2 pls. 1949. Detailed description; foodplant *Rafnia amplexicaulis.* [P. B.]

Dickson, C. G. C., "Recently observed food-plants of some Cape lepidopterous larvæ (4th series)." *Journ ent. Soc. southern Africa,* vol. 16: pp.73-76. 1953. Records of foodplants and plants, etc., selected for oviposition; 46 spp. (15 families). [P. B.]

Dickson, C. G. C., "Note on oviposition of *Thestor basutus* (Wllg.) (Lep.: Lycænidæ)." *Journ. ent. Soc. southern Africa,* vol.17: p.140. 1954. Eggs laid on *Vernonia natalensis,* but presence of ant *Anaplolepis custodiens* probably more significant for this (presumably) myrmecophilous sp. [P. B.]

Dickson, C. G. C., "On the association of *Lepidochrysops patricia* (Trim.) (Lepidoptera: Lycænidæ) with ants." *Journ. ent. Soc. southern Africa,* vol.18: pp.48-49. 1955. Pupæ found in nests of *Camponotus* sp. Foodplant (young larvæ): *Lantana salvifolia.* [P. B.]

van Dinther, J. B. M., "*Laphygma frugiperda* S. & A. and *Mocis repanda* F. in Suriname." *Ent. Berichten,* vol.15: pp.407-411, 427-431, 5 figs. 1955. Describes all stages & biology of these noctuids. [P. B.]

van Dinther, J. B. M., "Caterpillars injurious to *Brassica* species in Surinam." *Ent. Berichten,* vol.16: pp.201-206. 1956.

van Dinther, J. B. M., "Soy bean insects." *Ent. Berichten,* vol.16: pp.104-107, 3 figs. 1956. Describes life histories of Surinam Lepidoptera: *Laphygma frugiperda, Agrotis repleta,* & *Anticarsia gemmatilis.* [A. D.]

van Dinther, J. B. M., "Three noxious hornworms in Suriname." *Ent. Berichten,* vol.16: pp.7-9, 26-28, 42-44, 3 figs. 1956. Describes all stages & biology & figures adults of *Protoparce sexta paphus* (on tobacco, tomato, peppers), *Erinnyis alope* (on papaya), & *Pseudosphinx tetrio* (on *Plumeria*). [P. B.]

van Dinther, J. B. M., "Notes on the moth *Arsenura armida erythrinæ* (F.)." *Ent. Berichten,* vol.17: pp.229-232, 2 figs. 1957. Describes all stages & biology; larvæ feed on *Erythrina glauca* & cacao in Suriname. [P. B.]

van Dinther, J. B. M., "*Papilio anchisiades anchisiades* Esper, a citrus pest of minor importance." *Ent. Berichten,* vol.17: pp.213-216. 1957. Describes all stages. [P. B.]

Docters van Leeuwen, W. M., "Kweek van *Macrothylacia*" [in Dutch]. *Ent. Berichten,* vol.14: pp.30-31. 1952. Rearing notes.

Docters van Leeuwen, W. M., "On the biology of some Javanese Loranthaceæ and the role birds play in their life-history." *Beaufortia,* vol.4: pp.103-207, 10 pls., 23 figs. 1954. Records numerous insects feeding on plants of this family, including *Tajuria cippus, Delias* spp., *Dasychira mendosa,* & *Euproctis cataba.* [P. B.]

Dodge, Harold R., "Defoliating insects in the northern Rocky Mountains in 1955." *Northwest Sci.,* vol.31: pp.38-42, 1 map. 1957. Includes host records for *Choristoneura* spp., *Hemerocampa pseudotsugata, Zeiraphera griseana, Archips cerasivorana, Malacosoma sp., Tortrix cockerellana.* [P. B.]

Döring, Ewald, "Ein Beitrag zur Kenntnis der Cremaster von Microlepidopteren" [in German]. *Deutsche ent. Zeitschr.,* N.F., vol.1: pp.23-32, 64 figs. 1954. Describes & figures cremaster of 32 spp. of micros. [P. B.]

Döring, Ewald, "Ein Beitrag zur Kenntnis der Cremaster der Lepidopteren (Lep.)" [in German]. *Deutsche Ent. Zeitschr.*, N.F., vol.2: pp.326-331, 20 figs. **1955. De**scribes & figures cremaster in 20 spp. (*Hepialus* & Microlepidoptera, especially Zygænidæ & Ægeriidæ). [P. B.]

Döring, Ewald, *Zur Morphologie der Schmetterlingseier* [in German]. 154 pp., 61 pls. Berlin: Akademie-Verlag. 1955. See review in *Lepid. News*, vol.10: p 56.

van Doesburg, P. H., jr., "Enige waarnemingen betreffende de waard-parasiet relatie bij *Bupalus* (Lep. Geometridæ) en *Carcælia* (Dipt. Tachinidæ)" [in Dutch; German summary]. *Ent. Berichten*, vol.16: pp.173-175, 2 figs. 1956.

Donahue, Ralph J. & Mildred L., "A moth that likes company." *Natural History*, vol. 66: pp.201-203, 7 figs. 1957. Habits of larvæ of *Harrisina americana*. [P. B.]

Donohoe, Heber Clark, "The bionomics of the Raisin Moth, *Ephestia figulilella* Gregson." *Summ. Ph.D. Theses Univ. Minnesota*, vol.3: pp 47-49. 1949. Abstract.

Douglass, J. R., K. E. Gibson, W. E. Peay, & J. W. Ingram, "Western Bean Cutworm as a pest of corn." *Bull. ent. Soc. Amer.*, vol. 2, no. 3: p. 19. 1956. Abstract; *Loxagrotis albicosta*.

Douglass, J. R., J. W. Ingram, K. E. Gibson, & W. E. Peay, "The Western Bean Cutworm as a pest of corn in Idaho." *Journ. econ. Ent.*, vol. 50: pp. 543-545, figs. 1957. *Loxagrotis albicosta*, which has been a pest of beans, reported attacking ears of corn around Twin Falls, Idaho. [W. C.]

Drees, H., & H. Schwitulla, "Bekämpfung einer Epidemie von *Malacosoma neustria* L. durch die Tachine *Carcelia gnava* Meig." [in German; English summary]. *Zeitschr. Pflalnzenkrankh.*, vol. 64: pp. 215-228, 3 figs. 1957. Describes biology & life cycle of a parasite developing on *M. neustria* & *Arctia caja*. [P. B.]

Dresner, Edgar, "The toxic effect of *Beauveria bassiana* (Bals.) Vuill. on insects." *Ohio State Univ. Abs. doct. Diss.*, vol. 61: pp. 117-122. 1951. Including *Phthorimæa operculella;* abstract.

Drilhon, A., & C. Vago, "Discrimination entre deux types étiologiques de flacherie chez *Bombyx mori*. Diagnostics différentiels par l'electrophorèse" [in French]. *C. R. Soc. Biol.*, vol. 149: pp. 39-42, 1 fig. 1955. Method of distinguishing the form of this disease caused by *Bacillus cereus* from one of unknown cause. [P. B.]

Drooz, A. T., & D. M. Benjamin, "Parasites from two Jack-pine Budworm outbreaks on the Upper Peninsula of Michigan." *Journ. econ. Ent.*, vol. 49: pp. 412-413. 1956. Lists larval & pupal parasites of *Choristoneura pinus* [W. C.]

Dufrane, A., "Chernètes et lépidoptères" [in French]. *Bull. & Ann. Soc. ent. Belg.*, vol. 92: pp. 61-63, 1 fig. 1956. Presence of pseudoscorpion *Withius cæcus* on *Tinea biskraella* from S. Tunisia. [P. V.]

Dunk, H. C., "Observation on the early stages of *Apatura iris* Linn." *Ent. Rec. & Journ. Var.*, vol. 66: pp. 135-137. 1954.

Dunn, Paul Hayden, "The susceptibility of certain common insects to *Bacillus thuringiensis* Berliner." *Ohio State Univ. Abs. Masters' Theses*, no. 74: pp. 29-30. 1955. Abstract; including 9 Lepidoptera.

Dziurzyński, Adam, "Contributions to the knowledge of the development and morphology of *Antispila petryi* Mart. and other species of the genus *Antispila* occurring in environs of Cracow, Poland" [in Polish; English summary]. *Docum. physiogr. Polon.*, nr. 28: pp. 1-55, 12 figs. 1952. Important study on biology and morphology of this sp. [J. M.]

Easton, N. T., "Egg-laying of butterflies in close confinement." *Ent. Rec. & Journ. Var.*, vol. 66: pp. 276-277. 1954. Reports *Pieris* hybrid ♀♀ laying in small boxes while in transit. [P. B.]

Ebeling, Walter, & Roy J. Pence, "Orange Tortrix on avocados." *Calif. Agric.*, vol.11, no.8: pp.13-14, figs. 1957. Habits of *Argyrotænia citrana*. [W. C.]

Edwards, E. O., "The foodplants of the Chequered Swallowtail, *Papilio demoleus sthenelus* Macleay, 1826 (Lepidoptera: Papilionidæ)." *Proc. Roy. zool. Soc. New South Wales*, 1954-55: pp.63-64. 1956. Reports that in western Queensland the larvae of this species feed on *Psoralea patens* and *P. tenax* (Leguminosæ). The ovipositing adults are not attracted to *Citrus*, one of the host plants previously recorded for the species, in coastal areas. [I. C.]

Eisenbeiss, H., "From caterpillar to butterfly." *Nat. Hist.*, vol.65: pp.184-185, 8 figs. 1956. Pupation and emergence of *Papilio machaon*.

Elfferich, N. W., "Kweek van *Leucodonta bicoloria* Schiff." [in Dutch; English summary]. *Ent. Berichten*, vol.17: pp.137-138, 1 fig. 1957. Describes rearing; photos of larva & adult. [P. B.]

Eliescu, Grigore, "Beiträge zur Kenntnis der Verteilung der Eier von *Tortrix viridana* L. auf den Zweigen in Hinblick auf die Abschätzung der Befallsintensität" [in German]. *Beitr. Ent.,* vol.5: pp.462-472, 10 figs. 1955. Plot of egg distribution along twig follows regular curve, greater concentration being near tip; initial slope of curve is a measure of expected population size. [P. B.]

Eliot, N., "Dragon-fly preying on Humming-bird Hawk Moth." *Entomologist,* vol.88: p.21. 1955. *Macroglossa stellatarum.*

Eliot, N., "A natural check to a Gypsy Moth plague." *Entomologist,* vol.89: pp 5-8. 1956. Records larvævorid parasite. Also records parasites (2 new records) of *Libythea celtis* & *Nymphalis antiopa.* [P. B.]

Elton, E. T. G., "Infestation of 'moll' sheets by *Achroia grisella* Fabr. (Lep., Pyralidæ)" [in Dutch; English summary]. *Ent. Berichten,* vol.16: pp.12-14. 1956. Larvæ reported attacking material (modified cork) used as pinning sheets in insect boxes. [P. B]

Ene, M., & H. Almasan, "Destruction of eggs of the Gypsy Moth (*Lymantria dispar* L.) by insectivores in the forests of Badadag" [in Roumanian]. *Revista Padurilor,* vol.70: pp.225-226. 1955. [Not seen].

Etcheverry C., María, "Identificaciones lepidopterologicas" [in Spanish; English summary]. *Rev. chilena Ent.,* vol.3: pp.126-131. 1954. Records following spp. bred from alfalfa in Chile: *Hemiargus ramon, Leptotes trigemmatus, Laphygma frugiperda, Rachiplusia ni, Prodenia eridania, Anticarsia gemmatilis, Heliothis armigera;* key to adults. [P. B.]

Evans, William H., "Foodplants of *Pero macdunnoughi.*" *Lepid. News,* vol.10: p.168. 1957.

Fallig, P. W., "The Ichneumonidæ or parasitic Hymenoptera of Georgia." *Emory Univ. Mus. Bull.* no.9: 78pp. 1950. Lists hosts, including numerous Lepidoptera; no host index. [P. B.]

Fearnehough, T. D., "A note on rearing *Hydriomena ruberata* Freyer" *Ent. Rec. & Journ. Var.,* vol.64: p.88. 1952. Larval behaviour & pupation; reared on sallow. [P. B.]

Fearnehough, T. D., "Experiments with eggs of *Lysandra coridon.*" *Ent. Rec. & Journ. Var.,* vol.69: pp.230-231. 1957. When eggs containing fully formed larvæ which appeared to be hibernating normally were opened, larvæ emerged & began to feed. [P. B.]

Feddersen, Tage, "Mere om *Calotænia celsia*" [in Danish]. *Ent. Meddelelser,* vol 26: pp.506-507. 1953. These noctuids are attracted to flowering heads of *Festuca* & *Calamagrostis.* Sp. apparently well established in Denmark. [P. B.]

Ferrière, Ch., "Les parasites de *Lyonetia clerckella* près de Lausanne" [in French]. *Mitt. schweiz. ent. Ges.,* vol.25: pp.145-146. 1952. Records 8 parasites & their frequency. [P. B.]

Ferrière, Ch., "Parasites de *Lyonetia clerckella* en Valais (Hym. Chalcidoidea)" [in French]. *Mitt. schweiz. ent. Ges.,* vol.25: pp.29-40. 1952. Describes 6 eulophids (2 new spp.) reared from this moth. [P. B.]

Ferrière, Ch., "Observations sur les parasites de l'hyponomeute du pommier" [in French]. *Mitt. schweiz. ent. Ges.,* vol.26: pp.149-150. 1953. Records 11 parasites of *Hyponomeuta malinellus.* [P. B.]

Fiedler, H. G., "Biologie und Bekämpfung der Kaffeeminiermotte Ostafrikas unter Berücksichtigung des Klimas" [in German]. *Zeitschr. angew. Ent.,* vol.31: pp.38-76, 8 figs. 1949. Biology and control of *Leucoptera caffeina* and *L. coffeella.* The moths are similar but differ in structure and habits at all stages (which are carefully described). Some parasites recorded. [P. B.]

Fiedler, O. G. H., "Entomologisches aus Afrika (Beobachtungen über Kaffeeschädlinge). IV. Ist der Kaffeezünsler wirklich ein Schädling?" [in German]. *Zeitschr. angew. Ent.,* vol.32: pp.304-306. 1950. Biology of *Thliptoceras octoguttale* (Pyralididæ) on coffee. [P. B.]

Fife, L. C., C. B. Cowan, & J. W. Davis, "Factors influencing winter carryover of Pink Bollworm in central Texas." *Journ. econ. Ent.,* vol.50: pp.642-644. 1957. Effects of weather and host plant conditions on overwintering of *Pectinophora gossypiella.* [W. C.]

Figueroa Potes, Adalberto, "El cogollero del tomate en el Valle del Cauca. *Keiferia lycopersicella* (Busk) Lepidoptera — Gelechiidæ" [in Spanish; English summary]. *Acta agron.,* Palmira, vol.1: pp.1-18. 1950. Biology & control; brief description of stages. [P. B.]

Finlayson, L. H., & V. Ann Walters, "Abnormal metamorphosis in saturniid moths infected by a microsporidian." *Nature,* vol.180: pp.713-714. 1957. Infection of *Hyalophora cecropia, Antheræa pernyi,* & *A. polyphemus* with *Nosema* sp. results in adults with some pupal, or even larval, structures. Parasite apparently upsets hormone balance locally. [P. B.]

Fischer, Ch., "Quelques indications concernant l'élevage et l'hivernage de *Gastropacha quercifolia* O. et *G. populifolia* Esp." [in French]. *Bull. Soc. ent. Mulhouse,* 1948: pp.86-88. 1948. Notes on biology & rearing. [P. B.]

Fischer, Franz, "Zur Zucht der Raupen von *Heliothis scutosa,* Schiff." [in German]. *Ent. Nachrichtenbl. österr. und schweizer Ent.,* vol.3: pp.183-184. 1951. Foodplants *Artemisia, Anthemis arvensis.* [P. B.]

Fischer, Franz, "Interessante Beobachtungen bei einigen bekannten Noctuiden" [in German]. *Ent. Nachrichtenbl. österr. und schweizer Ent.,* vol.4: pp.38-43. 1952. Rearing notes on *Perigrapha cincta, Hylomania conspicillaris,* & *Episema glaucina.* [P. B.]

Flores, Hilario, "Acerca de la atraccion sexual a distancia en los lepidopteros" [in Spanish]. *Graellsia,* vol.8: pp.19-22. 1950. Shows that attraction of ♂ by virgin ♀ cannot be by electromagnetic radiation. [P. B.]

de Fluiter, H. J., "Insecten, schadelijk bij het kruisingswerk met populieren" [in Dutch]. *Tijdschr. Ent.,* vol.94: pp.vii-xi. 1951. Records *Amathes circellaris, A. lota, Epiblema nisella, Steganoptycha minutana,* & *Tachyptilia populella,* damaging *Populus.* [P. B.]

Foltin, Hans, "Neues und Wissenwertes aus Oberösterreich. Biologisches über einige Falterarten" [in German]. *Zeitschr. wiener ent. Ges.,* vol.39: pp.407-411. 1954. Biological notes on *Cerura furcula, Hoplitis milhauseri, Hadena gemina, Amphipyra livida,* & *Hylophila prasinana;* describes 2nd generation adults of last. [P. B.]

Ford, Leonard T., "*Ethmia bipunctella* Fabr." *Ent. Gaz.,* vol.1: p.28. 1950. Describes egg and larva; foodplant *Echium vulgare.* [P. B.]

Ford, Leonard T., "*Ethmia terminella* Fletcher (*sexpunctella* Hübner)." *Ent. Gaz.,* vol.2: p.139. 1951. Describes larva; foodplant *Echium.* [P.B.]

Ford, L. T., "Notes on Microlepidoptera." "Winter work for the microlepidopterist." *Ent. Rec. & Journ. Var.,* vol.67: pp.294-295, 328-329. 1955. Foodplants & methods of collecting various British spp. [P. B.]

Ford, L. T., "A note on the ova and larva of *Heterographis oblitella* (Zeller) (Lep: Phycitidæ)." *Ent. Gazette,* vol.8: p.27. 1957.

Ford, R. L. E., "Insects associated with the plant *Œnanthe phellandrium.*" *Ent. Gaz.,* vol.1: p.27. 1950. *Depressaria nervosa* feeds on flowers, *D. ultimella* in stems; two parasites recorded. [P. B.]

Fountain, H. G., "The life history of *Parage megæra* Linn." *Proc. Birmingham nat. Hist. philos. Soc.,* vol.18: pp.29-30. 1949. Description of all stages & emergence. [P. B.]

Fransen, J. J., & P. Nieuwdorp, "De invloed van de voedselplant op de ontwikkeling van de Ringelrups (*Malacosoma neustria* L.)" [in Dutch]. *Medded. Direct. Tuinbouw,* vol.12: pp.404-405. 1949. Comparson of larval development on 20 spp. of trees. [P. B.]

Franz, Jost, "Ein Vergleich des europäischen und des nordarikanischen Tannentriebwicklers (*Choristoneura murinana* (Hb.) und *C. fumiferana* (Clem))" [in German; English summary]. *Zeitschr. Pflanzenkrankh.,* vol64: pp.578-584, 4 figs. 1957. Points out great similarity in biology of these spp., & some differences in larval behaviour. [P. B.]

Franz, J., & A. Krieg, "Virosen europäischer Forstinsekten" [in German; English summary]. *Zeitschr. Pflanzenrankh.,* vol. 64: pp. 1-9. 1957. Survey of viruses recorded from European forest insects (mainly Lepidoptera—13 spp.) and general discussion of their biological significance. [P. B.]

Fraser, F. C., "*Argynnis aglaja* L. (Lep. Nymphalidæ) the prey of a frog, *Rana temporaria* L." *Ent. mo. Mag.,* vol. 88: p. 199. 1952.

Fraser, F. C., "*Cerura vinula* (L.) (Lep., Notodontidæ) larva feeding on *Salix repens* L." *Ent. mo. Mag.,* vol. 90: p. 251. 1954. New foodplant record. [P. B.]

Fraser, F. C., "High infestation of larvæ of *Dasychira fascelina* (L.) (Lep., Lymantriidæ) by *Amblyteles fossorius* (L.) (Hym., Ichneumonidæ)." *Ent. mo. Mag.,* vol. 90: p. 238. 1954.

Fraser, F. C., "Duplicated beak-marks on wing of *Nymphalis io* (L.) (Lep., Nymphalidæ)." *Ent. mo. Mag.,* vol. 90: p. 3, 1 fig. 1954.

Fraser, F. C., "High mortality of larvæ of *Euphydryas aurinia* (Rott.) (Lep., Nymphalidæ) from parasitization by *Apanteles bignelli* Marsh. (Hym., Braconidæ)." *Ent. mo. Mag.*, vol. 90: p. 253. 1954.

Fukazawa, Hiromu, "Observation on the hatching of eggs of *Luehdorfia puziloi* Erschov. (Papilionidæ)" [in Japanese]. *Shin Konchu,* vol. 4, no. 10: pp. 14-16, 2 figs., 3 tables. 1951.

Fukuda, Haruo, "Yearly life-cycle of *Celastrina albocœrulea* Moore in Kyûshû (Lycænidæ)." *Shin Konchu,* vol. 6, no. 5: pp. 21-22. 1953. Foodplants: *Prunus* (Rosaceæ), *Dicalix* (Symplocaceæ), *Ilex* (Aquifoliaceæ), & *Viburnum* (Caprifoliaceæ). [T.I.]

Fullaway, D. T., "New species of Hymenoptera." *Proc. Hawaiian ent. Soc.,* vol. 16: pp. 40-44. 1956. Includes parasites reared from *Cremastobombycia lantanella, Myelois ceratoniæ,* & *Opogona* sp. [P. B.]

Gäbler, H., "Nonnenauftreten in Sachsen" [in German]. *Allg. Forstzeitschr.,* vol.2: pp.108-109. 1947. Outbreak of *Lymantria monacha;* notes on population density, mortality, & predators. [P. B.]

Gäbler, Hellmuth, "Beobachtungen über den Kiefernprozessionsspinner" [in German]. *Zeitschr. Pflanzenkrankh.,* vol.58: pp.92-96, 4 figs. 1951. Notes on biology & control of *Cnethocampa pinivora.* [P. B.]

Gäbler, Hellmuth, "Die Tachine *Carcelia processionæa* Rtzbg. als Parasit des Kiefernprozessionsspinners *Cnethocampa pinivora* Tr." [in German]. *Zeitschr. angew. Ent.,* vol.34: pp.294-296, 3 figs. 1952. Notes on biology and morphology of parasite; mentions some other larvævorid flies attacking *Cnethocampa.* [P.B.]

Gäbler, Hellmuth, "Beitrag zur Kenntnis von tierischen Forstsamenschädlingen" [in German]. *Beitr. Ent.,* vol.3: pp.479-487, 8 figs. 1953. Biology of *Epiblema penkleriana, E. nisella, Orthosia circellaris, Xanthia gilvago,* & other insects attacking buds & catkins of various trees. [P. B.]

Garcés O., Carlos, & Luis Gallego F., "Algunas enfermedades y plagas que atacan al Manzano en Antioquia" [in Spanish]. *Rev. Facult. nac. Agron.,* Medellín, vol.7: pp.443-494, 20 figs. 1947. Notes on biology & control of pests of apple in Colombia, including *Carpocapsa pomonella, Automeris janus,* & *Phobetron hipparchio;* poor figures of larvæ & adults. [P. B.]

Gardiner, B. O. C., "Wasps attacking *Pieris brassicæ* L." *Ent. Rec. & Journ. Var.,* vol.64: p.355. 1955.

Gardiner, Brian O. C., "Some observations on breeding *Catocala fraxini* L" *Ent. Rec. & Journ Var.,* vol.68: pp.202-205. 1956. Successful rearing, through 2 generations, on Black Poplar. [P. B.]

Gardner, F. W., "Breeding of *Psodos coracina* Esp." *Ent. Gaz.* vol.1: pp.47-48, 1 fig. 1950. Describes early stages; reared on *Calluna vulgaris* and *Erica darleyensis.* [P.B.]

Gauss, Rudolf, "Die Lärchenminiermotte *Coleophora laricella* Hb., ein neuer Schädling and der Douglasie?" [in German]. *Zeitschr. angew. Ent.,* vol.40: pp.52-54, 2 figs. Feb. 1957. Reports of this sp. mining needles of Douglas Fir. [P. B.]

Gavrilovič, Dušanka, & Ljubodras Janković, "Ecological observations on caterpillar Gypsy Moth (*Lymantria dispar* L.) 1950-51" [in Serbian; English summary]. *Acad. serbe Sci. XXXI, Inst. Ecol. Biogeogr.,* no.4: pp.113-137, 8 figs. 1953. Most larval hatching from 6 to 10 A.M., none at night. New larvæ at 17°—20° C. fast for 4-6 days before feeding. Molting solitary for 1st & 2nd instars, social later. ♂ larvæ molt 5 times, ♀♀ 6 (80%) or 5 (20%) times. Larvæ feed (or at least defecate) most at night. [C. R.]

Gavrilović-Zečević, Dušanka, "Contribution to the knowledge of the Gypsy Moth's laying at Ada Huja 1949/50" [in Serbian; English summary]. *Acad. serbe Sci. XXXI, Inst. Ecol. Biogeogr.,* no.4: pp.93-111, 5 figs. 1953. Detailed analysis of oviposition sites. [C. R.]

Geier, P. "Enseignements écologiques du recensement par sondage d'un grand ensemble de pontes de *Cacœcia rosana* L. (Lep., Tortricidæ), exposées aux attaques d'un parasite (*Trichogramma cacœciæ* Marchal, Hym., Chalcididæ) et de predateurs ornithologiques" [in French; English summary]. *Mitt. schweiz. ent. Ges.,* vol.29: pp.19-40, 8 figs. 1956. Describes method of sampling for studying distribution of *C. rosana* egg masses in orchard. Describes distribution of clusters (not uniform). Considers effects of parasite on population negligible; bird predation, directed against the most dense concentrations of egg clusters, may support rather than diminish the abundance of the species. [P. B.]

Geier, P., "Observations sur les parasites du Carpocapse (*Cydia pomonella* L.) près de Genève" [in French; English summary]. *Revue suisse Zool.*, vol.64: pp 497-525, 19 figs. 1957. Records 6 larval parasites & 2 hyperparasites; describes biology of parasites & their effects on Codling Moth populations. [P. B.]

Geoffrion, Roger, "Influence de divers facteurs écologiques sur la fecondité de la cochylis (*Clysia ambiguella* Hb.) et du carpocapse (*Laspeyresia pomonella* L.)" [in French]. *C. R. Acad. Sci.*, Paris, vol.241: pp.1222-1225. 1955. Reduction or absence of light during larval period reduces number of eggs laid. [P. B.]

Hinton, H. E., "Protective devices of endopterygote pupæ" *Trans. Soc. Brit. Ent.*, vol.12: pp.49-92, 23 figs. 1952. Deals with passive methods (pensile cocoons, protective or warning color, protective resemblance) and active devices; the latter include mandibles, stridulatory organs, "gin traps" of hardened cuticle between adjacent, movable segments, etc. Distinguishes between devices effective against large (mostly vertebrate) and small predators. A stimulating paper on a neglected subject. [P.B.]

Hinton, H. E., "The larvae of the species of Tineidæ of economic importance." *Bull. ent. Res.*, vol.47: pp.251-346, 216 figs. 1956. Describes larvae of 32 spp., with figures of setal patterns & other structural characters; key to these larvae. Notes on habits of 16 other spp. [P.B.]

Hinz, Rolf, "Zur Systematik und Ökologie der Ichneumoniden I (Hym.)" [in German]. *Deutsche ent. Zeitschr.*, N.F., vol.4: pp.86-90. 1957. Records parasites of *Pieris brassicæ, Gonepteryx rhamni,* & *Miana ophiogramma.* [P.B.]

Hiraga, Sota, "Breeding of *Celastrina sugitanii* Matsumura (Lycænidæ)" [in Japanese]. *Essa Konchu Dôhôkai Kaihô,* vol.6: pp.83-89, 5 figs. 1952. Foodplant: *Æsculus turbinata.* [T.I.]

Hiraga, Sota, "Life-history of *Erebia niphonica* Janson (Satyridæ)" [in Japanese]. *Essa Konchu Dôhôkai Kaihô,* vol.6: pp.1-5, 5 figs. 1952. Foodplants: grasses. [T.I.]

Hiraga, Sota, "Life of *Maculinea arionides* (Lycænidæ)" [in Japanese]. *Shin Konchu,* vol.5, no.2: pp.16-18, 3 figs. 1952. Preliminary report on the phyto-predaceous habit. [T.I.]

Hiromoto, Senta, "Growth of caterpillars (Papilionidæ)" [in Japanese]. *Shin Konchu,* vol.5, no.1: pp.14-18, 2 figs., 8 tables. 1952. Weights of consumed leaves, excretion, and increase in larval weights are measured and compared in each larval instar of *Papilio xuthus, P. protenor demetrius,* & *Menelaides alcinous.* [T.I.]

Hirose, Makoto, "A mass of eggs produced by the joint laying of two or more females of *Neozephyrus taxila* (Lycænidæ)" [in Japanese]. *Shin Konchu,* vol.5, no.4: pp. 34-35. 1952.

Hodgson, S. B., "*Biston betularia* attacked by a wasp." *Entomologist,* vol.90: p.243. 1957.

Hoffman, Emil, "Biologische Beobachtungen bei unseren heimischen *Parnassius*-Arten der *apollo*-Gruppe" [in German]. *Ent. Nachrichtenbl.,* Vienna, vol.1: pp.79-86. 1954. Notes on rearing & biology of *P. apollo, P. delius,* & *P. phœbus styriacus.* Points out that size of *P. apollo* adults depends on food plant; those reared on *Sedum maximum* are larger than those fed *S. album.* [P.B.]

Holloway, Paul H., "Insects and ivy-bloom." *Ent. Rec. & Journ. Var.,* vol.63: pp.275-277. 1956. Records insect visitors, especially moths. [P.B.]

Houtman, G., "Twee mineerders, schadelijk voor het appelblad: *Nepticula malella* Hb. en *Phytomyza heringiana* Hendel" [in Dutch]. *Ent. Berichten,* vol.14: pp.67-70, 6 figs. 1952. Notes on biology of these miners in apple leaves. [P.B.]

Howard, J. O. T., "*Celerio galii* Schiff. at Dorking." "Breeding *Celerio galii* Schiff." *Ent. Rec. & Journ. Var.,* vol.67: pp. 235-236, 277-278. 1955. Account of rearing a British immigrant. [P.B.]

Howarth, T. G., "Notes on *Catocala fraxini* L. - a British resident species." *Ent. Gaz.,* vol.1: pp.41-44, 4 figs. 1950. Describes rearing; photos of larvæ. The species appears to be resident in Kent. [P.B.]

Howarth, T. G., "Notes on the life history of *Margaronia unionalis* Hbn." *Ent. Gaz.* vol.1: pp.87-88, 1 fig. 1950. Describes early stages; figures pupa. Reared on *Jasminum officinale.* [P.B.]

Howe, R. W., & J. A. Freeman, "Insect infestation of West African produce imported into Great Britain." *Bull. ent. Res.,* vol.46: pp.643-668, 8 figs. 1955. Reports on stored products pests found in shipments of ground nuts, cocoa, and some other materials; *Ephestia cautella, Corcyra cephalonica,* and *Plodia interpunctella* found in many shipments of all types. [P.B.]

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16 June 1961

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HARMONIZATION OF CONCEPTS OF HIGHER CLASSIFICATION OF THE PAPILIONIDÆ

by EUGENE MUNROE and PAUL R. EHRLICH

Previous work carried out independently by us on the basis of largely different sets of characters (Ehrlich, 1958; Munroe, 1953, and in press) led to interpretations of papilionid classification that were in harmony in major outline, though they differed in several points. Consultation and joint examination of certain characters has permitted resolution of all the points of difference and of some points of uncertainty in our previous arrangements. The present paper can be considered a supplement to and revision of our individual contributions on this subject.

Our earlier classifications agreed in considering the Baroniinæ, Parnassiinæ and Papilioninæ as subfamilies of Papilionidæ, in considering the phyletic separation of Baroniinæ as considerably antedating that of the Parnassiinæ and Papilioninæ, in considering the *Zerynthia* and *Parnassius* groups as not fundamentally distinct, and in associating *Lamproptera* with the Graphiini and *Cressida* and *Euryades* with the *Parides* complex. We differed mainly in that (1) EHRLICH classified *Teinopalpus* in a separate tribe of the Papilioninæ, whereas MUNROE placed this genus in the Graphiini; and (2) EHRLICH placed *Battus* and provisionally *Troides* and *Ornithoptera* in the Papilionini, whereas MUNROE placed them with *Cressida, Euryades* and *Parides*. Also, (3) although we are agreed that genera have been far too finely divided in recent work on several groups of butterflies, MUNROE divided the genera *Parides* and *Graphium* as understood by EHRLICH, who did not carry his work to the generic level. This division was based on genitalic and other characters. MUNROE attempted a more detailed phylogenetic classification than did EHRLICH, whose interests were in a broader field. Some points of major uncertainty remained, however, in MUNROE's classification. The most important of these were: (1) the phylogenetic relationship of the

Parnassiinæ and the Troidini; (2) the relationship of the red-tuberculate *Aristolochia*-feeding larval type to the green, Lauraceæ-feeding type; and (3) the origin and internal phylogeny of the Papilionini.

POINTS OF PREVIOUS DIFFERENCE

The points of difference seem best resolved as follows:-

(1) *Teinopalpus* appears to have real affinities with the most primitive Graphiini, but it differs in the inflation of the frons and the associated hypertrophy of the palpus, in lacking sclerotized patagia, in having smaller tentorial crests, in the weak development of the cubito-vannal cross-vein, in the sexual dimorphism and specialization of the pattern and wing-shape, in the atypical wing-venation, and in the reduced antennal scaling. It appears to be a matter of individual preference whether the differences or the resemblances should be emphasized. Possibly the best solution is to recognize Teinopalpiti and Graphiiti as subtribes of Graphiini. *Teinopalpus* lacks the spine of the prodiscrimen, as do other Graphiini except *Dabasa.* The statement to the contrary in Ehrlich (1958) resulted from an error in proofreading.

(2) *Troides* and *Ornithoptera,* as stated by MUNROE and hinted by EHRLICH, are typical members of the *Cressida - Parides* complex. The name Troidini is to be preferred over Cressidini for the union of the two tribes recognized by FORD, as names based on *Troides* are older in the literature and FORD's Troidini form by far the larger constituent of the combined group. *Ornithoptera* and *Troides* are undoubtedly derived from a common ancestor more like *Troides* than *Ornithoptera,* for *Troides* has no specialization of pattern or wing-shape that is not found or suggested in *Ornithoptera,* whereas *Ornithoptera* has greatly specialized pattern and strong sexual dimorphism and has lost the *Parides*-like sex-scaling on the anal margin of the hind wing, still evident in *Troides,* and has substituted a new set of sex-scaling on the upper surface of the fore wing. The retention of slight sclerotization of the patagia and the longer free course of R_1 indicate a separation of the *Troides-Ornithoptera* complex from a position near or below the base of the present genus *Parides,* but this conclusion requires confirmation from examination of a wider range of species. *Battus* is far more widely different. The narrow spinasternum and the absence of definite sensory pits on the under surface of the antenna indicate a separation of *Battus* from the remaining Troidini before the separation of the *Cressida - Euryades* and the *Parides - Troides* stocks. These four genera agree in having the two specializations, broad spinasternum and definite sensory pits. On the other hand, the detailed structural correspondence of the *Aristolochia*-feeding, fleshy-tubercled

larva, of the arcuate, flanged pupa, and of the male genitalia indicates beyond possibility of coincidence the direct relationship of *Battus* with the other Troidini. *Battus* is, however, by far the most distinctive genus of the tribe, and it is probably best here also to recognize two subtribes, Battiti and Troiditi.

(3) The generic separations advocated by Munroe appear to be reasonably founded. In the Troidini, *Pachlioptera*, comprising *P. hector, aristolochiæ, polydorus* and allies, is a compact group, certainly closely related to *Parides* and presumably derived from it, but differing in the radical character of near-abortion of the valves and pseuduncus and enlargement and sclerotization of the socii apparently to take over a clasping function. These differences are supported by minor differences in the structure of the female genitalia and in the larvæ and the pupæ. *Cressida* and *Euryades* are not closely related to *Pachlioptera* as assumed by Ford on the basis of an observation copied from Talbot and based in the first place on misinterpretation by the latter of an external examination of the male genitalia. In the Graphiini, division of the New World Kite Swallowtails (*Eurytides*), which, like the related Old World genus *Lamproptera*, retain the uncus and socii as a composite structure, from the main group of Old World species (*Graphium*), in which the uncus is aborted, appears to be satisfactory and to define homogeneous groups. The three groups of Old World Kite Swallowtails that retain the free R_1 that is characteristic of most *Eurytides* also all have peculiar genitalia. The Australian species *leosthenes* retains the uncus weakly as a finger-like structure; Munroe has proposed the genus *Protographium* for this species. *Protographium* is apparently a relict connecting link between the large genera *Graphium* and *Eurytides*. The *payeni - evan* group is very distinct in genitalia from *Graphium;* it resembles it in having lost the uncus, but has large horny socii, articulated firmly with the eighth tergite; it also differs from *Graphium* in the short cell and distorted discocellulars, in the weak sclerotization of the patagia and in having a small spine on the prodiscrimen, lacking in *Graphium*. This group forms a very distinct genus for which the name *Dabasa* is available. The European species *podalirius,* together with its Tibetan representative *podalirinus,* constitute the third group with free R_1. In this group the male genitalic structure is fundamentally similar to that of *Graphium,* but the valve is very simple and unusually elongate. The larva is unusual in appearance and food plant and has segmental red spots. This combination of characters would support separation of these two species as the genus *Iphiclides*. This separation has the advantage of making *Graphium* homogeneous for anastomosis of Sc and R_1. However, the separation is a weak one, and some students may prefer to unite these

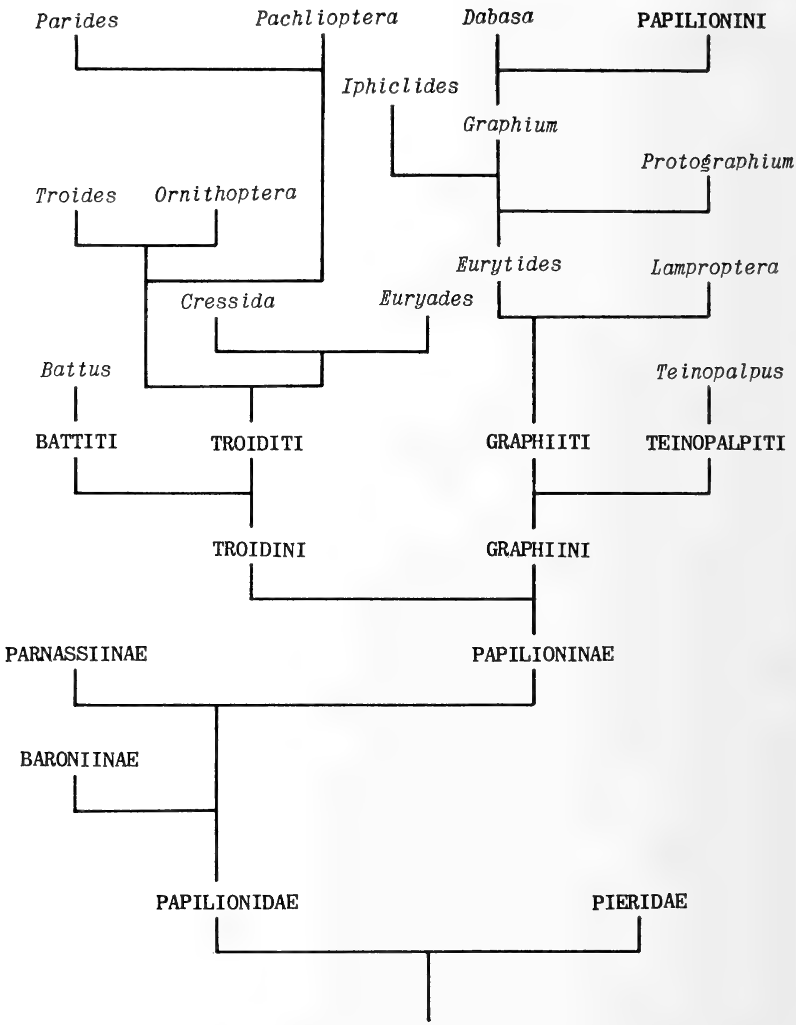
two genera. To summarize, these separations represent either rather large phyletic cleavages (*Eurytides, Graphium, Dabasa*) or distinct and well-characterized side-lines or relics (*Pachlioptera, Iphiclides, Protographium*). They are on a considerably coarser plane than the divisions currently fashionable in such groups as the Blues and Coppers. With the possible exception of the separation between *Iphiclides* and *Graphium,* they should be retained.

Points of Previous Uncertainty

(1) *Relationship of Troidini to Parnassiinæ and to other Papilioninæ.* The key to this problem appears to be the cubito-vannal vein. This was previously considered by Munroe to be a primitive character, but we now believe this interpretation to be erroneous. No similar vein is found in other families of butterflies, so far as our reading extends; it is certainly lacking in a variety of forms examined by us. No comparable vein is found in higher groups of moths, including Cossidæ and Castniidæ. The vein is also absent or rudimentary in the two other subfamilies of Papilionidæ, Baroniinæ and Parnassiinæ. The nearest parallel we have found outside of Papilioninæ is the sclerotized root of 1st V found in *Limenitis* and certain other Nymphalidæ. It is possible that the vein present in Papilioninæ is such a root stalked for a certain distance with Cu; alternatively it may be a structure formed *de novo.* It is noteworthy that in *Teinopalpus,* which has perhaps the most primitive genitalia of any papilionine, the vein is weakly developed. At any rate it seems highly probable that this vein is an unusual specialization, characteristic of the Papilioninæ, and that it indicates with great probability that this subfamily is a natural and monophyletic group, as would be suggested by their considerable uniformity in wing-venation and palpal structure, and by the possibility of harmonizing the different larval and pupal types without undue stretching of the imagination. As the Graphiini have more primitive genitalia, legs and antennæ than the Troidini, which resemble Parnassiinæ mainly in the early stages and in the presence in certain species of a sphragis, we must conclude that the Troidini are derived from an ancestor which on the defining characters of scaled legs, scaled antennæ and free, complete male genitalia we would be forced to refer to the Graphiiti. There is therefore no question of direct relationship of the Parnassiinæ and Troidini. There must have been a graphiine intermediary, though probably one more closely similar to generalized Troidini and Parnassiinæ than are existing species of Graphiini. We may recall at this point that the existing troidine genus *Battus* has apparently never acquired two of the most prominent speciali-

zations of the remaining Troidini. This involves the corollary conclusion that the Parnassiinæ-like features of *Euryades* and *Cressida* are secondary; this applies particularly to the narrowed, *Parnassius*-like valve. The sphragis in these genera and in certain primitive *Parides* may indeed be derived from the same source as that of *Parnassius*, though perhaps only as a common tendency, rather than as an overt character in an unbroken line.

(2) *Relationship of red-tuberculate,* Aristolochia-*feeding larva to green, sometimes brown, sometimes spinose, Lauraceæ - or Rutaceæ - feeding larva.* The solution of this problem is bound up with that of the previous one. If we assume, as we apparently must, that the Papilioninæ are a homogeneous, monophyletic group, it is ascribing too much to coincidence to suppose that the red-tuberculate, *Aristolochia*-feeding larva has been independently developed in the two groups Parnassiinæ and Troidini from smooth, green, Lauraceæ-feeding, skipper-like or pierid-like ancestors. On the other hand, it is not hard to imagine a reversion from Aristolochiaceæ to the lauraceous food-plant that characterizes several primitive hesperiids and pierids. The acquisition, perhaps several times, of a cryptic, green or brown, coloration would also be easy. It may be noted further that larvæ of many species in Graphiini and Papilionini retain red spots and/or tubercles in the final instar, while all known species are tuberculate and many red-spotted in earlier instars. This permits a decision between the alternative hypotheses presented in MUNROE's paper. The red-tuberculate, *Aristolochia*-feeding larva must be primitive, at least for the Parnassiinæ and Papilioninæ. It follows that the primitive Graphiini must have had red-tubercled larvæ, probably somewhat *Zerynthia*-like in aspect, and feeding on *Aristolochia*. The hearsay reports of the larva of *Lamproptera* that were cited by MUNROE (in press) appeared to fill this need, but unfortunately Mr. KENT WILSON (*in litt.*) informs us that these reports were erroneous and can be disregarded. Mr. WILSON's description of the early stages of *Lamproptera* will be awaited with interest. Larvæ of the *Eurytides lysithous* group have tuberculate and spotted larvæ, but there is a possibility of mimicry of *Parides* larvæ. In our present state of knowledge it cannot safely be assumed that all red spots and all tubercles are homologous. Comparative morphological study of a wide range of larvæ is badly needed. It may be noted parenthetically that the larva of the primitive though aberrant *Teinopalpus* is described as being smooth and green. It may be repeated for good measure that we have no knowledge or incomplete knowledge of several of the really critical life histories for phylogenetic interpretation, viz.: *Teinopalpus, Lamproptera,* and *Dabasa* from Asia and *Baronia* from Mexico.



Apparent sequence of separation of papilionid lines.
The significant feature of this diagram is the order of the bifurcations.

(3) *Origins and internal phylogeny of the Papilionini.* This problem continues to present many points of uncertainty. The most probable origin of the tribe still appears to be from the higher Graphiini. The presence of the spine of the discrimen is a point of similarity between Papilionini and Troidini that can be added to the well-known ones. This spine is lacking, however, in *Battus*, the troidine genus that has other *Papilio*-like characters. *Dabasa*, unlike other Graphiini, has the spine, though weakly. This would support the possibility that this genus arose close to the point of separation of Papilionini from Graphiini. On the whole it seems likely that the spine has been acquired independently in the Papilionini and the Troidini. It is obvious that final answers on the precise ancestry of the Papilionini are not possible on the evidence available to us. Still less can the vexed questions of the internal phylogeny of the Papilionini be properly resolved. This must await the results of more comprehensive studies than time or material have permitted us to make.

References

Ehrlich, Paul R., 1958. The comparative morphology, phylogeny and higher classification of the butterflies (Lepidoptera: Papilionoidea). *Univ. Kansas sci. bull.* 39: 305-370.

Munroe, Eugene, 1953. The phylogeny of the Papilionidæ. *Proc. 7th Pacific sci. congr., Auckland, 1949* 4: 83-87.

Munroe, Eugene, in press. The generic classification of the Papilionidæ. *Canadian ent., supplement* 17.

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and

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A NEW ENTOMOLOGICAL SERIAL

The Society Library has received the first two numbers of *Esakia* published by the Hikosan Biological Laboratory, Faculty of Agriculture, Kyushu University, Fukuoka, Japan. They include nine short papers by present or former members of the laboratory shaff; among these are two by Hiroshi Kuroko describing new microlepidoptera (Gracilariidæ and Cosmopterygidæ). The issues are well illustrated by photos and line drawings. Members desiring further information are advised to write to the Chief of the Laboratory, Professor Keizô Yasumatsu.

P. F. Bellinger

NEW LARVAL FOODPLANT FOR *ERYNNIS ZARUCCO* (HESPERIIDÆ) FROM LOUISIANA

by Roy O. Kendall

While visiting my father-in-law, Lawrence Alford, September 13, 1959 at Leesville, Vernon Parish, Louisiana, I took the liberty to examine the Black Locust trees, *Robinia pseudoacacia* L., which grow in his yard. At the front of this property is a clump of trees ranging in height from about five to fifteen feet. On these I found numerous larvæ of *Epargyreus clarus* Cramer. A short distance from this clump of trees, about three hundred feet, were two more small bushes about six feet high. I now proceeded to examine these and was pleasantly surprised to find five *Erynnis zarucco* Lucas larvæ hidden in leaf nests. The nests or protective shelters consisted of two or three leaflets pulled together and held there by strands of silk, typical of the genus.

The larvæ were all in the last instar. Except for one which was preserved, all pupated in their leaf shelters during the next two days. Of the pupæ, one was preserved; the remaining three emerged September 22 & 23, 1959. It was interesting to note the similarity of *E. zarucco* larva to that of *E. funeralis* Scudder & Burgess from Bexar County, Texas. A descriptive comparison based on this limited sample of *E. zarucco* follows:

Erynnis funeralis: Larva tan with dorsolateral yellow line segmentally punctuated with bright yellow squarish spots; indistinct whitish granulations. Head angled, black with two distinct orange-yellow spots on each cheek; a third spot at the uppermost part of the head tending to form a single large spot at the crown; below this a small spot not always distinct.

Erynnis zarucco: Larva cream colored with dorsolateral yellow line segmentally punctuated with yellow squarish spots not quite so brilliant as *E. funeralis;* distinct whitish granulations. Head angled, black with six distinct orange-yellow spots.

Determination of the adults was made by John M. Burns of the University of California, at Berkeley.

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A NEW MELANIC FORM OF *CATOCALA CONNUBIALIS* FROM NEW JERSEY (NOCTUIDÆ)

by JOSEPH MULLER

During 1956 to 1959 I caught seven dark *Catocala* at black lights, which I was not sure where to place at first. They look somewhat like *Catocala micronympha* form "gisela", but with the outer margin and the basal area concolorous or nearly so. Since I have never caught *micronympha* in this area, I thought these melanic specimens might be a dark form of *C. connubialis* race *pulverulenta* Brower, which is taken at bait and light. In 1959 I obtained eggs from two females of *pulverulenta*, and reared them to adults the following spring. Among the offspring were normal *pulverulenta* and the melanic form. Exact count was not kept of pupæ, and of specimens given away and set free; but of the reared specimens approximately 67% were typical *pulverulenta*, 11% *pulverulenta* with brown band showing clearly, and 22% the unnamed melanic form (see figures). The latter is hereby named as follows.

CATOCALA CONNUBIALIS PULVERULENTA form "BROWERI" Muller, NEW FORM

This new form is a true melanic, having a deep sooty black shade over the whole of the forewings, head, and thorax, and having an extension of the black bands on the hind wings. These black bands are commonly fused near the anterior margin, and the inner band extends basally and over the disk from the inner margin. The brown or light band just outside the transverse posterior line is variable and shows more or less definitely across the dark shading, and the ground color may be lighter between the transverse anterior line and the base. The reniform and subreniform are not discernible, unless as a faint subreniform ring. Specimens are the same size as normal *pulverulenta*.

HOLOTYPE female: Lebanon, Hunterdon County, New Jersey, 16 July 1958, at black light, *leg.* JOSEPH MULLER. Deposited in the American Museum of Natural History.

ALLOTYPE male: same data, except reared from egg in 1960.

PARATYPES: four females, 23 July 1958, 27 June, 8 July, and 16 July 1959; two males, 2 July 1956 and 26 July 1958, all six at black light; ten males and nine females reared from eggs and emerging in 1960. A pair of reared paratypes is in the collection of A. E. BROWER, Augusta, Maine; the three specimens figured, including one paratype, are deposited in the Peabody Museum of Natural History of Yale University; the allotype and other paratypes are in the author's collection.

Catocaia connubialis pulverulenta, reared forms from Lebanon, New Jersey. Top — form "broweri" (paratype); middle — brown-banded form; bottom — typical *pulverulenta.* (photo JOHN HOWARD)

My thanks to Dr. BROWER for examining this new form and critically reading this manuscript. It is a pleasure to dedicate this new form to him. Dr. BROWER now considers *pulverulenta* to be a subspecific name, not that of a form.

R. D. 1, Lebanon, N. J., U. S. A.

STUDIES OF THE CHROMOSOMES OF NORTH AMERICAN RHOPALOCERA. 4. NYMPHALINÆ, CHARAXIDINÆ, LIBYTHEINÆ

by KODO MAEKI and CHARLES L. REMINGTON

This paper concludes the report of our first systematic survey of the groups of the Rhopalocera. The first supplement, giving new counts for species of various families, is in preparation. Our preceding papers (Maeki & Remington, 1960a, 1960b, 1961) gave notes on our techniques and sources of material and presented new data and discussions of the cytotaxonomy of the Hesperiidæ, Megathymidæ, Pieridæ, Papilionidæ, Lycænidæ (*sensu lato*), and part of the Nymphalidæ (*s. l.*).

For the Nymphalidæ we are following the subfamily classification of EHRLICH (1958), but we include the Libytheinæ as one more subfamily of the Nymphalidæ. In some compelling characters they seem to us closer to the Nymphalidæ than do the Danainæ, among others.

Most of the specimens for which the chromosomes are reported here were collected in 1959. Some additional species of Nymphalidæ are included in our first supplementary paper, and there are counts for several Acræinæ and Nymphalinæ and one Charaxidinæ in our forthcoming paper on African species.

As with the previous groups, we have noted in square brackets our designations of the individuals studied; this number will be found on the specimen and the slides of its testes, all preserved for permanent reference in the Peabody Museum of Yale University. In the lists that follow, "*n*" represents the haploid chromosome number, "I" refers to the primary spermatocyte division and "II" to the secondary spermatocyte division. No females were studied in these groups.

Fixed testes of several species not in the following descriptive list were sectioned and examined but did not show any meiotic divisions. The numbers of specimens of these species are as follows: 1 *Euphydryas* near *phaeton* (Drury) from Connecticut; 1 *Chlosyne nycteis* (Doubleday & Hewitson); 1 *Vanessa atalanta* (Linné) from Connecticut; 5 *Nymphalis milberti* (Godart) from Colorado; 1 *Polygonia vau-album* (Schiff.) from Connecticut; and 1 *Limenitis arthemis* (Drury) from Vermont.

A. NYMPHALIDÆ – NYMPHALINÆ:

1. *Dryas julia* (Fabricius). *N* = 31. Counts were made in 25 nuclei (I) and 20 nuclei (II) in testes of 8 males [M54-1, M54-2, M54-3, M54-4, M54-6, M54-7, M54-8, M54-9] taken at El Salto, S. L. P., Mexico, 4 August 1959. Three chromosomes are distinctly smaller than the others, which are fairly uniform in size.

2. *Dione juno* (Cramer). *N* = 31. Counts were made in 7 nuclei (I) and 5 nuclei (II) in testes of 1 male [M55] taken at El Salto, 4 August 1959. Four chromosomes appear to be small and 27 large.

3. *Euptoieta hegesia* (Cramer). *N* = 31. Counts were made in 20 nuclei (II) in testes of 1 male [M15] taken at Ciudad Victoria, Tamps., Mexico, August 1959. The caryotype shows 1 large, 27 medium, and 3 distinctly smaller chromosomes. No primary divisions were found.

4. *Speyeria cybele charlottii* (Barnes). *N* = 29. Counts were made in 30 nuclei (I) and 30 nuclei (II) in testes of 7 males [245, 246, 247, 259, 263, 261, 958] taken about 6 miles east of Somerset, Gunnison Co., Colorado, August 1959 and 17 July 1960. Divisions were plentiful and sufficient counts were easily obtained; very many more could have been added, but it was clear that the number was invariable in these 7 males. The same number was consistently found in 3 males [1015, 1017, 1019] taken at Rabbit Ears Pass, 22 July 1960. Several individuals from near Somerset with diverse numbers in a single pair of testes were also studied and will be reported separately in a paper on hybridization. As with some of the following species of *Speyeria,* it is likely that the *cybele* concept of L. P. GREY represents a superspecies of several genetically partly incompatible populations which must eventually be regarded as separate species. Possibly some of these young species will even prove to have different chromosome numbers, but we have not yet sampled sufficiently to have data bearing on this point.

5. *Speyeria aphrodite ethne* (Hemming). *N* = 29. Counts were made in 30 nuclei (I) and 20 nuclei (II) in testes of 3 males [254, 256, 266] taken 6 miles east of Somerset, 15 August 1959. There appear to be four size classes in the normal caryotype: 2 largest, 6 large, 20 medium, 1 small. As with S. *cybele charlotti* and S. *atlantis nikias,* the sample from the Somerset locality also included males with various numbers of non-synapsing chromosomes in the first meiotic division and therefore presumably of hybrid origin.

6. *Speyeria coronis halcyone* (Edwards). *N* = 30. Counts were made in 20 nuclei (I) and 20 nuclei (II) of 3 males [701, 702, 703] taken in Clear Creek Canyon, el. 6300′, 26 June 1960, *leg.* C. L. REMINGTON & J. DONALD EFF. There are 4 large, 16 medium, and 10 small elements. Three

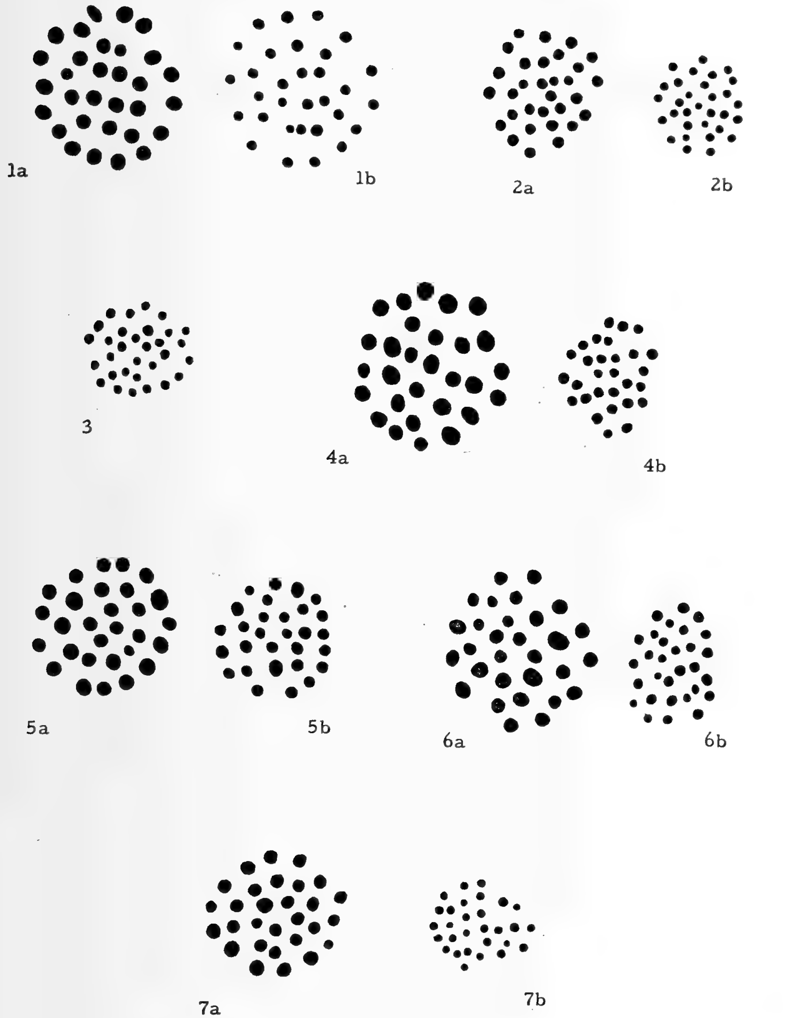


Fig. 1a — *Dryas julia* (I); fig. 1b — same; fig. 2a — *Agraulis juno* (I); fig. 2b — same; fig. 3 — *Euptoieta hegesia* (II); fig. 4a — *Speyeria cybele charlottii* (I); fig. 4b — same (II); fig. 5a — S. *aphrodite ethne* (I); fig. 5b — same (II); fig. 6a — S. *coronis halcyone* (I); fig. 6b — same (II); fig. 7a — S. *zerene sinope* (I); fig. 7b — same (II). [On plates 1-5 are camera lucida drawings of caryotypes, not necessarily showing precise size relationships of individual chromosomes; magnifications all 3900 diameters; I = primary and II = secondary spermatocyte divisions.]

other males [707, 724, 726] taken at the same time showed no suitable divisions. One other male [704] taken with these gave an anomalous count which will have to be discussed later.

7. *Speyeria zerene sinope* dos Passos & Grey. $N = 29$. Counts were made in 10 nuclei (I) and 10 nuclei (II) in testes of 2 males [1060, 1061] taken on the western slope of Rabbit Ears Pass, Routt Co., Colorado, 23 July 1960, *leg.* C. L. & P. S. REMINGTON. A third male taken at the same time showed no suitable divisions, but many more excellent nuclei could have been counted in these 2 males. There are 7 large, 21 uniformly medium, and 1 small chromosomes.

8. *Speyeria callippe meadii* (Edwards). $N = 30$. Counts were made in 15 nuclei (I) and 15 nuclei (II) in testes of 1 male [166] taken at Gothic, Gunnison Co., Colorado, 30 July 1959. The number was later verified in a second male [756] taken 6 miles east of Somerset, 29 June 1960. Two chromosomes are distinctly larger and 2 smaller than the other 26, rather uniform elements. No meiotic divisions were found in two males [104, 757] taken at the same localities in 1959 and 1960.

9. *Speyeria egleis secreta* dos Passos & Grey. $N = ?$ Counts were made in testes of one male [1030] taken on the western slope of Rabbit Ears Pass, 22 July 1960, *leg.* C. L., P. S., & E. E. REMINGTON. A rapid tally shows an unclear condition which requires longer study before interpretation can be appropriate. We have fixed testes of 15 other *secreta* males and must section some of these before the caryotype of this paradoxical *Speyeria* can be reported with certainty.

10. *Speyeria atlantis nikias* (Ehrmann). $N = 29$. Counts were made in 80 nuclei (I) and 65 nuclei (II) in testes of 11 males [25, 48, 49, 50, 59, 79, 80, 107, 164, 167, 305] taken at Gothic, 17 to 30 July and 22 August 1959. A twelfth male [979] taken at Gothic, 18 July 1960, showed several primary divisions, all with $n = 29$; this male is of the uncommon "Appalachian type" with very dark disc on the underside of the hind wing. Other males [1045, 1075] taken 2 mi. E. of Clark and on the west slope of Rabbit Ears Pass, Routt Co., Colorado, 22 and 23 July 1960, by C. L. & J. E. REMINGTON also showed $n = 29$ in the several primary spermatocytes examined. Two chromosomes are very large, 6 moderately large, and the other 21 are uniform and a little smaller. As with S. *charlottii* and S. *ethne* (above), a few males showed some asynaptic first metaphase chromosomes; they are probably wild hybrids between separate species of the superspecies *atlantis*.

11. *Speyeria hydaspe sakuntala* (Skinner). $N = 29$. Counts were made in 10 nuclei (I) and 10 nuclei (II) in testes of 1 male [1051] taken on the west slope of Rabbit Ears Pass, 23 July 1960, *leg.* C. L.

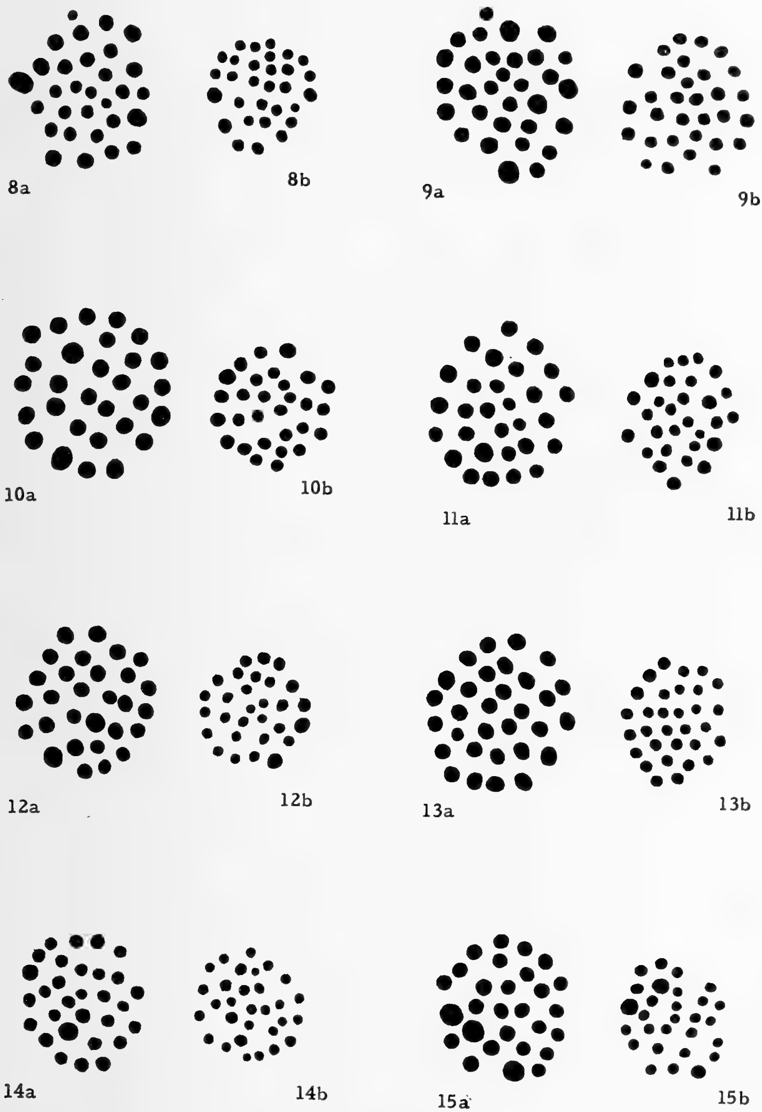


Fig. 8a — *Speyeria callippe meadii* (I); fig. 8b — same (II); fig. 9a — *S. atlantis*, variant; fig. 9b — same (II); fig. 10a — *S. atlantis nikias* (I); fig. 10b — same (II); fig. 11a — *S. hydaspe sakuntala* (I); fig. 11b — same (II); fig. 12a — *S. normonia eurynome* (I); fig. 12b — same (II); fig. 13a — *Boloria titania* (I); fig. 13b — same (II); fig. 14a — *B. selene* (I);fig. 14b — same (II); fig. 15a — *B. eunomia* (I); fig. 15b — same (II).

REMINGTON. Suitable divisions were numerous in this male. There are 2 very large, 5 moderately large, 18 medium, and 4 small elements. Other males taken at the same time showed many abnormal meiotic metaphases and will have to be re-studied when more time is available.

12. *Speyeria mormonia eurynome* (Edwards). $N = 29$. Counts were made in 50 nuclei (I) and 40 nuclei (II) in testes of 4 males [5, 11, 12, 31] taken at Gothic, 17 July 1959, and 1 male [203] taken at Copper Lake, el. 10,800'. Gunnison Co., Colorado, 7 August 1959. The count was verified in numerous nuclei from 3 males [763, 784, 785] taken at Gothic, 30 June and 2 July 1960. The caryotype shows 2 chromosomes distinctly larger and 2 or 3 distinctly smaller than the other 24 or 25.

13. *Boloria titania helena* (Edwards). $N = 31$. Counts were made in 20 nuclei (I) and 20 nuclei (II) in testes of 5 males [21, 53-1, 53-2, 184, 186] taken near Copper Lake, 17 and 19 July and 1 August 1959. In general, the chromosomes are extremely uniform in size, but 1 small element is visible in primary spermatocyte metaphases.

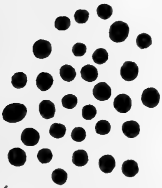
14. *Boloria selene tollandensis* (Barnes & Benjamin). $N = 30$. Counts were made in 10 nuclei (I) and 10 nuclei (II) in testes of 1 male [860] taken at Gothic, 9 July 1960, *leg.* W. A. Christian. The count was verified in a second male [859] taken at the same time. There are 1 large, 27 medium, and 2 small elements. No meiotic divisions were found in 2 other males taken at Gothic, 10 and 25 July 1960.

15. *Boloria eunomia cælestis* (Hemming). $N = 28$. Counts were made in 15 nuclei (I) and 10 nuclei (II) in testes of 1 male [54] taken at Copper Lake, 19 July 1959. There are 3 large, 22 medium, and 3 small elements.

16. *Euphydryas anicia eurytion* (Mead). $N = 31$. Counts were made in 10 nuclei (I) and 10 nuclei (II) in testes of 1 male [828] taken at Copper Lake, 4 July 1960. There are 1 very large, 10 fairly large, and 20 smaller chromosomes. This is the high altitude form. A complicated cytological condition in a lower sample is being discussed elsewhere.

17. *Chlosyne harrisii* (Scudder). $N = 31$. Counts were made in 5 nuclei (I) in testes of 1 male [542] taken at Karner, Albany Co., New York, 7 June 1960, *leg.* R. W. PEASE, JR. There are 6 large elements, the others being uniform and smaller. No secondary divisions were found.

18. *Chlosyne palla* (Boisduval). $N = 31$. Counts were made in 20 nuclei (I) in testes of 1 male [27] taken at Gothic, 17 July 1959. This count was verified in numerous primary spermatocyte divisions in a male [790] taken at Gothic, 2 July 1960. Seven other males [85, 86, 87, 778, 779, 788, 789] taken at Gothic, July 1959 and 1960, and 1 male [1113] taken at Rabbit Ears Pass, 23 July 1960, showed no meiotic divisions,



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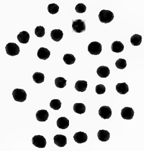

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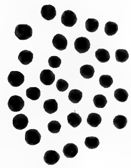

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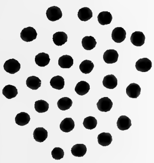

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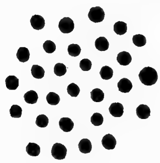

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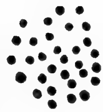

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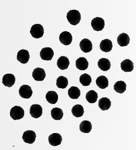

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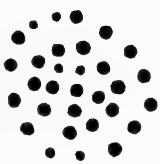

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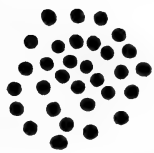

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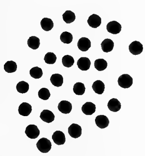
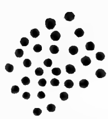


23a



23b

Fig. 16a — *Euphydryas anicia eurytion* (I); fig. 16b — same (II); fig. 17 — *Chlosyne harrisii* (I); fig. 18 — *C. palla* (I); fig. 19a — *C. damœtas* (I); fig. 19b — same (II); fig. 20 — *Phyciodes tharos* (I); fig. 21 — *P. phaon* (I); fig. 22 — *Polygonia zephyrus* (I); fig. 23a — *Vanessa virginiensis* (I); fig. 23b — same (II).

and no secondary spermatocytes were found in male 27. The chromosomes are uniform in size.

19. *Chlosyne damœtas* (Skinner). *N* = 31. Counts were made in numerous nuclei (I) and (II) in testes of 2 males [26-2, 51] taken near Copper Lake 17 and 19 July 1959. A third male [26-1] taken with 26-2, showed no suitable nuclei. While there is no difference in number between this high altitude sibling and *C. palla,* there appears to be a significant difference in size distribution; *C. damœtas* has 2 large, 23 medium, and 6 small chromosomes.

20. *Phyciodes tharos* (Drury). *N* = 31. Counts were made in 20 nuclei (I) of 1 male [317-4] taken at West Rock, New Haven, Connecticut, 3 September 1959. No secondary spermatocyte divisions were found. Four other males taken with this one showed no suitable meiotic divisions.

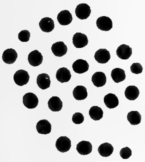
21. *Phyciodes phaon* (Edwards). *N* = 31. Counts were made in 13 nuclei (I) in 3 males [F107, F111, F112] taken at the Corkschew Swamp, near Immokalee, Collier Co., Florida, 19 April 1960, *leg.* K. MAEKI. Three chromosomes are about one-third the size of the others. No secondary divisions were found. No meiotic divisions were found in 8 other males taken at the same time nor in 4 males taken at the Archbold Biological Station, 22 April 1960.

22. *Polygonia zephyrus* (Edwards). *N* = 31. Counts were made in 15 nuclei (I) in testes of 2 males [111-1, 111-2] taken at Gothic, 23 July 1959. No secondary divisions were found. All the chromosomes are similar in size. Both of these males had passed the preceding winter as adults and were extremely battered and worn. A third male [288] taken at Gothic 17 August 1959 had no meiotic divisions; it was fresh and had undoubtedly emerged within a few days.

23. *Vanessa virginiensis* (Drury). *N* = 31. Counts were made in 15 nuclei (I) and 5 nuclei (II) in testes of 1 fresh male [336] taken at West Rock, 7 September 1959. There are 2 large. 25 medium, and 4 small chromosomes.

24. *Junonia cœnia* (Hübner). *N* = 31. Counts were made in 9 nuclei (I) and 10 nuclei (II) in testes of 1 male [M22-1] taken at Ciudad Victoria, 1 August 1959. A second male taken at the same time showed no meiotic divisions. There are 4 distinctly smaller chromosomes; the others appear to be uniform in size.

25. *Junonia evarete zonalis* (C. & R. Felder). *N* = 31. Counts were made in 25 nuclei (I) in testes of 1 male [M33-1] taken at Ciudad Victoria, 2 August 1959. At this locality these two *Junonia* were flying together in approximately equal numbers, both were fresh, and no phenotypic intermediates were found: — clear justification for their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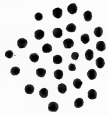
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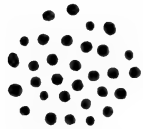
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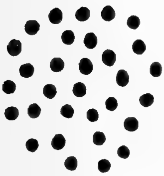
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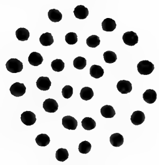
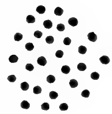
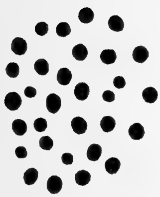

27a


27b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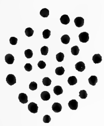
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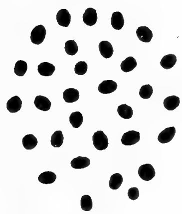
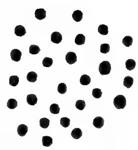
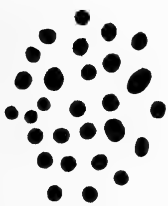

29a


29b


30a

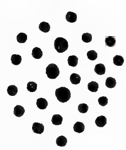

30b

Fig. 24a — *Junonia cœnia* (I); fig. 24b — same (II); fig. 25 — *J. evarete* (I); fig. 26 — *Anartia fatima* (I); fig. 27a — *A. jatrophæ* (I); fig. 27b — same (II); fig. 28a — *Metamorpha steneles* (I); fig. 28b — same (II); fig. 29a — *Hamadryas glauconome* (I); fig. 29b — same (II); fig. 30a — *Biblis hyperia* (I); fig. 30b — same (II).

being ranked as separate species. The caryotype showed no numerical difference, hardly surprising in a group as invariable as the Nymphalini, even from genus to genus. However, the size relations are different, *J. evarete* having 6 small chromosomes, and all the other 25 synapsed chromosomal units are somewhat smaller than those of *J. cœnia.*

26. *Anartia fatima* (Fabricius). $N = 31$. Counts were made in 15 nuclei (I) in testes of 2 males [M19-1, M19-3] taken at Ciudad Victoria, 1 August 1959. No secondary divisions were found. A third male taken at the same time showed no suitable nuclei for counts. Six chromosomes are somewhat smaller than the others, which are uniform in size.

27. *Anartia jatrophæ* (Johannson). $N = 31$. Counts were made in 20 nuclei (I) and 15 nuclei (II) in testes of 2 males [M2-1, M2-3] taken at Ciudad Victoria, 1 August 1959. A third male taken at the same time had no suitable divisions, the caryotype shows 27 large and 4 smaller chromosomes. The same number characterizes race *guantanamo* Munroe in Florida, where we found numerous primary and secondary divisions with $n = 31$ in 2 males [F91, F122] taken at the Corkscrew Swamp, 19 April 1960, *leg.* K. MAEKI.

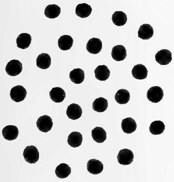
28. *Metamorpha stelenes* (Linné). $N = 31$. Counts were made in 20 nuclei (I) and 15 nuclei (II) in testes of 2 males [M27-1, M27-2] taken at Ciudad Victoria, 2 August 1959. There are 26 chromosomes with large but diverse size and 5 small elements.

29. *Hamadryas glauconome* (Bates). $N = 31$. Counts were made in 16 nuclei (I) and 7 nuclei (II) in testes of 2 males [M57-1, M57-2] taken at El Salto, S. L. P., Mexico, 4 August 1959. There are 25 rather uniformly large and 6 smaller chromosomes.

30. *Biblis hyperia* (Cramer). $N = 28$. Counts were made in 18 nuclei (I) and 13 nuclei (II) in testes of 5 males [M1-1, M1-3, M1-4, M1-5, M1-6] taken at Ciudad Victoria, 1 August 1959. A sixth male taken at the same time showed no meiotic divisions. There are 3 large, 21 medium, and 4 small chromosomes. The caryotype, like the facies of the imago, suggests that the relationship of this genus to its supposed near relatives such as *Hamadryas* should be re-investigated.

31. *Limenitis weidemeyerii* (Edwards). $N = 30$. Counts were made in 30 nuclei (I) and 30 nuclei (II) in testes of 6 males [2, 125, 127, 158, 176, 177] taken near Gothic, on 16, 27, 28, and 31 July 1959. Dividing cells were numerous even in males which had presumably been flying for many days. There is little diversity of chromosomal size in this species.

32. *Limenitis astyanax* (Fabricius). $N = 30$. Counts were made in 15 nuclei (I) and 20 nuclei (II) in testes of 2 males [385, 386] taken at West Rock, 23 August 1959. There are 2 elements smaller than the other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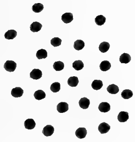
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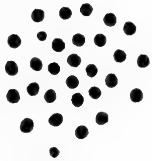
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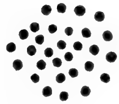
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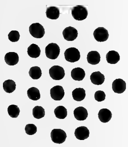
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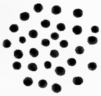
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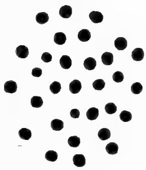
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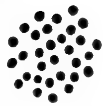
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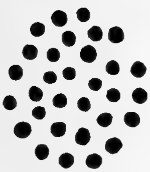
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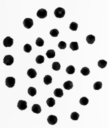
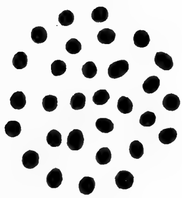
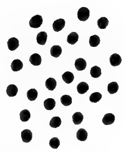

35b


36a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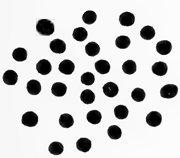
37a

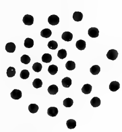
37b

Fig. 31a — *Limenitis weidemeyerii* (I); fig. 31b — same (II); fig. 32a — *L. astyanax* (I); fig. 32b — same (II); fig. 33a — *L. archippus* (I); fig. 33b — same (II); fig. 34a — *Asterocampa celtis* (I); fig. 34b — same (II); fig. 35a — *A. leilia* (I); fig. 35b — same (II); fig. 36a — *Anœa aidea* (I); fig. 36b — same (II); fig. 37a — *Libytheana bachmanii* (I); fig. 37b — same (II).

28, which are fairly uniform in size. A "proserpina"-type, presumed to be a hybrid with *arthemis,* taken at the same time shows no synaptic failure in the 15 primary spermatocyte divisions found.

33. *Limenitis archippus* (Cramer). *N* = 30. Counts were made in 45 nuclei (I) and 35 Nuclei (II) in testes of 4 males [320-1, 320-2, 320-3, 320-4] taken at Woodbridge, New Haven Co., Connecticut, 3 September 1959, and 1 male [409] ex-pupa 6 October 1959, mother from Woodbridge. There are 12 large, 15 medium, and 3 small elements.

34. *Asterocampa celtis* (Boisduval & Leconte). *N* = 31. Counts were made in 30 nuclei (I) and 20 nuclei (II) in testes of 5 males [344, 348, 391-1, 391-2, 391-3] taken on West Rock, 23 August to 11 September 1959. There are 28 large and 3 smaller chromosomes. The condition of the wings indicates that 4 of these males were young; the other was very battered and undoubtedly old, but nevertheless normal meiosis was still taking place in its testes.

35. *Asterocampa leilia* (Edwards). *N* = 31. Counts were made in 15 nuclei (I) and 10 nuclei (II) in testes of 1 male [M17] taken at Ciudad Victoria, 1 August 1959. Apparently 10 of the chromosomes are distinctly larger and 5 smaller than the rest. Dr. W. J. REINTHAL kindly verified the determination.

B. NYMPHALIDÆ – CHARAXIDINÆ:

1. *Anæa aidea* (Guérin). *N* = 30. Counts were made in 20 nuclei (I) and 10 nuclei (II) in testes of 3 males [M39-1, M39-2, M39-3] taken at Ciudad Victoria, 2 August 1959. The chromosomes are all very large and are rather uniform.

C. NYMPHALIDÆ – LIBYTHEINÆ:

1. *Libytheana bachmanii* (Kirtland). *N* = 31. Counts were made in 20 nuclei (I) and 10 nuclei (II) in testes of 7 males [M14-1, M14-2, M14-3, M14-5, M14-6, M14-7, M14-8] taken at Ciudad Victoria, 1 August 1959. The chromosomal size is diverse, with 4 elements being distinctly smaller than the others. MICHENER (1943) suggested that *Libytheana* from northern Mexico is *L. carinenta mexicana* Michener "or may show intergradation between [*L. bachmanii*] *larvata* and *mexicana*". He differentiated *L. carinenta* from *L. bachmanii* on the basis of the shape of the median distal process of the 8th abdominal tergum of the male. In this character our specimens are almost a perfect match with *L. bachmanii* from South Carolina and with MICHENER's drawing of *bachmanii* (his fig. 4).

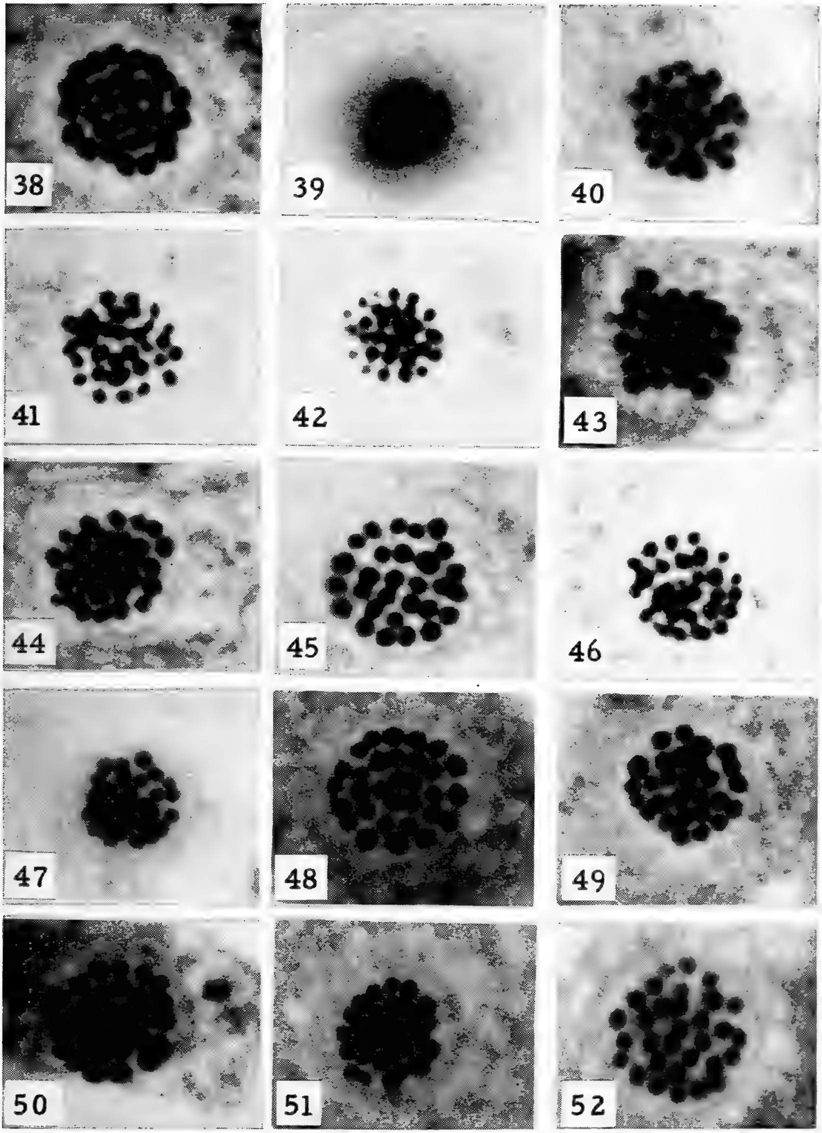

Fig. 38 – *Dryas julia* (I); fig. 39 – *Euptoieta hegesia* (II); fig. 40 – *Speyeria cybele charlottii* (I); fig. 41 – *S. coronis halcyone* (I); fig. 42 – *S. zerene sinope* (I); fig. 43 – *S. callippe meadii* (I); fig. 44 – *S. atlantis*, variant; fig. 45 – *S. atlantis nikias* (I); fig. 46 – *S. hydaspe sakuntala* (I); fig. 47 – *S. mormonia eurynome* (II); fig. 48 – *Boloria titania* (I); fig. 49 – *B. eunomia* (I); fig. 50 – *Chlosyne palla* (I); fig. 51 – *Junonia evarete* (I); fig. 52 – *Anartia fatima* (I).

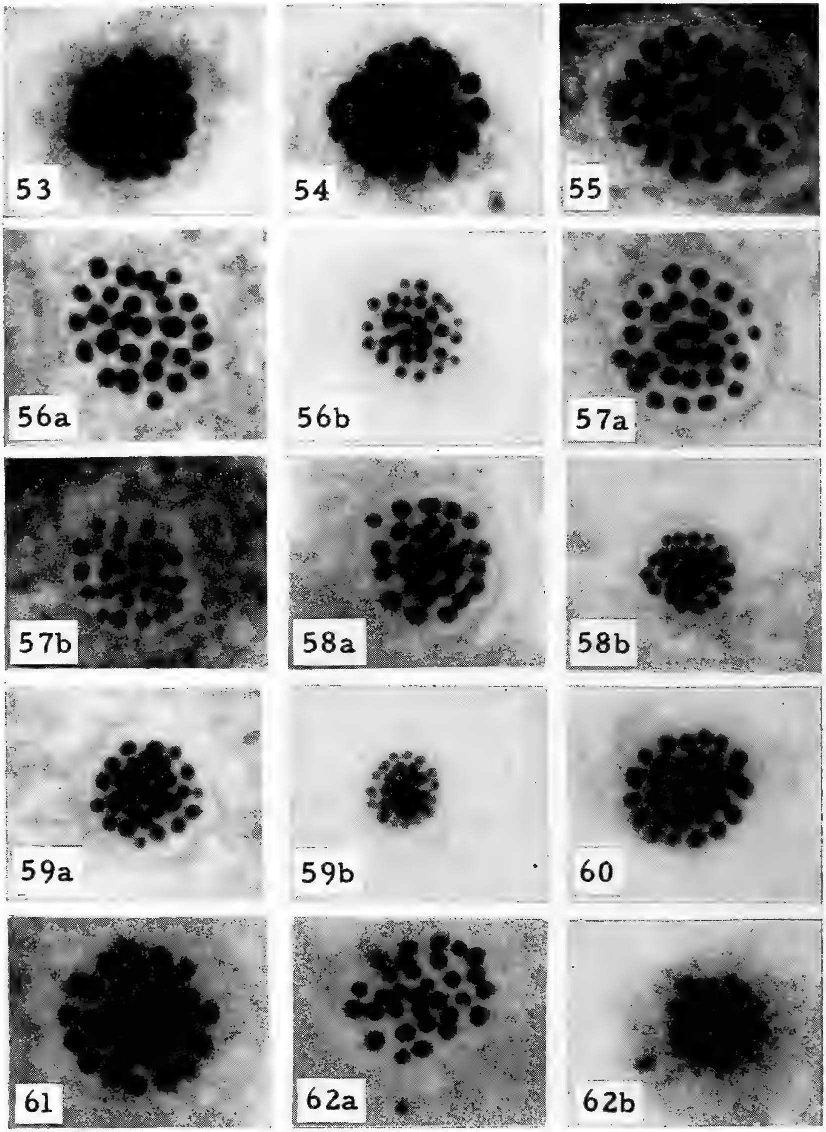

Fig. 53 – *Anartia jatrophæ* (I); fig. 54 – *Metamorpha steneles* (I); fig. 55 – *Hamadryas glauconome* (I); fig. 56a – *Biblis hyperia* (I): fig. 56b – same (II); fig. 57a – *Limenitis weidemeyerii* (I); fig. 57b – same (II); fig. 58a – *L. astyanax* (I); fig. 58b – same (II); fig. 59a – *L. archippus* (I); fig. 59b – same (II); fig. 60 – *Asterocampa leilia* (I); fig. 61 – *Anæa aidea* (I); fig. 62a – *Libytheana bachmanii* (I); fig. 62b – same (II).

Table 6. CHROMOSOME NUMBERS OF THE NYMPHALIDÆ: NYMPHALINÆ, CHARAXIDINÆ, LIBYTHEINÆ.

Species	Number (n)	Division	Reference
D. Nymphalinæ:			
DRYAS JULIA (Fabr.)	31	♂ (I, II)	Present paper
AGRAULIS JUNO (Cramer)	31	♂ (I, II)	Present paper
EUPTOIETA HEGESIA (Cram.)	31	♂ (II)	Present paper
Boloria pales (Schiff.)	30	♂ (I, II)	de Lesse, 1953
Boloria aquilonaris (Stichel) (= *arsilache* auctt.)	30	♂ (I, II); 29-30 ♀ (I)	Federley, 1938 de Lesse, 1953
Boloria napæa (Hoffmsg.)	31	♂ (I, II)	de Lesse, 1953
Boloria græca (Staud.)	31	♂ (I, II)	de Lesse, 1960
Boloria eunomia ossianus (Herbst)	28	♀ (I)	Federley, 1938
BOLORIA EUNOMIA CÆLESTIS (Hem.)	28	♂ (I, II)	Present paper
Boloria selene selene (Schiff.)	30	♂ (I, II), ♀ (I)	Federley, 1938
BOLORIA SELENE TOLLANDENSIS (Barnes & Benj.)	30	♂ (I, II)	Present paper
Boloria freija (Thunb.)	31	♂ (I), ♀ (I)	Federley, 1938
Boloria frigga (Thunb.)	31	♀ (I)	Federley, 1938
Boloria thore scandinavica (Rygge)	30	♀ (I)	Federley, 1938
Boloria thore jezoensis (Mats.)	31	♂ (I, II)	Maeki, in press
Boloria euphrosyne (Linné)	31	♂ (I, II), ♀ (I)	Federley, 1938 Lorkovič, 1941
Boloria titania titania (Esper)	31	♂ (I, II)	de Lesse, 1953
BOLORIA TITANIA HELENA (Edw.)	31	♂ (I, II)	Present paper
Argyronome laodice (Pallas)	31	♂ (I)	Maeki, 1953a, b Maeki & Makino, 1953
Argyronome ruslana (Motsch.)	26	♂ (I)	Maeki & Makino, 1953 Maeki, 1953b
Issoria lathonia (Linné)	30	♂ (I, II), ♀ (I)	Federley, 1938
Brenthis ino ino (Rott.)	12-13	♂ (I, II); 13-14 ♀ (I)	Federley, 1938
Brenthis ino tigroides (Fruhs.)	14	♂ (I)	Maeki, 1953a, b Maeki & Makino, 1953
Brenthis daphne rabdia (Butler)	14	♂ (I, II)	Maeki, in press
Brenthis daphne daphne (Schiff.)	13	♂ (I, II)	de Lesse, 1960
Fabriciana niobe (Linné)	29	♂ (I, II); 28-29 ♀ (I)	Federley, 1938 de Lesse, 1960
Fabriciana adippe (Schiff.)	29	♂ (I, II); 28 ♀ (I)	Federley, 1938 Lorkovič, 1941 Maeki, in press
Fabriciana nerippe (Felder)	29	♂ (I, II)	Maeki, in press

[1]Tables 1 (Papilionidæ), 2 (Hesperioidea), 3 (Pieridæ), 4 (Lycænidæ), and 5 (3 subfamilies of Nymphalidæ) are in Parts 1, 2, and 3 of this series of papers (*Journ. lepid. soc.* 13: 199; 14: 51-53, 136-141; 1960-61).

Table 6 – continued.

Mesoacidalia charlotta (Haw.) (= *aglaja*) (3 sspp.)	29	♂ (I, II), ♀ (I)	Federley, 1938 Maeki, 1953a, b Maeki & Makino, 1953 de Lesse, 1960
SPEYERIA CYBELE (Fabr.)	29	♂ (I, II)	Present paper
SPEYERIA APHRODITE (Fabr.)	29	♂ (I, II)	Present paper
SPEYERIA CORONIS (Behr)	30	♂ (I, II)	Present paper
SPEYERIA ZERENE (Bdv.)	29	♂ (I, II)	Present paper
SPEYERIA CALLIPPE (Bdv.)	30	♂ (I, II)	Present paper
SPEYERIA ATLANTIS (Edw.)	29	♂ (I, II)	Present paper
SPEYERIA HYDASPE (Bdv.)	29	♂ (I, II)	Present paper
SPEYERIA MORMONIA (Bdv.)	29	♂ (I, II)	Present paper
Argynnis paphia (Linné)	29	♂ (I, II); 28 ♀ (I)	Federley, 1938 Maeki, 1953a, b Maeki & Makino, 1953 de Lesse, 1960
Argynnis anadyomene (Felder)	37	♂ (I)	Maeki & Makino, 1953 Maeki, 1953b, 1961
Damora pandora (Schiff.)	29	♂ (I)	de Lesse, 1960
Damora sagana (Dbldy.)	31	♂ (I)	Maeki, in press
Argyreus hyperbius (Linné)	31	♂ (I, II)	Maeki, 1953b
Euphydryas iduna (Dalman)	31	♀ (I)	Federley, 1938
Euphydryas maturna (Linné)	31	♂ (I, II), ♀ (I)	Beliajeff, 1930
Euphydryas aurinia (Rott.)	30	♂ (I, II)	Federley, 1938 Lorković, 1941
EUPHYDRYAS ANICIA EURYTION (Mead)	31	♂ (I, II)	Present paper
Melitæa cinxia (Linné)	31	♀ (I)	Federley, 1938
Melitæa phœbe "auctt."	31	♂ (I)	de Lesse, 1960
Melitæa diamina (Lang.)	31	♂ (I)	de Lesse, 1960
Melitæa trivia (Schiff.)	31	♂ (I, II)	de Lesse, 1960
Melitæa transcaucasica Turati	29	♂ (I, II)	de Lesse, 1960
Melitæa didyma (Esper)	28	♂ (I, II)	de Lesse, 1960
Melitæa persea (Kollar)	ca. 27-28	♂ (II)	de Lesse, 1960
Melitæa montium Belt.	27	♂ (I, II)	de Lesse, 1960
Mellicta athalia (Rott.)	31	♂ (I, II), ♀ (I)	Federley, 1938 de Lesse, 1960
Mellicta varia (Meyer-Dür)	31	♂ (1)	de Lesse, 1960
CHLOSYNE HARRISII (Scud.)	31	♂ (1)	Present paper
CHLOSYNE PALLA (Edw.)	31	♂ (1)	Present paper
CHLOSYNE DAMŒTAS (Skin.)	31	♂ (I, II)	Present paper

Table 6 — continued.

PHYCIODES THAROS (Dury)	31	♂ (1)	Present paper
PHYCIODES PHAON (Edw.)	31	♂ (I)	Present paper
Cyrestis thyodamas Bdv.	31	♂ (I)	Maeki, 1953b
Araschnia levana (Linné) (2 sspp.)	31	♂ (I, II)	Lorkovič, 1941 Maeki, 1953a, b Maeki & Makino, 1953
Araschnia burejana Bremer	31	♂ (II)	Maeki, 1953a b Maeki & Makino, 1953
Polygonia c-album (Linné) (sev. sspp.)	31	♂ (I, II), ♀ (I)	Kernewitz, 1914, 1915 Beliajeff, 1930 Federley, 1938 Maeki, 1953a, b Maeki & Makino, 1953
Polygonia c-aureum (Linné)	31	♂ (I)	Maeki & Makino, 1953 Maeki, 1953b
Polygonia vau-album (Schiff.)	31	♂ (I)	Maeki, in press
Polygonia egea (Cramer)	31	♂ (I)	de Lesse, 1960
POLYGONIA ZEPHYRUS (Edw.)	31	♂ (I)	Present paper
Vanessa atalanta (Linné)	31	♂ (I, II)	Federley, 1938
Vanessa indica (Herbst)	31	♂ (I, II)	Maeki, 1953a, b Maeki & Makino, 1953
Vanessa cardui (Linné)	31	♂ (I, II)	Lorkovič, 1941
VANESSA VIRGINIENSIS (Dru.)	31	♂ (I, II)	Present paper
Nymphalis antiopa (Linné)	31	♂ (I, II) ♀ (I)	[Stevens, 1906 — error?] Federley, 1938 de Lesse, 1960
Nymphalis xanthomelas (Esper) (2 sspp.)	31	♂ (I)	Lorkovič, 1941 Maeki, 1953a, b Maeki & Makino, 1953
Nymphalis polychloros (Linné) (2 sspp.)	31	♂ (I, II)	Lorkovič, 1941 Maeki, 1953a, b Maeki & Makino, 1953
Nymphalis canace (Linné)	31	♂ (I)	Maeki & Makino, 1953 Maeki, 1953b
Nymphalis io (Linné)	31	♂ (I, II)	Maeki, 1953a b Maeki & Makino, 1953
Nymphalis urticæ (Linné) (2 sspp.)	31	♂ (I, II)	Beliajeff, 1930 Federley, 1938 Maeki, 1953a, b Maeki & Makino, 1953
Precis almana (Linné)	31	♂ (I, II)	Maeki, 1953b
JUNONIA CŒNIA (Hbn.)	31	♂ (I, II)	Present paper
JUNONIA EVARETE (Felder)	31	♂ (I)	Present paper

Table 6 — continued.

ANARTIA FATIMA (Fabr.)	31	♂ (I)	Present paper
ANARTIA JATROPHÆ (Joh.)	31	♂ (I, II)	Present paper
METAMORPHA STELENES (L.)	31	♂ (I, II)	Present paper
HAMADRYAS GLAUCONOME (Bates)	31	♂ (I, II)	Present paper
BIBLIS HYPERIA (Cramer)	28	♂ (I, II)	Present paper
Limenitis populi (Linné) (2 sspp.)	30	♂ (I, II), ♀ (I)	Federley, 1938 Maeki, in press
Limenitis camilla (Linné) (2 sspp.)	30	♂ (I, II)	Beliajeff, 1930 Maeki, 1953a, b Maeki & Makino, 1953
Limenitis glorifica (Fruhs.)	30	♂ (I)	Maeki & Makino, 1953 Maeki, 1953b
Limenitis rivularis (Scop.)	30	♂ (I)	Maeki, in press
Limenitis anonyma (Lew.)	30	♂ (I)	de Lesse, 1960
LIMENITIS WEIDEMEYERII Edw.	30	♂ (I, II)	Present paper
LIMENITIS ASTYANAX (Fabr.)	30	♂ (I, II)	Present paper
LIMENITIS ARCHIPPUS (Cram.)	30	♂ (I, II)	Present paper
Neptis philyra (Mén.)	30	♂ (I)	Maeki, in press
Neptis pryeri (Butler)	30	♂ (I)	Maeki, in press
Neptis aceris (Esper)	30	♂ (I, II)	Maeki, 1953a, b Maeki & Makino, 1953
ASTEROCAMPA CELTIS (Bdv. & Lec.)	31	♂ (I, II)	Present paper
ASTEROCAMPA LEILIA (Edw.)	31	♂ (I, II)	Present paper
Apatura ilia (Linné)	31	♂ (I)	Maeki, 1953a, b Maeki & Makino, 1953
Thaleropis jonia (Eversm.)	31	♂ (I)	de Lesse, 1960
Hestina japonica (Felder)	30	♂ (I)	Maeki, 1953a, b Maeki & Makino, 1953
Sasakia charonda (Hew.)	29	♂ (I, II)	Maeki, 1953a, b Maeki & Makino, 1953
E. Charaxidinæ:			
ANÆA AIDEA (Guérin)	30	♂ (I, II)	Present paper
F. Libytheinæ:			
Libythea celtis (Linné) (2 sspp.)	31	♂ (I, II)	Lorkovič, 1941 Maeki, 1953a, b Maeki & Makino, 1953
LIBYTHEANA BACHMANII (Kirt.)	31	♂ (I, II)	Present paper

Discussion

Table 6 shows the chromosome numbers of the 98 Nymphalinæ, 1 Charaxidinæ, and 2 Libytheinæ for which counts have now been recorded. Of the 36 species described in the present paper, 33 are species and 3 are subspecies new to cytology. All 3 previously reported species are *Boloria,* and the Nearctic races have the same numbers as their Palearctic conspecifics. The classification of the Nymphalinæ is still in an uncertain state, particularly at the generic level and to some extent in the interrelationships of the tribes. For the Argynnini we were influenced in our grouping by recent work of dos Passos and Grey (1945) and Warren (1955), for the Melitæini by Higgins (1955) and Bauer (1961), for *Precis* and *Junonia* by Munroe (1951) and de Lesse (1952), and for all nymphaline groups by Shirozu (1960). As noted above, we regard the libytheines as comfortable members of the broadened family Nymphalidæ. That the charaxidines and acræines deserve the full status of subfamilies seems less likely.

The groups with one distinctive chromosome number are the Nymphalini (all 23 species in 2 genera have $n = 31$), the Limenitini (all 11 species in 2 genera have $n = 30$), the Heliconiini (3 genera, 1 species each, have $n = 31$), and the Libytheinæ (both accepted genera, 1 species each, have $n = 31$). Obviously too few are known in the last two groups for confident generalizing.

A large enough proportion of the bolorians and argynnans is now known cytologically to allow some evaluation of their current systematics in the light of this character. There is a little diversity in number, and few large deviations from the basic 30-31 for the bolorians and 29 for the argynnans. The major chromosomal deviants are also somewhat anomalous in their genitalic morphology. *Boloria eunomia* has been set apart as a monospecific genus or subgenus, *Proclossiana;* so far it is also the only bolorian with $n = 28$. *Brenthis ino* and *daphne* are radically different from other argynnines in chromosome number (13-14); they had been recognized as somewhat isolated genitalically, but perhaps this genus deserves even more distinctive treatment taxonomically. *Argyronome ruslana* and *Argynnis anadyomene* are extremely atypical of argynnines in haploid number, although each has a presumed congener which is cytologically like most of the related genera. Size relations of the chromosomes of these two species may give clues to the evolution of their caryotypes (*e. g., Papilio cresphontes* and *P. thoas,* see Maeki & Remington, 1960a). The caryotypes support Grey's (1958) view that *anadyomene* ($n = 37$) stands well away from *paphia* ($n = 29$). Can it be that the genus *Argyronome* of Warren is also too heterogeneous, with *laodice* ($n = 31$) and *ruslana* ($n = 26$) having such different caryotypes?

Counts are known for a member of each of a majority of the superspecies of the Nearctic genus *Speyeria*. The cytological evidence, being published elsewhere, points to the likelihood that these "species" contain numerous biologically separate semispecies in the sense of LORKOVIC (1955, 1958).

As with various *Papilio, Pieris, Aricia, Agrodiætus,* and *Erebia* (see our first three papers), different chromosome numbers have been reported for geographic populations within supposed "species" of Nymphalinæ. Any of the following pairs may be found to be best treated as two species rather than two subspecies:

Boloria thore	(Finland)	– $n = 30$ (♀)
	(Japan)	– $n = 31$ (♂)
Brenthis ino	(Finland)	– $n = 12\text{-}13$ (♂)
	(Japan)	– $n = 14$ (♂)
Brenthis daphne	(Italy)	– $n = 13$ (♂)
	(Japan)	– $n = 14$ (♂).

The early Finnish counts need to be verified, since FEDERLEY was faced with special problems in oogenesis, but the recent counts for Italian and Japanese *B. daphne* should be considered certain. Each of the other pairs of geographically remote populations show no difference in number: *Boloria eunomia, B. selene, B. titania, Fabriciana adippe, Mesoacidalia charlotta, Argynnis paphia, Araschnia levana, Polygonia c-album, Vanessa cardui, Nymphalis xanthomelas, N. polychloros, N. urticæ, Limenitis populi, L. camilla, Libythea celtis.*

The timing of male meiosis in relation to the seasonal physiology of Lepidoptera is of particular interest to us. Studies on this subject in moths as well as butterflies are being presented elsewhere, but comments are appropriate here on the meiotic timing in the many Nymphalini which hibernate as adults. We have reported chromosome counts for 2 males of *Polygonia zephyrus* whose condition and date indicated with certainty that they had overwintered as adults and were about eleven months old. In most hibernating Nymphalini meiosis apparently takes place before winter. Testes of numerous males of *Nymphalis xanthomelas, N. antiopa, N. io, N. urticæ, N. canace,* and *Polygonia vau-album* fixed in Japan in spring and early summer were full of mature sperm and had no meiosis in progress. It is notable that the only exception in the Japanese hibernators studied was *Polygonia c-album;* like our Colorado *P. zephyrus,* it has post-hibernation meiosis. In 1959 we fixed testes of 5 *N. milberti* collected at Gothic from 19 July to 22 August. Some of these had recently eclosed, and at least one had apparently overwintered as an imago, but none showed any meiosis. We also found no meiosis in testes of a *P. vau-album album* (Bdv. & Lec.) from Connecticut fixed 27 September 1960 nor in testes of a *Vanessa atalanta* from Connecticut fixed 20 September 1960. These were both pre-hibernators. With *Polygonia* it is clear that meiosis occurs extensively, perhaps solely, following hibernation in males which do hibernate. In contrast, meiosis occurs in *Nymphalis* either prior to hibernation or extremely early in spring but not later.

In these four papers we have summarized the chromosome numbers for 359 species of Rhopalocera. Total additional species or probable species listed by de Lesse (1960) are the following: 13 Hesperiidæ, 9 Pieridæ, 51 Lycænidæ. Thus, the numbers of about 460 species of the butterflies have now been recorded. This is more than triple the number listed at the time of the latest (1956) edition of the Makino *Atlas*. It is likely that soon a majority of the recognized Palearctic and Nearctic species will have been studied. Probably no other large group of animals except *Drosophila* approaches that degree of cytotaxonomic knowledge for this vast region.

Summary

1. The chromosome numbers and some size relations are reported for 34 species of Nymphalinæ, 1 of Charaxidinæ, and 1 of Libytheinæ from Mexico, Colorado, Connecticut, and Florida. Of these, 33 are species new to cytology. All counts are from spermatocyte divisions.

2. The haploid number is consistently 31 in the Nymphalini and Heliconiini, 30 in the Limenitini, and is 31 in the only two Libytheinæ known. The number tends to be 30-31 in the bolorian Arynnini and 29 in the argynnan Argynnini, with a few deviants.

3. The timing of meiosis in Nymphalini which hibernate in the imaginal stage is discussed. *Nymphalis* spp. apparently complete meiosis before or immediately after hibernation, whereas *Polygonia c-album* and *P. zephyrus* have most or all meiosis taking place during the long post-hibernation period.

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References

Bauer, D. L., 1961. Tribe Melitæini *in* Ehrlich, P. R. & A. H., *How to know the butterflies*: 127-146, figs. 237-284.

Beliajeff, N. K., 1930. Die Chromosomenkomplexe und ihre Beziehung zur Phylogenie bei den Schmetterlingen. *Zeitschr. induk. Abstamm.-und Vererbungsl.* 54: 369-399, 3 pls.

Ehrlich, P. R., The comparative morphology, phylogeny and higher classification of the butterflies (Lepidoptera: Papilionoidea). *Univ. Kansas sci. bull.* 39: 305-370, 64 figs.

Federley, H., 1938. Chromosomenzahlen finnländischer Lepidopteren. I. Rhopalocera. *Hereditas* 24: 397-464, 47 figs.

Grey, L. P., 1958. Warren's argynnid classification (Nymphalidæ). *Lepid. news* 11: 171-176.

Higgins, L. G., 1955. A descriptive catalogue of the genus *Mellicta* Billberg (Lepidoptera: Nymphalidæ) and its species, with supplementary notes on the genera *Melitæa* and *Euphydryas*. *Trans. roy. ent. soc. London* 106: 1-131, 2 pls.

Kernewitz, B., 1914. Über Spermiogenese bei Lepidopteren. *Zool. Anz.* 45: 137-139.

..............., 1915. Spermiogenese bei Lepidopteren mit besonderer Berücksichtigung der Chromosomen. *Archiv Naturgeschichte* (A) 81: 1-34, 3 pls., 14 figs.

de Lesse, H., 1952. Note sur les genres *Precis* Hb. et *Junonia* Hb. (Lep. Nymphalidæ). *Bull. soc. ent. France* 57: 74-77, 2 figs.

..............., 1953. Formules chromosomiques de *Boloria aquilonaris* Stichel, *B. pales* D. et Schiff., *B. napæa* Hoffm. et quelques autres Lépidoptères Rhopalocères. *Rev. franç. lépid.* 14: 24-26, 1 pl., 5 figs.

..............., 1960. Spéciation et variation chromosomique chez les lépidoptères. *Ann. sci. nat. zool. biol. anim.* (sér. 12) 2: 1-223, 222 figs.

Lorkovič, Z., 1941. Die Chromosomenzhlen in der Spermatogenese der Tagfalter. *Chromosoma* 2: 155-191, 13 figs.

..............., 1955. Semispecies a necessary new taxonomic category. *Biol. glasnik* 7: 236-237.

..............., 1958. Die Merkmale der unvollständigen Speziationsstufe und die Frage der Einführung der Semispezies in die Systematik. *Uppsala univ. årsskrift* 1958: 159-168, 1 fig.

Maeki, K., 1953a. Chromosome numbers of some butterflies (Lepidoptera-Rhopalocera). *Japanese journ. genetics* 28: 6-7, 5 figs.

..............., 1953b. A chromosome study of Japanese butterflies (Lepidoptera-Rhopalocera). *Kwansei Gakuin Univ., annual studies* 1: 67-70.

Maeki, in press. [Chromosome numbers of Japanese Nymphalidæ; *Japanese journ. genetics.*]

Maeki, K., & S. Makino, 1953. Chromosome numbers of some Japanese Rhopalocera. *Lepid. news* 7: 36-38.

Maeki, K., & C. L. Remington, 1960a. Studies of the chromosomes of North American Rhopalocera. 1. Papilionidæ. *Journ. lepid. soc.* 13: 193-203, 2 pls., 7 figs.

..............., 1960b. *Idem.* 2. Hesperiidæ, Megathymidæ, and Pieridæ. *Journ. lepid. soc.* 14: 37-57, 7 pls.

..............., 1961. *Idem.* 3. Lycænidæ, Danainæ, Satyrinæ, Morphinæ. *Journ. lepid. soc.* 14: 127-147, 5 pls.

Michener, C. D., 1943. Some systematic notes on the Libytheidæ (Lepidoptera). *Amer. mus. novitates* 1231: 2 pp., 6 figs.

Munroe, E. G., 1951. The genus *Junonia* in the West Indies (Lepidoptera, Nymphalidæ). *Amer. mus. novitates* 1498: 16 pp.

dos Passos, C. F., & L. P. Grey, 1945. A genitalic survey of Argynninæ (Lepidoptera, Nymphalidæ). *Amer. mus. novitates* 1296: 29 pp., 54 figs.

Shirozu, T., 1960. *Butterflies of Formosa in colour.* 481 pp., 76 pls., 479 figs. Hoikusha, Osaka.

Stevens, N. M., 1906. Studies in spermatogenesis. Part II. A comparative study of the heterochromosomes in certain species of Coleoptera, Hemiptera, and Lepidoptera, with especial reference to sex determination. *Carnegie inst. Washington publ.* 36: 33-74, pls. 8-15.

Warren, B. C. S., 1955. A review of the classification of the subfamily Argynninæ (Lepidoptera: Nymphalidæ). Part 2. Definition of the Asiatic genera. *Trans. roy. ent. soc. London* 107: 381-392, 4 pls.

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HOW TO KNOW THE BUTTERFLIES. By Paul R. and Anne H. Ehrlich. 1961. 262 pp., 525 figs. Publisher: Wm. C. Brown Co., 135 South Locust St., Dubuque, Iowa, U. S. A.; price $2.75 (paper cover, spiral-bound) and $3.25 (cloth-bound).

This, like the fine *Guide* by A. B. Klots, is much more than a field manual; it is a good introduction to "knowing" the North American butterflies. The main text is in the form of an identification key, accompanied by excellent drawings by Mrs. Ehrlich of most of the species and by summary statements of the geographic distribution, flight periods, and larval foodplants for each. It is intended only for determination down to species. The Skippers are arbitrarily separated from the "Butterflies" (= Papilionoidea only) and omitted from the volume. A major merit of the book is the 30-page introduction to the practice of lepidopterology. The ingredients of this palatable first course are: techniques of collecting and preparing specimens; making genitalic and other dissections and recognizing the principal structures; and comments on problems of variation, classification, and amateur research.

Butterfly taxonomy has moved so rapidly in recent years and has become so sophisticated in some groups that no one person is qualified to deal authoritatively with all groups, even for North America. Dr. Ehrlich has solved this problem by inducing several of the most active specialists to prepare the sections on their groups. These are: D. L. Bauer, H. K. Clench, C. F. dos Passos, J. C. Downey, L. P. Grey, A. B. Klots, W. S. McAlpine, and K. H. Wilson. As always with an array of contributors, there is some unevenness in the treatment and quality. But for me the sections by Dr. KLOTS are superb summaries at the species level for those two complicated genera, *Colias* and *Boloria.* BAUER's treatment of the Melitæines is a valuable progress report on the emerging classification of the group. CLENCH for the whole Hairstreak group (and to a lesser degree BAUER for his section) presents a smashing new classification for North America, with wide impact for the Neotropic region as well.

My principal criticism of the new book is on a policy level: - it is a mistake to allow major taxonomic revisions to appear first in a collectors' guide. A collectors' guide and a taxonomic revision have almost opposite missions, and the drawbacks to combining them in so limited a space are all too obvious in this book.

A few minor errors and omissions should be noted. The name "*Precis orithya*" is used on figure 300, but "*lavinia*" in the text, for the species E. G. MUNROE calls *Junonia cœnia* in his 1951 revision. The geography of Calinaginæ and Morphinæ is not mentioned on page 83, although for other exotic groups it is clearly given. The Table for distinguishing Butterflies, Skippers, and Moths omits some of the best characters and includes without enough caution some commonly unreliable ones. The instructions for distinguishing males from females need drawings. The terms *sphragis* and *osmeterium* are misspelled throughout. Numerous listed foodplants are probably wrong and if given at all should be phrased more equivocally or there should be a prominent general statement of caution in the preface. The dark forms of *Papilio glaucus* and *P. rudkini* will not run in the key, and the *Papilio* key is inadequate in general.

Some outstanding features of the book include: separate statements of flight season when a species has very different flight periods at different latitudes or altitudes; the precise locality of each figured specimen if known; and the mention of familiar synonymous or misapplied names if their omission would be confusing to collectors. There is an illustrated glossary of terms in the back (however, its interlarding with the index is a nuisance for using both glossary and index).

This book is the only source to which a lepidopterist can go at present for distinguishing the species of the Papilionoidea of all North America, learning the current names, and placing them in the best arrangement. For this region it is by far the most basic reference in existence today, and its low price should cause many collectors to keep a spiral-bound copy in their field kits and a cloth-bound copy on the reference shelves.

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ESPECIALLY FOR FIELD COLLECTORS

(Under the supervision of FRED T. THORNE, 1360 Merritt Dr., El Cajon, Calif., U.S.A.)

BUTTERFLY HUNTING IN THE MOUNTAINS OF CENTRAL JAPAN

by KAIYA KUBO

The Tobira Spa is located between Mt. Hachibuse and the Utsukushi-ga-hara Heights, and can be reached in an hour by bus from Matsumoto City, Nagano Prefecture, central Japan. In 1956, I stayed at one of the spa hotels from early June through the end of the summer season to collect and photograph butterflies there.

In early summer when the fresh-green hills and valleys are adorned with scarlet mountain azaleas, the most abundant butterflies on the wing are perhaps *Parnassius glacialis* and *Papilio maacki*. The former is an elegant butterfly, though without red spots on the white wings, while the latter is one of the finest 'black' swallowtails of Japan. These huge swallowtails are frequently seen gathering on the edges of way-side pools and streams, or even the puddles on the bus road. The drinking butterflies were so numerous that I was tantalized over and over again at the sight of startled butterflies that scattered away from the road on which the bus was carrying me to the mountain resort. The number of butterlies getting together to take moisture varies from two to fifteen. They did not form an exclusive drinking society, for they were often joined by other species *e. g. Papilio machaon, P. bianor, P. macilentus, Dichorragia nesimachus* (Nymphalidæ), *Daimio tethys* (Hesperiidæ), etc. In photographing these large butterflies taking to water, I had no particular difficulties in approaching them, but every time I focussed my camera near the road I could not escape from inquisitive people, who only caused the butterflies to fly away. When the butterflies are absorbed in drinking water, they seldom flutter. Some of the spring brood butterflies (that is, those resulting from the hibernated pupæ) keep the wings open while drinking, but others of these, and all summer brood individuals, drink with their wings closed.

Parnassius glacialis and *Pararge deidamia* (Satyridæ) are two butterflies, appearing about the same time, which are difficult to photograph in spite of their slow, fluttering flight. The former flies incessantly while there is sunshine and hardly alights on anything other than flowers, and after all I could not take a good picture of it at the Tobira area. The latter, an uncommon mountain satyrid, has a peculiar habit of resting on the cliff, usually half way up from the road. I had to disturb one butterfly continually by throwing stones to it, trying to make it come down. It finally alighted on a stone by the roadside to pose for me. Here are some of the butterflies to be seen about the middle of June: the danaid *Caduga sita* (Blue Monarch or Chestnut Tiger); *Argynnis anadyomene* and *Araschnia burejana* (Nymphalidæ); the satyrid *Neope goschkevitschii, Leptalina unicolor* and *Erynnis montanus* (Hesperiidæ), *Anthocaris scolymus,* the lycænid *Rapala arata;* and hibernated specimens of *Nymphalis antiopa, Inachus io, Polygonia c-album, Gonepteryx rhamni,* etc. (Incidentally, the Mourning Cloak is a single-brooded highland butterfly in Honshu, and hibernated butterflies have the wing borders whitened.) The best season for the Papilionidæ is early June.

Apart from the adult insects, there are found on grassy patches about this time various caterpillars that grow to be summer butterflies. On plantains and *Veronica virginica* are seen the spiny larvæ, with a beautiful orange dorsal line, of a Heath Fritillary, *Mellicta ambigua,* and a little later, in mid-June, luxuriant wild Hops, *Humulus cordifolius,* are ravaged by the gregarious black larvæ of the Peacock (*I. io*). The latter seem to be easy prey of parasitic flies and wasps, and I was disappointed to find a great many grown larvæ of the lot collected had been parasitized. As a result, I obtained only a few adults from the pupæ. Toward the end of this month, fresh butterflies emerge, one species after another; *Fabriciana adippe, Paraneptis rivularis* and *P. pryeri* (Nymphalidæ); *Libythea celtis; Japonica lutea* and *Antigius attilia* (Lycænidæ); then *Inachus io*. They are soon followed by *Kalkasia alwina, Argynnis paphia, Apatura ilia,* all fine Nymphalid butterflies. About the same time, in early July, a large number of *Iratsume orsedice* (one of the several Hairstreaks indigenous to Japan) make their appearance on the tips of sunny twigs. I saw a female of *I. orsedice* sit on a leaf of a willow branch extending over the river, and having climbed the willow tree with great care I snapped it with my camera. After developing the film, however, I found the shots had not been successful. Though many Hairstreaks can be spotted at the extremities of branches jutting out of the foliage, it is difficult to get good pictures unless by lucky chances.

On July 3, I made my way across the slopes and grasslands to the Sanjiro Ranch for the first time. I reached the destination after two hours' walk, and there I was able to take specimens of *Pararge achine* and *Aporia hippia* (neither of which is found near the Spa), as well as *Mellicta ambigua, Paraneptis rivularis, Fabriciana adippe,* etc. *Aporia hippia* is one of the nine Alpine Butterflies of Japan. I took a male specimen at the Tobira Spa bus terminus on July 8, which proved to be unusual in view of the distribution of its food-plant, a Barberry.

I went farther beyond the Ranch on the 11th, and decided to put up at the Sakura-shimizu Hut, near Ishikiriba (or quarry) for a few days with a view to making best use of my net and camera up on the Heights. During this stay I made my first ascent to the Utsukushi-ga-hara Heights (highest point: 6800 feet above sea level). On the wind-blown field, which also becomes a meadow during the summer, there were not many kinds of butterflies flying. What I collected there were *Aporia hippia, Colias erate,* and some Fritillaries. However, many species could be seen on the lower half of the slope. Especially numerous were *Lycæides subsolana,* a large, pretty Blue, and *Paraneptis rivularis.* On the afternoon of the same day, I found a Nymphalid butterflies' assembly on the edge of a pool in a deserted charcoal kiln. I was photographing these drinking butterflies — *Nymphalis xanthomelas, P. rivularis, Ladoga camilla, M. ambigua,* etc. — when a butterfly was seen to settle on a white flower of *Astilbe japonica.* I took it for a Small Purple Emperor, *Apatura ilia,* at first sight, but on approaching it I found it to be a melanic aberrant *Fabriciana adippe.* I was too excited to try to take a photo.

Two days later I observed the oviposition of the Barberry White, *Aporia hippia.* When I was walking amid the Sanjiro Ranch, I saw a female butterfly flying lingeringly over a shrub of Barberry, touching leaves at intervals. I watched her closely for a while, and then walked up stealthily in the thorny bush. In the meantime she had settled on the underside of a leaf, head downwards and grasping the edge of the leaf very firmly. She laid one yellow, bottle-shaped egg, then let her abdomen dangle, and in about 10 seconds she eagerly bent it to resume oviposition. After forming a layer consisting of about 100 eggs closely glued together, the female butterfly began to make a second one, but this time she did not lay more than half as many. All this took place in about 20 minutes, and I had consumed all the exposures of a roll of film when the butterfly was gone. The whole process was really worth observing, in spite of the fact that I had to sit in the thorny scrub under the scorching sun.

Many butterflies emerge in mid-June, when, on a fine day, everyone is sure to see various kinds of fresh specimens on the wing, even within a few steps from the hotel. Most abundant species then were: *Gonepteryx mahaguru, Apatura ilia, Brenthis daphne, Antigius attilia.* Like many other Sulphurs of tropical lands, newly-emerged adults of *Gonepteryx mahaguru* huddle together on wet soil to drink. One day I caught sight of a group of 10 butterflies or so, but while I was preparing my camera, several charcoal burners came along, and the sensitive yellow butterflies had fled before I could warn the people. Many mountain butterflies gather in this way, attracted either by moisture or animal droppings. Also, *Araschnia burejana* and *Halpe varia* (Hesperiidæ) are often found in groups of more than ten individuals. I found it difficult to photograph the latter butterflies drinking together, as these skippers were very nervous. To approach them unnoticed was only possible until I was about seven feet away; when I went nearer they began to fly, one by one.

On July 18 I repaired to the Ranch. This time I had given up taking pictures so that I could freely collect butterflies. The meadow was alive with *M. ambigua* and *Mesoacidalia charlotta.* After taking a sizable number of each species I proceeded to Hirokoba by way of Oidaira. The path ran through a dark softwood, and since horses and cattle were put to grass passing this course, there were quite a few droppings here and there on the way. "But they do attract many butterflies," I said to myself. Indeed, I had not known the real blessing of this mountain-path nuisance until I saw a black butterfly whirling over a log bridge suddenly land on cow-dung on the path, just about seven feet ahead of me. It *was* a rare Alpine Butterfly, *Limenitis populi!* With my heart pounding fast, yet trying my best to be cool-headed, I netted it – I made it! How I pinched it, how I put it in a paper envelope, entirely escaped my memory. But, at any rate, it was a fine, perfect male specimen. This was the only example I was ever able to take there, and I did not have the pleasure of even seeing another. Looking back upon that event, however, I still regret that I did not carry a camera with me that day.

I revisited the Ranch five days later. Toward evening I took a Hairstreak, *Antigius butleri,* sitting on a leaf of *Clethra barbinerivis* on my way back to the quarry. The season for *Chrysozephyrus smaragdinus* was now beginning. The steep hill at the back of a reservoir would prove to be a promising collecting ground of this emerald-green Hairstreak, good footings were found and a longer rod handle used for a net.

Then some of the finest summer butterflies, many of which are the second brood (marked with "II" in the following), begin to emerge in the last week of July. For example, there are the gigantic *Papilio maacki* (II); *Æromachus inachus* (Hesperiidæ); *Strymon merus, Araragi enthea, Rapala arata* (II), *Favonius jezoensis, F. cognatus* (all Lycænidæ); *Pararge deidamia* (II); and the White-Admiral-like second brood butterflies of *Araschnia burejana.* Early August is the hottest time of the year, and it is no wonder that butterflies also feel thirsty in the daytime. Thus, the wayside pools and puddles are frequently visited by drinkers such as *Polygonia vau-album* (Compton Tortoise), *N. antiopa, I. io* (II), *P. c-album* (II), *Dichorragia nesimachus* (II), *Choaspes benjamini* (Hesperiidæ), etc. Though not very common, *Pyrgus maculatus* (II) can be taken at times. *Papilio maacki* are most numerous between August 5 and 15, and male butterflies form larger groups on the ground than in June. Going up a stream by stepping stones, one will most probably come across a batch of butterflies engaged in drinking water. The flowers of *Clerodendron tricotomum* are great *Papilio*-attracters, being in full bloom about the 10th of this month. However, males of *P. maacki* do not frequent them. Other Swallowtails, such as *P. macilentus* (II), *P. protenor* (II) and *P. xuthus* (II) may be taken on them.

I went to the Tobira Pass by bus on August 16. The winding bus road reminded me of the toll highway of Nikko. It was only a 40 minutes' ride, but on foot it would take over two hours to go from the Spa to the Pass. The view from the bus was simply superb, and there was a curve at which a distant view of the snow-capped Japan Alps could be enjoyed. On getting off the bus at the terminal stop, I was astonished at an unusual sight several yards away. The road, the precipice on the left side, and the ground were scattered with fresh specimens of *Nymphalis antiopa*. They were all taking moisture, and I, after twenty minutes' easy hunting, ran out of envelopes although I put three butterflies in each. My net, new and white, got blotted all over with that red excrement characteristic of many a nymphalid butterfly.

A week later, on the 23rd, I went there with a camera. The Mourning Cloaks were still found in plenty, though not so many as in my previous visit. A large maple tree had been uprooted in a small landslide, and several butterflies were sitting on the trunk to sip the sap exuding from a break. The road leading to the Pass is overlooked by cliffs for a few hundred yards near the bus terminal. Such a place is a haunt of *Pararge deidamia* and *Caduga sita*. Later on, I noticed a number of empty pupa cases hanging from the rugged surface of the cliff at a point of the Pass. They had been left by those numerous Mourning Cloaks. It is known that many nymphalid caterpillars leave the food-plants or their breeding ground to pupate in far-off places, but there was no knowing where the fully grown larvæ of *N. antiopa* came from.

From the Tobira Pass runs a path leading to the Utsukushi-ga-hara Heights via Mt. Cha-usu. From late August through early September, this ridgeway is crowded with *I. io* coming to the abundant, pale purple flowers of *Scabiosa japonica*. Thistles in the meadow also attract *Gonepteryx rhamni*. The busy butterfly season ends in mid-September, when, with the exception of some Fritillaries, those occasionally seen are only such hibernators as *N. antiopa, P. c-album, G. rhamni*. And it was also time for me to bid good-by to the Tobira Spa and the Utsukushi-ga-hara Heights, where I had so enjoyed my stay of a quarter of a year.

Translated from the Japanese original by TADAHIRO TAKAKURA.

Communicated by

TARO IWASE, 4 Shinhana-Cho, Hongo, Tokyo, JAPAN

RECENT LITERATURE ON LEPIDOPTERA

(Under the supervision of PETER F. BELLINGER)

B. SYSTEMATICS AND NOMENCLATURE

Bauer, David L., "A new geographical subspecies of *Chlosyne hoffmani* (Nymphalidæ) from Washington State)." *Journ. Lepid. Soc.*, vol. 13: pp. 207-211, 8 figs. 1960. Describes as new *C. h. manchada* (1600 ft., Tumwater Canyon, Drury, Chelan Co., Wash.).

Bauer, David L., "A new species of *Chlosyne* (Nymphalidæ) from western Mexico." *Journ. Lepid. Soc.*, vol. 13: pp. 165-169, 2 figs. 1960. Describes as new *C. gloriosa* (Tepic, Nayarit).

Baynes, E. S. A., "An Irish subspecies of *Chiasma clathrata* L. (Lep. Geometridæ)." *Entomologist*, vol. 92: pp. 20-21. 1959. Describes as new *C. c. hugginsi* (Burren, Co. Clare). [P. B.]

Berger, L. A., "Remarques sur quelques Hesperiidæ africaines du Muséum de Paris (Lepidoptera–Rhopalocera)" [in French]. *Lambillionea*, vol. 59: pp. 90-94. "1959" [1960]. Describes as new *Abantis nigeriana rougeoti* (Lastorville, Gabon). Records numerous spp. from French Guinea, Ivory Coast, & Gabon. [P. B.]

Berio, E., "Etude de quelques Noctuidæ Erastriinæ de Madagascar (Lepid. Noctuidæ)" [in French]. *Mém. Inst. scient. Madagascar, sér. E*, vol. 5: pp. 133-135, 1 pl., 34 figs. 1954. Study of some Madagascar Noctuidæ Erastriinæ; describes as new *Porphyrinia ragusanoides* (Tananarive), *P. viettei* (Tananarive); *Eublemma chopardi* (Ankaratra Mt.); *Smicroloba discata malgassica* (Tananarive); *EUMICREMMA* (type species: *minima* Guenée); *Cerynea tetramelanosticta* (Mauritius); *Sophtha chopardi* (Tananarive), *S. omopisoides* (Tananarive), *S. ozolicoides; HYPERSOPHTHA*, & type *H. falcata; Hypobleta viettei; Lithacodia mysteriosa, L. mabillei, L. varioplagata, L. decorina, L. annularis, L. rubrilis* (all from Ankaratra Mt.), *L. cupreofuscoides* (Tananarive); *Eustrotia micardoides* (Ankaratra Mt.); *Micardia argentoides* (Tananarive), *M. terracottoides* (Ankaratra Mt.); *Eulocastra incognita* (Faux Cap). [P. V.]

Bernardi, G., "Note sur les *Belenois creona* de Madagascar (Lep. Pieridæ)" [in French]. *Naturaliste malgache*, vol. 3: pp. 155-157, 2 figs. 1951. Study of *B. creona* in Madagascar. [P. V.]

Bernardi, G., "Revision des Pierinæ de la faune malgache (Lepid. Pieridæ)" [in French]. *Mém. Inst. scient. Madagascar, sér. E.*, vol. 5: pp. 239-275, 4 pls., 41 figs. 1954. Important revision of the Pieridæ Pierinæ from Madagascar, giving, for every species, bibliographical references, description, repartition in the island. At the end of the study biogeographical discussions. [P. V.]

Bernardi, G., "Contribution à l'étude des catégories taxonomiques: II. Les Règles internationales de la Nomenclature zoologique et la notation des catégories taxonomiques" [in French]. *Bull. Soc. ent. France*, vol. 62: pp. 224-250. "1957" [1958]. Detailed discussion of the provisions of the *Règles* in regard to subspecies, and of various suggested notations for other species-group categories (e. g. superspecies, semispecies). Examples mainly from the Lepidoptera. [P. B.]

Bernardi, G., "La réhabilitation du *Parnassius phœbus gazeli* Praviel (Lep. Papilionidæ)" [in French]. *Alexanor*, vol. 1: pp. 23-27, 2 figs. 1959. Rehabilitation of the subspecies *gazeli*, of the high valley of Boreon in the Alpes-Maritimes. [P. V.]

Bernardi, G., "Note sur la convergence de deux *Leptosia* (Lep. Pieridæ)" [in French]. *Rev. franç. Ent.*, vol. 26: pp. 227-231, 4 figs, 1959. Note on the convergence of two pierids of the genus *Leptosia*, with description of *L. hybrida somereni* n. ssp. (Uganda, W. Elgon) and discussion about *L. alcesta wigginsi*, of which *L. uganda* is a new synonym. [P. V.]

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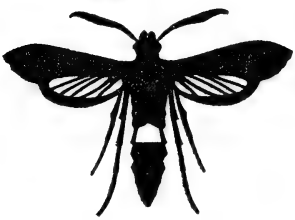

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7 September 1961

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JOURNAL OF THE LEPIDOPTERISTS' SOCIETY

Volume 14 1960 Number 4

THE DISTRIBUTION, HABITS, AND LIFE HISTORY OF *EUPTYCHIA MITCHELLII* (SATYRIDÆ)

by WILBUR S. MCALPINE, STEPHEN P. HUBBELL, and THOMAS E. PLISKE[1]

Mitchell's Satyr, *Euptychia mitchellii* French (figs.19,20), is an inconspicuous brownish butterfly of the family Satyridæ. It is seldom seen in collections, for it lives in secluded places and is very local in distribution. Its habitat, from which it never strays more than a few feet, is a type of bog characterized by Tamarack (*Larix laricina*) and Poison Sumac (*Rhus vernix*). The range of this butterfly is small; the species is known from only fifteen localities, nine of which are in southern Michigan. Doubtless because of its restricted occurrence and the rather inaccessible and inhospitable environment in which it lives, *E. mitchellii* is one of the few satyrids of the eastern United States for which no description of the life history has been published. The studies here reported were undertaken to fill this gap.

The closest relatives of *Euptychia mitchellii* are *E. a. areolata* J. E. Smith and its northern subspecies *E. a. septentrionalis* Davis, and *E. cymela* Cramer. The latter, which is common in the territory inhabited by *mitchellii* and sometimes occurs with it, is easily distinguished by the well-marked ocelli on the upper surface of its wings, its lighter coloration, and its stronger flight. In Michigan *cymela* generally flies from early June until the middle of July, in contrast with the brief flight period of *mitchellii;* its time of occurrence varies greatly, however, depending upon conditions in different seasons.

[1]More than twenty years ago the senior author reared *Euptychia mitchellii* from egg to adult; he photographed, drew and described the immature stages, and in 1939 presented his results in a talk before the Detroit Entomological Society. His findings were not, however, published, and the two junior authors, not knowing of the earlier work, made an independent study of the life history of this butterfly in 1958. Subsequent comparison of notes led to collaboration on the present paper, which summarizes all that is known concerning the occurrence and life history of the species. The field observations and detailed descriptions of the immature stages are by MCALPINE and HUBBELL, the rearing data by MCALPINE and PLISKE, the photographs by MCALPINE, and the line drawings by HUBBELL.

The authors acknowledge with gratitude the help of various sorts given them by Drs. T. H. HUBBELL, WARREN H. WAGNER, JR., and EDWARD G. VOSS, all of the University of Michigan, in connection with this study.

The relationship of *E. mitchellii* to *E. areolata* is evidently much closer than to *cymela.* The two agree in being dark-colored and in lacking ocelli on the upper surfaces of the wings (though in some specimens of *mitchellii,* especially females, the ocelli of the lower surface show through faintly). The differences between typical *areolata* and *mitchellii* in the markings of the under surface are, however, striking. In *E. a. areolata* ocelli are absent or very small and indistinct on the fore wings, while those of the hind wings are elongate and narrow; in *mitchellii* the ocelli of the fore wings are always present and usually well defined, and those of the hind wings are slightly oval to nearly circular. *Euptychia a. areolata* occurs from Texas to Florida and Georgia; northward along the Atlantic coastal plain it intergrades clinally with the northern subspecies, *E. a. septentrionalis,* the type locality of which is Lakehurst, New Jersey. Subspecies *septentrionalis* is distinctly more like *mitchellii* in appearance; although the lower surface of the fore wings is almost without ocelli, the ocelli of the hind wings are shorter and more oval than in typical *areolata,* longer and narrower than in *mitchellii.* It is possible that the isolated New Jersey records of *mitchellii* discussed below might have been based on specimens of *E. a. septentrionalis* showing extreme variation in the direction of *mitchellii,* or even, as has been suggested to the authors by T. H. Hubbell and W. H. Wagner, Jr., that *mitchellii* is a well defined subspecies of *areolata.* In the absence of proven intergradation, however, *mitchellii* should be regarded as a species distinct from *areolata.*

History and Distribution

Mitchell's Satyr was described as *Neonympha Mitchellii* by G. R. French (1889 : 25) from six males and four females taken by Prof. J. N. Mitchell at Wakelee in Cass County, Michigan, in "a dry upland meadow near a wet meadow and marsh." Later Mitchell found the species much more abundant in the marshy area. R. H. Wolcott (1893 : 102) reported *mitchellii* from a two acre bog in South Grand Rapids, Kent County, Michigan, noting that he had collected it there some three years before French described it and had found the species common in the same place each year from 1886 to 1893. Wolcott's bog has been destroyed by the growth of Grand Rapids, but some of his specimens still exist; two, taken July 20, 1892, and July 7, 1893, are in the University of Michigan Museum of Zoology. Mitchell apparently knew of Wolcott's discovery, since in discussing *mitchellii* French (1889 : 27) remarked, "Professor Mitchell is of the opinion that the species has been found as far north as Kent County, Michigan."

S. H. Scudder (1889 : 1785) redescribed *Neonympha mitchellii* in minute detail, apparently from specimens sent him by French. Maynard (1891 : 218) included the species in his *Manual,* and it was listed in Skinner's *Catalogue* (1898), but no additional records were published until Holland, in *The Butterfly Book* (1898 : 203) reported it from "northern

New Jersey, near Lake Hopatcong," and J. B. SMITH, in the *Insects of New Jersey* (1900: 373; 1910: 413) noted its capture by C. W. JOHNSON at Dover in June. PALLISTER (1927 : 203) also refers to a specimen taken at Dover by JOHNSON, but gives the date as July 10, 1890. ENGLEHARDT (1936: 110, 221) thought that the Lake Hopatcong and Dover records might have been based on the same specimens, the location of which was not known to him; but MCALPINE saw a male and female *E. mitchellii* in the collection of FRANK CHERMOCK of Pittsburg, labelled as taken at Woodport on Lake Hopatcong but without date or collector's name, which were probably the basis of HOLLAND's record. In 1938 C. F. DOS PASSOS (*in litt.*) informed MCALPINE that a careful search made that year for *mitchellii* in likely spots near Lake Hopatcong had been unsuccessful. In more recent attempts A. B. KLOTS also failed to find it, and noted that much of the boggy land around the lake where it might have been expected to occur has been filled in for residential purposes; he is of the opinion (1951 : 66) that the northern New Jersey records (Dover and Woodport) "are a bit dubious."

J. C. PALLISTER (1927: 203) reported that he had found *E. mitchellii* in a swampy meadow on the edge of a peat swamp near Streetsboro in Portage County, Ohio, where it was "very abundant" on July 4, 1925, and "plentiful" on July 10, 1926. This new locality was included by HOLLAND in the second edition of *The Butterfly Book* (1931: 180). GEORGE RAWSON, writing about *mitchellii* to E. G. VOSS in 1954, said that some 15 years earlier he, with E. S. THOMAS and JOHN THOMAS, went to Streetsboro to look for the species, but without success, the bog having been converted into a truck farm. EDWARD C. WELLING, however, in a letter to VOSS, mentions a specimen taken in "the Streetsboro bogs" on June 10, 1950.

MCALPINE first encountered *E. mitchellii* in 1934, at the type locality near Wakelee in Cass County, Michigan; he continued his observations of the colony there at intervals until 1940, accompanied on some occasions by SHERMAN MOORE and W. W. NEWCOMB. In brief notes (1936: 110, 221) he reported that at Wakelee the species "is found along very narrow grassy strips bordering small watercourses in the middle of a dense tamarack swamp," and mentioned that he had obtained eggs and was carrying a number of larvæ over the winter. SHERMAN MOORE (1939: 8) listed the species from two new localities, Kalamazoo and Washtenaw counties, Michigan. The first of these records was based on three males (the only individuals seen) collected by MCALPINE on July 11, 1937, along a small stream in a tamarack bog at Sugar Loaf Lake in southern Kalamazoo County. Specimens from that county, taken July 7 and 14, are also in the collection of Michigan State University, according to R. W. HODGES. MOORE's Washtenaw County record was based on specimens taken in various years from a colony in a small bog at Sharon Hollow, in Sharon Township, south of the present Waterloo Recreation Area, by GEORGE RAWSON (discoverer of the colony), J. H. NEWMAN, and SHERMAN MOORE. In 1953 *mitchellii* was again collected at the Sharon Hollow bog by Warren H. Wagner, Jr., who in 1957 took Hubbell and Pliske there and thus made possible their study. Another Washtenaw County locality, hitherto unrecorded, is near Willis, adjacent to the Wayne County line. Here Walter Stinson found a single male on July 10, 1931, in a tamarack swamp that had been cut over long ago, and McAlpine took another the following year, also on July 10. These were the only individuals found, in spite of careful search.

Recently a number of additional localities for *E. mitchellii* have come to light. Ronald Hodges (*in litt.*) mentions a specimen from Barry County, Michigan, taken on July 24, as being in the Michigan State University collection. In 1955 M. C. Nielsen found a colony in a bog in the Three Rivers State Game Reserve in St. Joseph County, Michigan, (Section 7, T.7 S., R.12 W.) ; specimens have been taken there on July 4, 6, and 8. In 1958 E. G. Voss located a colony in another bog on the same Reserve, but in Cass County. The same year Voss found *E. mitchellii* common on July 16 in a boggy area about one mile west of Millburg in Benton Township, Berrien County, Michigan; here it occurred in an open area of sedges and grasses in a swamp forest of Tamarack, Poison Sumac, and White Birch, near Blue Creek. All of the known Michigan county records are included in Moore's revised list of Michigan butterflies (1960).

George Rawson, in the letter mentioned above, states that in 1954 Donald Eff of Boulder, Colorado, received two specimens taken by an Indiana collector at Cedar Lake, about 15 miles south of Hammond, in Lake County, Indiana. Finally, F. S. Badger (1958 : 41) has recently described the results of his search for *E. mitchellii.* In Michigan he found it at the original Wakelee bog site, and also at the Three Rivers locality discovered by Nielsen. In Indiana he encountered it at Cedar Lake in LaGrange County, and one mile southeast of Fremont in Steuben County. This completes the list of known localities for the species; but with a knowledge of its habitat and food plants it should not be too difficult to find others.

Habitat and Behavior of Adults

The observations recorded here were made on two colonies of *Euptychia mitchellii,* the first set by McAlpine at the Wakelee bog (principally during the years 1935-1937), the other by Hubbell and Pliske at the Sharon Hollow bog in 1958.

The Wakelee bog, situated about one mile northeast of the town of Wakelee, lies in an elongate depression surrounded, except on the east and northeast, by rolling gravelly hills and upland. McAlpine estimated the area of the whole tract at more than 200 acres, of which considerably less than half is bog and marsh occupied by *mitchellii,* while Badger (1958 : 41) states that the bog is about a mile long and varies from one-quarter to one-half mile in width. The bounding slopes on the north and south rise fifty to seventy-five feet above the floor of the swamp and are covered with an open forest of hard maple, beech, oak, and hickory. On the west the swamp is bordered by an extensive upland meadow and an abandoned apple orchard. Along much of the bog margin are seepage areas and numerous springs on the adjoining slopes. The depression is drained to the east by a small creek called the Rocky River, fed by the wandering streamlets that cross the swamp. A mixed growth of Tamarack and Poison Sumac occupies the greater part of the bog, interspersed with Red Osier (*Cornus stolonifera*) and other shrubs; along the stream channels that cut through the forest are narrow belts of sedge marsh with occasional cattails and an abundance of water cress. The many small openings and a larger area of swampy meadow toward the east end have a ground cover made up principally of narrow-leaved sedges and marsh grasses. In 1935-1937 these marshy areas were pastured by cattle and more or less trampled; the sedges and grasses in them were not very tall, only one or two feet in height. BADGER speaks of the "waist-high" growth in the sedgy areas at the time of his visit in 1954-1956, but this doubtless refers only to the open marsh. In the '30's most of the larger Tamaracks were dead, and growing up among them was a rather dense stand of young Tamaracks, tall Poison Sumac, and other shrubbery. To judge from BADGER's description, the original density and height of the swamp forest have been regained in the succeeding twenty years.

During the years when this bog was visited by MCALPINE (1934-1940) adults of *Euptychia mitchellii* were present from about July 1 to 15. The butterflies were closely restricted to the bog. They occurred both in the open meadow-like areas and along the narrow waterways through the stands of Tamarack, as well as at the margins of the swamp, and were generally found where sedges and grasses form the ground cover. Although *mitchellii* was quite abundant during its brief flight period, MCALPINE believes that it would be most difficult to determine the *mitchellii* population in this bog with any degree of accuracy due to the rough terrain along the waterways, the uncertainty as to the size of the occupied areas and the variations in density of the butterflies from one part to another. MCALPINE's observations do show that the population fluctuates noticeably in numbers from season to season.

MCALPINE noted that the flight of *E. mitchellii* is weak and short, and usually just above the marsh grass; when a specimen is flushed by walking through the grass it usually flies only a short distance before alighting on a grass or sedge stem. Late in the afternoon he often found individuals hanging from the stems, where they were easy to capture. In collecting this butterfly great care must be taken, as the wing scaling is very easily rubbed off; unless specimens are caught soon after emergence they are always worn. An occasional *Lethe eurydice* Joh. was seen in the bog with *mitchellii,* and *E. cymela* occurred near the hardwood borders.

The observations made by HUBBELL and PLISKE at Sharon Hollow were begun in the summer of 1958. This bog is very much smaller than the one at Wakelee, with an area of only two or three acres, but is otherwise quite similar both in vegetation and surroundings. It occupies a hollow, bordered on the south by an extensive, mature beech-maple forest, apparently virgin, which is equalled in grandeur by few others in southern Michigan. To the west lies a sloping, long-uncultivated field now being overgrown by willows, sumac, elms, and poplars; beyond is a small shallow body of water called Grass Lake. A small creek which drains this lake is bordered by large willows to the point where it enters the bog; thence it winds eastward, dividing the bog into two quite different parts. The southern section contains all the Tamarack and most of the Poison Sumac, with some Red Osier, and is much the larger in area. The northern section consists in part of a wet meadow occupied chiefly by sedges and grasses, in part of a boggy meadow where Shrubby Cinquefoil (*Potentilla fruticosa*) is dominant. To the north of these moist meadows are pastures on large hills, and to the east lowland pastures and cultivated fields.

On September 6, 1958, Edward G. Voss visited the bog and identified the woody plants present; his list is given here, since it helps to characterize the particular type of bog to which this butterfly is apparently confined.

Co-dominants: *Larix laricina* (Tamarack) and *Rhus vernix* (Poison Sumac). Other species: *Acer rubrum, Aronia prunifolia, Betula lutea, B. pumila, Cornus obliqua, C. racemosa, C. stolonifera, Euonymus obovata, Fraxinus americana, F. nigra, Ilex verticillata, Juniperus communis* (one), *Lindera benzoin, Lonicera dioica, Parthenocissus quinquefolia, Populus deltoides, P. tremuloides, Potentilla fruticosa, Rhamnus alnifolia, Rhus glabra* var. *borealis, R. radicans, Ribes americana, R. hirtellum, Rosa palustris, Rubus pubescens, R. strigosus, Salix bebbiana, S. candida, S. discolor, S. fragilis* (one large), *S. serisissima, Sambucus canadensis, Smilax tamnoides* var. *hisida, Tilia americana* (one small), *Vaccinium corymbosum, V. macrocarpon, Ulmus* sp., and *Vitis* sp.

In addition to the above, more than 100 species of herbaceous plants were observed, including Sundews (*Drosera*) and Pitcher Plants (*Sarracenia*) in the wetter areas; relatively little sphagnum moss is present.

The first visit to the bog in 1958 was on July 5; the skies were overcast, and a light rain was falling when the bog was reached at 11:30 a.m. During the twenty minutes the rain continued, no *E. mitchellii* and few butterflies of any kind were seen. In the afternoon periods of rain alternated with brief intervals of sunshine, during which the year's first individuals of *mitchellii* were seen flying about. No females were found; of the four males followed and watched closely, none seemed selective of the objects upon which they rested. During the intermittent showers they sat with folded wings in some sheltered place, in a vertical position with head either up or down. In flight *E. mitchellii* could be easily distinguished from the other and more common satyr, *E. cymela,* which, although not a resident of the bog, often strayed into it. *Euptychia mitchellii,* as Badger has described, has a slow, weak flight, never rising more than a foot above the grasses and sedges even when disturbed. Seen from a distance, the flying insect appears and disappears among the grass tops, giving the effect of dancing and bobbing. *Euptychia cymela*, on the other hand, is a rather strong and jerky flier. It frequently rises to fly in a zig-zag manner high about the foliage of a tree, where it often alights to sun itself; then suddenly it will drop to the level of the grass tops, where it will remain for some time.

A second trip to the bog was made on July 8. The weather was perfect, with sunny, clear skies. In the three day interval since the first visit *E. mitchellii* had increased tremendously in numbers; counts made in representative areas led to an estimate that 500 or more individuals were flying on this date, which was near if not at the peak of the flight period. The butterflies were quite evenly dispersed throughout the bog; as many were seen in the denser groves of Tamarack south of the creek as in the open meadows on the north side. In the boggy meadows individuals were easy to follow, but inevitably they seemed to move into an impenetrable stand of Poison Sumac or a wall of Tamarack trees, so that it was seldom possible to watch any single one for more than a quarter of an hour. During the late morning and afternoon 14 individuals of *E. mitchellii* were captured, examined to determine their sex, and released to be followed and watched. They did not seem to be much disturbed by this handling, since upon release they did not fly rapidly and wildly off. The first 13 examined were males in fresh condition; late in the afternoon a single female was found.

Many other species were flying in the bog and in the adjacent wet meadows on this same day, several of which were more numerous than *E. mitchelli. Poanes massasoit* Scudder was by far the most abundant skipper. *Atrytone conspicua* Edw. was common in the northern and eastern peripheries of the bog, along with an occasional individual of *A. logan* Edw. Among the grasses and sedges of the northernmost meadow *Lethe eurydice* was flying with *Euptychia mitchellii.* (Both McAlpine and Hubbell observed that these two species are easily distinguished in flight; the first is more active, and its light brown color does not resemble the rich mahogany brown of *E. mitchellii*). Several specimens of *Euphydryas phaeton* Drury were collected and one or two battered individuals of *Limenitis astyanax* Fab. were seen within the bog. In the small, sheltered clearings *Lycæna dorcas* Kirby was found often, *Boloria selene* Schiff. frequently, and *Strymon acadica* Edw. and *S. titus* Fab. occasionally. Other visitors to the bog included *Speyeria aphrodite* Fab., *S. cybele* Fab., *Boloria toddi* Holland, *Everes comyntas* Godart, *Colias philodice* Latr., *C. eurytheme* Bdv., *Pieris protodice* Bdv. & Lec., *P. napi* Linné and *Atrytone ruricola* Bdv. *Speyeria aphrodite* and *S. cybele* congregated in large numbers in the meadow of Shrubby Cinquefoil, from which they strayed into the tamarack section of the bog. In the cinquefoil meadow occurred the largest colony of *Lycæna dorcas* the junior authors have ever seen, containing perhaps several thousand individuals. *Boloria toddi* and *B. selene* were also abundant in this meadow, and an aberrant dark form of the first was captured here. Several *Colias philodice* and *Ancyloxipha numitor* Fab. were observed in the meadow, and two *Speyeria idalia* Drury and one very ragged survivor of *Lycæna thoë* Guérin were collected. *Pieris napi* strayed into the bog from the beech-maple woods on the south, and *P. protodice* came in at the southwest corner from the nearby open hillsides where it was common. Additional July records from the vicinity include *Strymon liparops* Bdv. & Lec., *S. falacer* Godart, *Poanes viator* Edw., *Polites verna* Edw., *P. themistocles* Latr., *P. peckius* Kirby, *P. manataaqua* Scudder, and *Epargyreus clarus* Cramer.

As noted above, the first female *Euptychia mitchellii* was found late in the afternoon, and from that time on, all attention was focused on her activities. During the more than an hour that she was watched she flew very little; her abdomen was swollen with a heavy burden of eggs, and when she did fly it was in short "jumps" of less than two feet. More often than not she alighted upon a sedge later identified as *Carex stricta,* but laid no eggs upon it. As evening approached she stopped flying altogether, and was evidently going to rest for the night. It therefore seemed best, in case females were actually as scarce as they seemed to be, to capture her alive in the hope that she would oviposit in confinement. This butterfly, taken to Ann Arbor in a tin container, was caged with samples of the common grasses and sedges of the bog, and laid the eggs which were reared by Pliske.

When the third visit was made, on July 11, the sky was partly cloudy all day, affecting the flight behavior of *E. mitchellii.* It seemed that whenever the sun passed behind a cloud, individuals that were flying would alight almost immediately; as soon as the sun reappeared they would begin to fly again. To test this impression several were watched at the same time in the wet meadow. Within moments after the sun was hidden every one had dropped out of sight into the grass; five minutes later, with the return of full sunshine, they were all on the wing again. During long periods of cloudiness without rain, however, some would fly. McAlpine had earlier observed that *E. mitchellii,* like other satyrids, can often be seen in flight on cloudy days. Although the objective of the trip had been to observe oviposition on the food plant, no females were found among many individuals examined. The males were still common, but their wings were becoming ragged and worn.

At the time of the next visit, July 16, the population of *Euptychia mitchellii* was found greatly reduced and all the males were battered. A fresh female was found in the meadow, and was kept under observation while a search was made for others. Five ragged males were caught, and then a second female, also fresh. Although closely watched for some time, neither female was seen to oviposit, and both were eventually lost in the denser parts of the bog. Fortunately, the female captured July 8 had in the meantime laid 107 eggs, many of which proved to be fertile.

From the observations made on *E. mitchellii* at Sharon Hollow it seems probable that the peaks of the flight periods of males and females are staggered, the females emerging later than the males. It also appears that in this locality the ratio of males to females may be as high as ten to one.

Subsequent trips to the Sharon Hollow bog were made on July 24, September 6, and October 3, primarily to map and describe the area and attempt to find the larvae in their natural habitat. No adults of *E. mitchellii* were seen on these occasions, and no eggs or larvae were found.

Life History

The major features of the life history of *Euptychia mitchellii* may be summarized as follows: The species is single-brooded. In southern Michigan the flight season is restricted to about two weeks, generally about the first to the fifteenth of July, but varying somewhat with the season. The earliest dates for adults are June 21 (empty pupal case) and June 28 (capture), the latest July 20 (capture). Peak abundance of males is reached about July 4-8, and of females apparently a few days later. Oviposition occurs over a period of about ten days, an individual female laying as many as 100+ eggs on the stems of sedges. The eggs hatch in from seven to eleven days. Caterpillars reared in captivity rejected *Carex stricta,* but reached maturity on two other species of *Carex* and one of *Scirpus,* suggesting that in their natural habitat they may eat various species of sedge. Three larval molts occur in the summer and fall, the last in early September. The sluggish fourth instar larva eats relatively little and soon attaches itself, an inch or two above the ground, to a stem or lower leaf of its food plant; it spins a few strands of silk or a thin silk pad to which it clings. Stiff and dormant, it passes the winter in this position, protected only by the drooping leaves of the sedge and whatever snow cover there may be. With the advent of warm weather the caterpillars again become active, probably usually after the middle of May. There are two more larval molts in the spring, followed by the molt to the pupal stage, which occurs in June. Emergence of the adult takes place in about 10 to 15 days.

Although oviposition was not observed in the field, eggs were obtained from females confined with grasses and sedges from the bogs. On July 14, 1935, McAlpine caged three females at the Wakelee bog and took them to his home in Birmingham; one died in transit. The following morning two eggs were found on grass stems. One of the remaining females was killed by a small grass spider on July 16; the other became entangled in the netting of the cage and died on July 17. On the morning of July 18 it was found that 81 eggs had been laid on the stems of the smaller grasses and sedges, to which they were somewhat insecurely attached by a vitreous substance. Additional eggs were obtained from a caged female the following year, and some of the larvæ that emerged from both lots were reared to maturity.

The female caught at Sharon Hollow on July 8, 1958, was caged by Pliske with leaves of the presumed food plant, *Carex stricta,* in a large gauze-topped glass jar, which was placed where it received three hours of morning sunlight and was in shade the rest of the day, simulating conditions prevalent in the bog. This female laid 15 eggs on July 9 between 12:15 and 3 p.m., 5 on July 10 between 10:45 and 11:45 a.m., 36 on July 11 between 10 a.m. and noon, 25 on July 12 between 10 a.m. and 1 p.m., 6 on July 13 between 10:30 a.m. and noon, 4 on July 14 between 11 a.m. and noon, 4 on July 15 between 11 a.m. and noon, and 2 on July 16 at 10 a.m. She died on July 17, after having laid a total of 107 eggs. The eggs were not laid consistently on the sedge leaves, but at random, singly or in small groups, on the glass, earth, and sedge. This may have been because no stems were available, since the females caged by McAlpine oviposited almost exclusively on stems. Most of the eggs were laid during the hours when the jar was in sunlight, and more than half of them on two successive days, July 11 and 12. Each egg was placed in a separate glass vial for rearing.

The eggs obtained by McAlpine hatched in seven to eight days. Those obtained by Pliske hatched on six successive days, July 19-24, the respective numbers being 2, 11, 10, 14, 6, and 4, making a total of 47, or 44% of those laid. In this batch of eggs an average of 10 days elapsed between oviposition and hatching.

The most striking feature characteristic of the first instar larvæ is the disproportionately large, bilobate, almost black head, which under close examination can be seen to be a very dark violet brown. Soon after hatching the larva usually eats most of the egg shell. Those reared by McAlpine fed on the leaves of two quite different sedges from the bog, entire plants of which were brought in and potted: Foxtail Sedge (*Carex alopecoidea*), which they appeared to prefer, and the "Bulrush" (*Scirpus atrovirens*). They would eat the tender tip, or start at the edge of the leaf and work to the center, and then eat downward, sometimes causing the leaf to bend over and droop. The larvæ in Pliske's vials did not accept the leaves of the rather coarse sedge *Carex stricta,* but when offered a choice of eight kinds of grasses and sedges collected in the bog and about the house they fed with apparent avidity on *Carex cephalophora* and some were reared to maturity on it. Since this sedge grows in dry oak woods it can scarcely be one of the normal food plants. Probably *E. mitchellii* feeds on a variety of sedges; in any event the restricted occurrence of the butterfly is obviously not attributable to its choice of food. In McAlpine's rearings the duration of the first stadium was 12 to 14 days for most individuals and up to 18 days for a few; the average in Pliske's rearings was 16 days.

In Pliske's rearings the earliest Instar II larva appeared August 1, and by August 8 all forty of the healthy larvæ had molted and entered this stadium, which had an average duration of 12 days. McAlpine's Instar II larvæ molted at the end of 14 to 16 days.

The third and succeeding instars are quite similar in general appearance except for their increasing size - lime green with paler longitudinal lines, tapering to a somewhat constricted neck and bifurcate tail. The body surface is rather smooth in appearance to the unaided eye, but densely papillose and bristly as seen under a lens. In Pliske's vials the molt to the third instar occurred between August 13 and 18; in preparation for it the larvæ took position, head up, on a mat of silk which each had spun 24 hours previous to the molt on the grass wall of the vial. The appetite of the Instar III larvæ was noticeably smaller than in the previous stages, and the larvæ were less active, spending much of each day motionless, and feeding only at intervals. McAlpine's third instar larvæ rested head down on the underside of a sedge leaf near its base until late afternoon, when they did their feeding;

those reared by PLISKE more often fed in the morning. Since it appeared that this might be the stage in which hibernation would take place, PLISKE placed about one-third of the vials containing third instar larvæ outdoors, the rest being kept inside. The larvæ outdoors remained inactive, did not feed, and molted between September 6 and 10, with an average duration of 26 days for the third stadium. Those kept indoors remained lethargic until the last two days of August, when they became more active and resumed eating; this group molted between September 4 and 9, with an average duration of 24 days for the third stadium. MCALPINE's larvæ, kept in an unheated garage, molted in early September after 16 to 20 days in the 3rd stadium.

All of PLISKE's larvæ that had been put outdoors eventually died. Those kept indoors failed to enter diapause, which had begun to manifest itself as the lethargic interval in the third stadium, and proceeded with their development. They were fairly active and ate well, and all molted again between September 20 and 22, the average duration of the fourth stadium having been only 14 days. The fifth instar larvæ continued to feed, but at a reduced rate, until shortly before pupation. On October 14 two of the remaining 15 healthy larvæ attached themselves to a pad of silk on the sides of their vials, with the head down and curled underneath the body. One of these pupated the next day, and 10 others had done so by October 26, the average duration of the fifth stadium having been 30 days. Two larvæ that had assumed the prepupational position were placed outdoors; they never completed pupation. About 12 days after pupation the bluish-green of the chrysalis began to acquire a brownish tinge, first in the area of the wings and later spreading to the whole surface. The change from green to brown was completed in an average of four days, and one day later the butterfly emerged, if at all. The insects that completed transformation were all males; the first emerged October 31, and four others by November 12. Six of the eleven pupæ failed to transform.

Not knowing of MCALPINE's prior findings, HUBBELL and PLISKE concluded that under natural conditions the winter would be passed as a fourth instar hibernating larva, and that a fifth and sixth instar would be expected to occur in the spring. This is suggested by the duration of the stadia in PLISKE's rearings: I - 16 days; II - 12 days; III - 24-26 days; IV - 14 days; V - 30 days. In this series the third and fifth stadia are much longer than the others. The length of the third is probably a normal feature of the life history (in MCALPINE's rearings it was 16 to 20 days), reflecting the increasing sluggishness of the larvæ with its approach to the diapause period. The long fifth stadium in the individuals that went uninterruptedly through their life history indoors was thought to correspond to two normal stadia. This conclusion was supported by the small size of the five reared males (wing expanse in mm. 25.8 - 30.0, mean 28.0) as compared with that of wild males taken at Sharon Hollow (wing expanse in mm. 31.6 - 34.8, mean 33.2), MCALPINE's earlier rearings fully substantiate this hypothesis.

MCALPINE in 1935 kept 13 hibernating caterpillars on potted sedges in his garage until late fall, when seven were placed outside in a bushel basket set flush with the ground surface. A thaw in late February flooded the basket. Examination on March 22 revealed only two living larvæ, one still clinging to its silken mat on a dead sedge leaf, the other on the ground at the base of a sedge. They had been covered with water and ice during the last week in March and the first half of February and thus had survived a very severe test. One of these resumed activity, fed, and eventually pupated and emerged as a stunted male butterfly. In the summer of 1936, additional eggs were secured, and of the caterpillars that hatched three were carried through the winter and matured as full sized males. From these observations it appears that the fourth stadium normally endures from early September to late May of the following year, the fifth from 13 to 15 days, and the sixth from 12 to 15 days. The duration of the pupal stage McAlpine found to be from 10 to 15 days, while in the individuals reared indoors by Pliske it varied from 15 to 18 days.

McAlpine found two pupæ in the Wakelee bog on June 21, 1936. One had already hatched (considerably earlier than usual); the other was photographed (figs.17,18). They were both suspended by the cremaster from a button of silk attached to the underside of leaf blades of the sedge *Scirpus atrovirens,* within two or three inches of the ground,, as in the instance of those reared by McAlpine. They were about 15 mm. in length, a little larger than the pupæ of the reared individuals.

Descriptions of the Immature Stages

The following descriptions were made by McAlpine and Hubbell from living and freshly killed specimens, which were then preserved in alcohol; the descriptions were later verified and amplified by reference to preserved material. All of the precise color specifications are based on comparison with the plates in the Villalobos *Colour Atlas* (1947). For conciseness they are given as abbreviated formulæ in which the hue is followed by degree of chromaticity and lightness value, thus lime, 5°-7°, 9-11.

EGG (figs. 11, 12). Spheroidal or rounded cubical, diameter 0.8-1.0 mm. Surface of shell covered with irregularly polygonal, shallow cells, usually 5- or 6- sided, each $\pm$0.05 mm. across; cell margins very slightly raised, floors of enclosed saucer-like depressions finely and closely granular in appearance. Color whitish green to light lime green, changing to very pale brown before hatching; dark head of larva visible one or two days before hatching. Egg somewhat insecurely attached to stem of sedge by a vitreous substance. Duration of stage, 7-11 days.

FIRST INSTAR LARVA (figs. 1-4, 13). Body when newly hatched pale ochre or light yellow-green, including legs and prolegs; after feeding, light lime green; head with silky sheen, medium to dark violet brown verging on black, ocelli and mandibles dark brown.

Head very large and prominent, width and height 1.5 $\pm$ times that of body, length 0.67 $\pm$ times width. Vertex slightly angulate-impressed between right and left lobes of head, each lobe crowned with a rounded prominence bearing two coarse light brown pointed setæ, one apical and erect, the other lateral and projecting anterolaterally. Side of head with several smaller protuberances, each topped with a single short, light brown seta: two above lateral ocelli, one slightly caudoventrad of the other; one just back of lateral ocelli; one, very small, a little dorsocaudad of ventrolateral ocelli. Facial region with several short setæ. Head surface densely and very shallowly pitted, resembling sand-blasted glass.

Body cylindrical, segments annulated, thoracic segments equal in height and breadth, except anterior part of prothorax slightly higher than broad. Caudal end large, dorsally with a pair of short, narrowly conical, slightly divaricate, backwardly directed processes separated by the large, rounded anal lobe, processes whitish or faintly rosy. Dorsal and lateral surfaces of body with many conspicuous light brown or colorless setæ, clubbed or knobbed at tip, arising from low, conical but not papillose bases (fig. 4); these setæ arranged as follows: prothorax with 10 on anterior part, 5 on each side of mid-dorsal line above spiracles and forming transverse row around body; mesothorax and metathorax each with 8, 4 on each side of mid-dorsal line, arranged as on prothorax; abdominal segments 1-8 each with 10, 5 on each side of mid-dorsal line, of which 2 are dorsal, 1 lateral above spiracle, and 2 ventrolateral below spiracle on the fleshy substigmatal fold (which extends caudad from the mesothorax or metathorax, lying immediately above the bases of the prolegs and terminating above the base of the caudal proleg). Dorsal knobbed setæ of first 8 abdominal segments arranged in two zigzag lines, one on each side of mid-dorsal line; lateral setæ forming a straight line above spiracles; ventrolateral pair forming a zigzag line, with posterior seta of each segment slightly higher than anterior. Ninth abdominal segment with 4 knobbed setæ, 2 on each side of mid-dorsal line; distolateral processes of terminal segment with a proximodorsal and a proximolateral seta in addition to one (rarely two) at the pointed tip. Admesal pair of knobbed setæ of 9th abdominal segment longest, one-half length of head; setæ on dorsal head prominences, on dorsum of prothorax, and at tips of anal processes next in length; setæ in dorsal zigzag rows somewhat shorter, the admesal ones longer than the outer ones. Ordinary pointed (unknobbed) setæ arranged as follows: on prothorax a forked pair above leg base; on mesothorax and metathorax a single fine seta above each leg base; first and second abdominal segments each with 4 short ventral setæ, 2 on each side of midventral line in transverse row; prolegs each with several fine, colorless setæ, those of anal proleg 5, in close group on lateral surface; anal region with several minute, colorless setæ and a forked pair just below each dorsolateral terminal process. Spiracles, except on prothorax and eighth abdominal segment, very small, inconspicuous; all ringed with pale brown.

Coloration: General body color light lime green (lime, 5°-7°, 9-11); longitudinal striping as follows: a pair of very faint white dorsal admesal lines inside the zigzag rows of setæ, a broad dorsolateral whitish band, two very fine whitish stigmatal lines, and a broader whitish stripe on substigmatal fold.

Length at emergence, 2.5-3.0 mm; length at end of stadium, 4.5-6.0 mm. Duration of stadium 11-18 days.

SECOND INSTAR LARVA (fig. 5). Head and body light lime green, former with a trace of olive green. Head smaller in relation to body than in Instar I. Knobbed setæ absent in this stage (and in all later stages), head and body covered irregularly and rather densely with small, fleshy, subconical whitish papillæ, each abruptly apiculate, the seta-like tip being short, stout, blunt-ended, and colorless or light brown. Head bilobed as in Instar I, but crowning prominences less pronounced; each head-lobe topped with a low tubercle, light brown or faintly rosy, which in turn bears three minute papillæ, the two more anterior ones larger than the third. Remainder of head with numerous papillæ, surface between these densely and minutely pitted, the pitting slightly deeper than in Instar I. Body segments annulated except in immediate vicinity of spiracles; usually 5 or 6 annuli to the segment. Substigmatal fold forming a more prominent fleshy ridge than in Instar I. Caudal end of body bifurcate; the conical processes longer and basally broader, more pointed, and larger relative to anal lobe than in Instar I; their surfaces papillose like remainder of body, whitish, becoming light brown or faintly rosy at extreme tip.

Coloration: General color of head and body light lime green (lime, 5°-7°, 12-13); whitish striping as in Instar I but more pronounced, papillæ above and along stripes more densely set than elsewhere; setæ at tips of caudal processes dark brown or black; spiracles as in Instar I.

Length at emergence, 4.5-6.0 mm ; length at end of stadium, 7.5-11 mm. Duration of stadium, 11-16 days.

THIRD INSTAR LARVA (figs. 6, 7). Head and body very slightly deeper lime green and head smaller in relation to body than in Instar II, very densely covered with whitish papillæ, those on head with a short brown or black apiculate tip, those on body with whitish translucent tips. Caudal furcate processes somewhat longer and more pointed than in Instar II, brownish or rosy at tips; dorsal prominences of head lobes relatively smaller. Body segments distinctly annulated, except for large areas around spiracles; those areas, except that around prothoracic spiracle, without papillæ. Spiracles light yellowish brown with brownish black centers. Substigmatal fold more prominent than in Instar II; venter with setæ but without papillæ. Coloration as in Instar II except as noted (lime, 9°-11°, 11-13) ; longitudinal whitish lines somewhat more distinct.

Length at emergence, 7.5-11.0 mm.; length at end of stadium 9.0-13.0 mm. Duration of stadium, 16-27 days.

FOURTH INSTAR LARVA. General appearance, shape, color, and arrangement of papillæ and setæ much as in Instar III. Base color: lime, 5°-7°, 13-15. Different shades of lime green, in longitudinal bands, now evident. Coloration, proceeding from mid-dorsal line to substigmatal fold, as follows: mid-dorsal line medium lime green; thin whitish line closely parallel to mid-dorsal line; band between last and dorsolateral line light lime green; dorsolateral line broad and whitish; a wide upper lateral band of light lime green; a thin mid-lateral whitish line just above spiracles; a narrow medium lime green band; a thin whitish line through the spiracles; a wide lower lateral band of light lime green; a wide whitish band on substigmatal fold. Head of same shade as the medium lime green bands on body.

Length at emergence, 9-13 mm.; length at end of stadium, 11-16 mm. The larva hibernates in this stadium, from early September until late May of the following year.

FIFTH INSTAR LARVA (fig.8). Very similar to Instar IV; surface of head rough, covered with fine green and white papillæ tipped with whitish translucent apiculæ; papillæ more numerous than in Instar IV on both head and body; low conical protuberances at dorsolateral apices of vertex flesh-colored; dorsolateral whitish band wider and anal processes slightly more pointed than in Instar IV, the latter brownish or slightly rosy at tips; ocelli pale shining green, ringed with pale brown. Coloration of body as in Instar IV; dorsolateral band and other whitish lines: lime, 5°-6°, 17-19; light lime green bands: lime, 5°-7°, 13-15; medium lime green bands: lime, 7°-10°, 9-12; head: lime, 8°-10°, 9-11.

Length 11-19 mm. Duration of stadium 15-18 days.

SIXTH INSTAR LARVA (figs.14-16). Very similar in form and coloration to Instar V. Length, 19-28 mm. Duration of stadium, 20-25 days.

PUPA (figs.9, 10, 17, 18). General color light lime green, except abdomen and venation of wing sheaths, which are slightly darker and more bluish; thorax and especially abdomen minutely mottled with pale green or white; abdominal mottling caused by many fine integumental thickenings, which are longitudinally wavy, whitish, and separated by very shallow impressions, not affecting the general smooth appearance of the pupa. Head and mesonotum in side view abruptly truncate cephalad, the truncation straight or weakly concave, at right angles to and strongly rounding into dorsal outline of mesonotum, meeting ventral surface of head shield in an abrupt, slightly acute angle. Dorsum of head sheath planate, its cephalic margin truncate with weak median notch, sides gently divergent cephalad to the moderately acute, prominent anterolateral angles. Mesonotal surface considerably elevated and compressed, forming a mid-dorsal crest which in side view is strongly convex anteriorly. Wing sheaths slightly raised along anal margin to form a distinct, rather sharply angulate ridge. Frontal transverse ridge, apices of angulate frontal processes, and (sometimes) the elevated margins of wing sheaths slightly tinged with golden brown. Spiracles whitish, inconspicuous; tip of abdomen slightly divided, reminiscent of larval furcate anal process. Length, 10.5-15.5 mm. Duration of stadium, 10-15 days.

ADULT (figs.19, 20). Since the butterfly has been fully described by FRENCH, SCUDDER, and others, and illustrated by HOLLAND, KLOTS, and BADGER, only its variation is here discussed. As BADGER has noted, the number of ocelli on the lower surfaces of the wings is somewhat variable. In a series of 40 males and 40 females collected by MCALPINE in the Wakelee bog, he found the following variation in this character: fore wing, both sexes, 4 ocelli in most individuals, 3 in a few, 2 in a single specimen; hind wing, males, 5 and 6 ocelli in about equal numbers of specimens; hind wing, females, 6 ocelli in nearly 60% of specimens, 5 in nearly 40%, three specimens with 5 ocelli on one wing and 6 on the other, one specimen with 6 on one wing and 7 on the other. In this series the average wing expanse of males is 32.5 mm., of females 35.4 mm. In a smaller series of males taken by HUBBELL and PLISKE at Sharon Hollow the wing expanse averages 33.2 mm., with a range of 31.6-34.8 mm. Most of the reared specimens are smaller, the range in PLISKE's series being 25.8-30.0, average 28.0, but some of those reared by MCALPINE are of normal size.

Literature Cited

Badger, F. S., Jr., 1958. *Euptychia mitchellii* (Satyridæ) in Michigan and Indiana Tamarack bogs. *Lepid. news* 12 : 41-46, 6 figs.

Englehardt, G. P., 1936. *Cissia mitchellii* in New Jersey. *Bull. Brooklyn ent. soc.* 31: 110 [additional notes on p.221].

French, G. H., 1889. A new species of *Neonympha. Canadian ent.* 21 : 25-27.

Holland, W. J., 1898. *The butterfly book.* New York, Doubleday, Page & Co. xx + 382 pp., 48 pls., 183 text figs.

---------------, 1931. *The butterfly book,* 2nd revised edition. Garden City, N. Y., Doubleday, Doran & Co. xii + 424 pp., 77 pls., 198 text figs.

Klots, A. B., 1951. *A field guide to the butterflies.* Boston, Houghton Mifflin Co. xvi + 349 pp., 40 pls.

Maynard, C. J., 1891. *A manual of North American butterflies.* Boston, DeWolfe, Fiske & Co. iv + 226 pp., 10 pls., 60 text figs.

McAlpine, W. S., 1936. [Habitat of *Cissia mitchelli* in Cass County, Michigan]. *Bull. Brooklyn ent. soc.* 31 : 110, 221.

Moore, Sherman, 1939. A list of the butterflies of Michigan. *Occ. pap. Mus. Zoology Univ. Michigan* 411: 1-23.

---------------, 1960, A revised annotated list of the butterflies of Michigan. *Occ. pap. Mus. Zoology Univ. Michigan* 617 : 39 pp., 1 pl., 1 fig.

Pallister, John C., 1927. *Cissia mitchellii* (French) found in Ohio, with notes on its habits. Lepidoptera-Satyridæ. *Ohio journ. sci.* 27 : 203-204.

Scudder, S. H., 1889. *The butterflies of the eastern United States and Canada, with special reference to New England.* Cambridge. Author. Vol.3: iv + pp. 1775-1958, 89 pls., 2 maps.

Skinner, H., 1889. *A synonymic catalogue of the North American Rhopalocera.* Philadelphia, Amer. Ent. Society. xvi + 100 + xvi pp.

Villalobos-Dominguez, C., & Julio Villalobos, 1947. *Colour atlas.* (English translation by A. M. Homer). Buenos Aires, Ateneo Edit.

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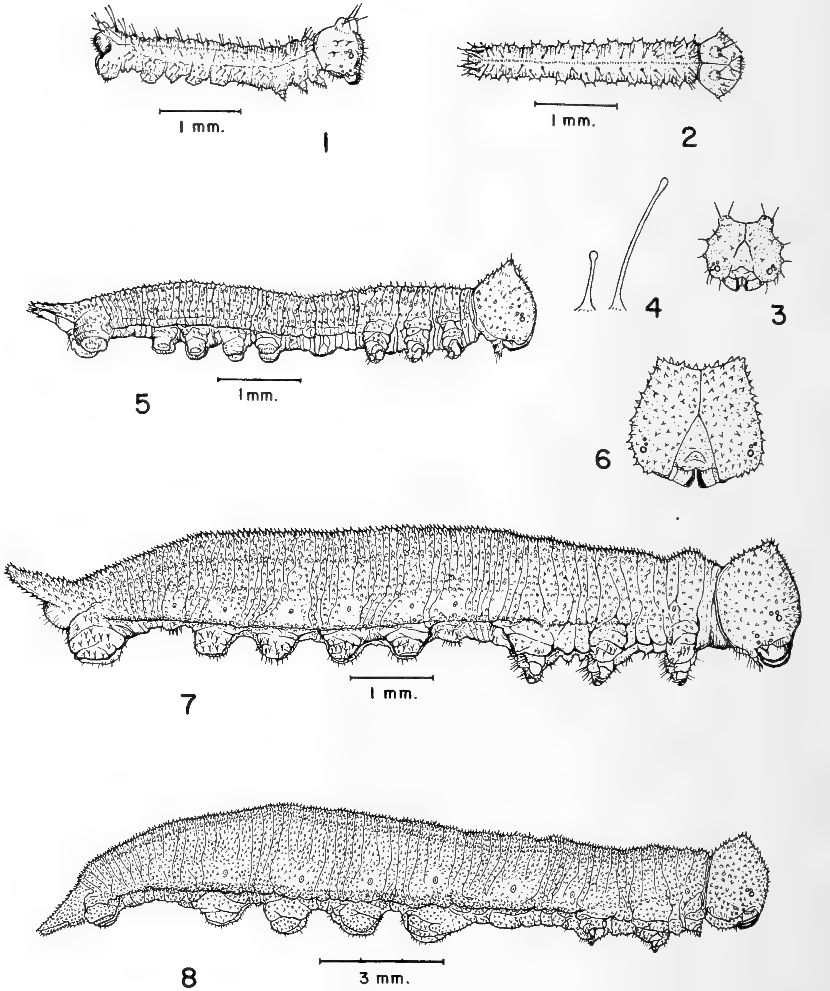
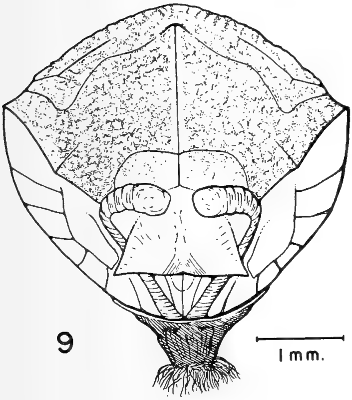
PLATE 1 *EUPTYCHIA*



Figs.1, 2. Instar I larva, July 22, 1958, lateral and dorsal views. **Fig.3. Instar I** larva, cephalic view of head. Fig.4. Instar I larva, longest and shortest clubbed dorsal setæ, greatly enlarged. Fig.5. Instar II larva, 6 August 1958, lateral view. Fig.6. Instar III larva, cephalic view of head. Fig.7. Instar III larva, 15 August 1959, lateral view. Fig.8. Instar V larva (last larval instar of indoor rearings), 5 October 1958, lateral view.

(Drawings from life by S. P. Hubbell)



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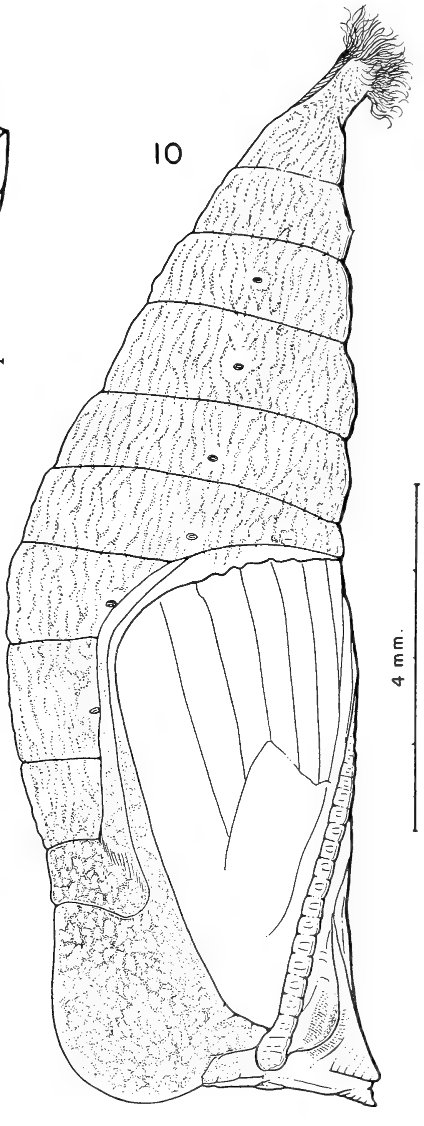

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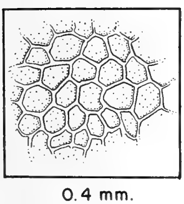

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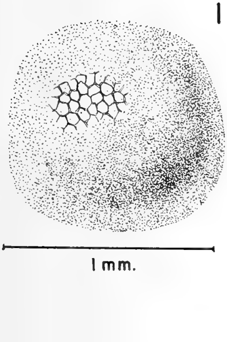

Figs.9, 10. Pupa, 26 October 1958, cephalic and lateral views. Fig.11. Egg, 10 July 1958, part of surface sculpture, much enlarged. Fig.12. Egg, from above, surface sculpture indicated only on high-lighted part.

(Drawings from life by S. P. HUBBELL)

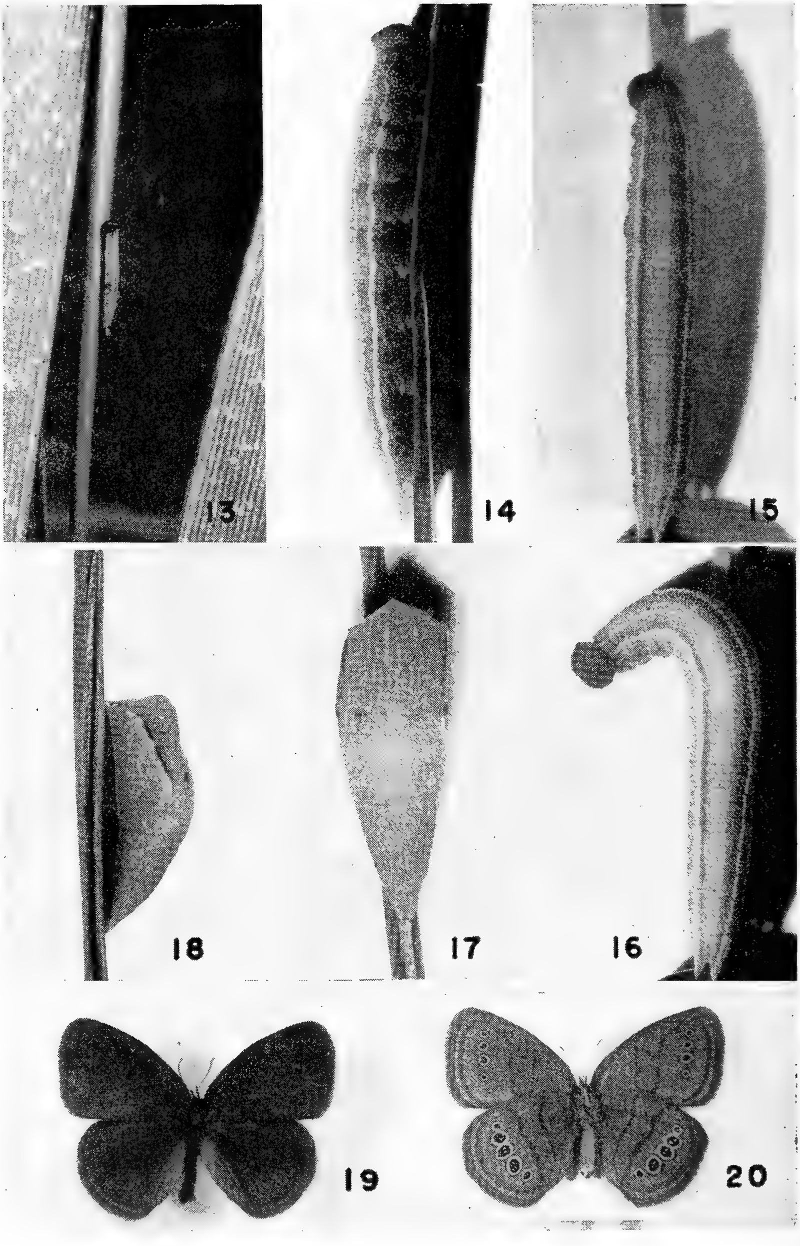

Fig.13. Instar I larva, lateral view. Figs.14-16. Instar VI larva, lateral and two dorsal views. Figs. 17, 18. Pupa, dorsal and lateral views. Fig.19. Adult male, Wakelee, Michigan, upper surface. Fig.20. Adult female, Wakelee, Michigan, under surface.

(Photographs by W. S. McAlpine)

TECHNIQUES FOR CAPTURE-RECAPTURE STUDIES OF LEPIDOPTERA POPULATIONS

by Paul R. Ehrlich and Susan E. Davidson

One of the primary requirements in the study of any animal population is the development of techniques which minimize the effect of the research program on the situation investigated. This problem is ever present in biological work, and is particularly important in attempts to study an animal under "natural" conditions.

During the past year techniques of investigation have been developed for research on the population dynamics and genetics of a colony of the checkerspot butterfly, *Euphydryas editha* Boisduval, which we feel have certain advantages over those employed by previous workers (*e.g.,* Dowdeswell, *et al.,* 1940). The colony range was subdivided into a number of areas easily recognized by landmarks, and these areas were given letter designations. During the flight period of the butterfly a standard routine was followed. Either daily or (late in the flight period) every other day, a regular route through the areas was worked by two investigators. One collected every specimen of *Euphydryas editha* encountered (a more than 95% capture success rate was maintained throughout the study). The other carried a knapsack containing slotted boxes lettered to correspond with the areas. As each butterfly was collected it was grasped with forceps and with its wings folded over its back placed deep in a glassine envelope. The envelope was then dropped into the appropriate slotted box.

After the collecting routine had been completed for all areas the investigators returned to a central point in each area to carry out the releasing procedure. Each individual was removed from its envelope and examined for marks. If none were found the individual was given a number, and marked with that number. Marking was accomplished with a "Magic Marker" dye pencil. This felt-tipped marking device deposits a quick-drying permanent stain on the wings. Specimens were marked on the under surface, using a 1-2-4-7 system; tens on the right wings, digits on the left wings (see Fig. 1). Different colors were used for hundreds. During marking one person held the specimen with the wings folded over the back and applied the dye with the marker held in the other hand. The other person inserted a smooth piece of cardboard between the upraised wings to act as a backing for applying the dye, and manipulated the wings with forceps where necessary. The marking procedure is shown in Figure 2. The area in which the individual was captured and its sex, condition, and wing length were recorded. Then the butterfly was released and watched until it was seen to be flying normally. If when the specimen was removed from its envelope it was found to be marked, then its number, area of recapture, and condition were recorded and it was released.

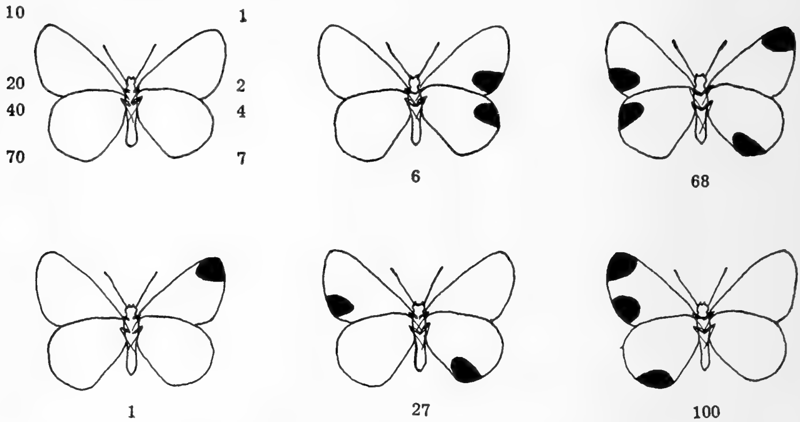

Fig. 1. The "1-2-4-7" marking system. Key individual in upper left.

With the procedure outlined above, information was gathered on the population size, dispersal, variation, emergence pattern, and sex ratio of the butterfly under study. These data may be analyzed for subpopulations determined on the basis of sex, area, time of capture, recapture pattern, condition, etc. For a further record of the variation present a random sample of males was removed from the population. This was done by killing every tenth male regardless of mark or condition. The only exceptions to this sampling procedure were made when individuals were accidentally killed or badly injured. When this happened the damaged butterfly was substituted for the next individual scheduled to be sampled. During the five week flight period of *Euphydryas editha*, 185 specimens (119 males, 66 females) were marked and released and these marked specimens were retaken a total of 224 times.

The analysis and interpretation of the data gathered will be reported elsewhere. The routine outlined above has several advantages over those used previously. It seems desirable to complete the collecting before any releasing is done. Although this does not allow the individual to be released in precisely the location of its capture, it does prevent the recapture of individuals already handled on the same day. Considering the rather high number of multiple recaptures, minimizing the handling was deemed more critical than precise release points. We feel that sufficient release point accuracy was achieved by releasing in the center of the appropriate area, especially as many individuals are chased before capture and thus suffer a certain unavoidable displacement.

Previous workers have solved the "same day recapture" problem by placing the butterflies in individual pillboxes. At least in the species which we have studied, the butterflies show no sign of damage after repeated stays in glassine envelopes. The latter have the advantage of being semi-transparent (no problem of determining occupancy) and much less bulky. The envelopes restrain the insects without damaging them. Handling is greatly facilitated as the butterflies are easily inserted into and removed from the envelopes.

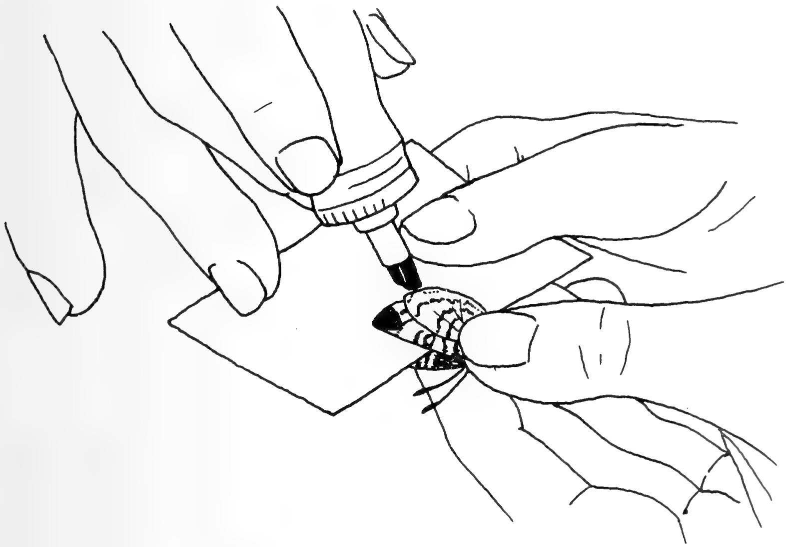

Fig. 2. Marking technique.

The marking system has the following advantages. Every butterfly can be given an individual number. The marks can be made large without significantly adding to the weight of the butterfly, and the marking device is neat and simple (no "paintpot" to spill). Having a fairly large mark and using the 1-2-4-7 system greatly reduces the problem of detecting marked individuals which have been damaged (single paint spots may be totally lost). One quickly grows accustomed to the 1-2-4-7 system and can read the marks instantaneously. Furthermore, we believe our field observations and data show no signs of our study causing serious disturbance in the behavior of the population. There was no indication of "net shyness" or "net happiness", and no sign of damage caused by the handling system (our few "mistakes" were sampled). One question which still needs to be investigated is the possible effects of the marks on predation, mating behavior, and the like.

With minor modifications we feel that our techniques will be applicable to a broad spectrum of field studies of Lepidoptera populations.

Acknowledgements

We would like to acknowledge the assistance of J. C. Montgomery and O. E. Sette with several aspects of the work described. This work was supported in part by a grant G-14740 from the U. S. National Science Foundation.

Literature Cited

Dowdeswell, W. H., R. A. Fisher, & E. B. Ford, 1940. The quantitative study of populations in the Lepidoptera. I. *Polyommatus icarus* Rott. *Annals eugenics* 10: 123-136.

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THE HABITAT OF *BOLORIA TITANIA* IN ONTARIO

On August 14th 1959, while driving along a gravel road in Capreol township (Lot 2, Concession 1), Sudbury District, Ontario, an uncollected *Boloria* was seen and tentatively identified as *B. titania.* Two attempts with my shirt failed to capture it. A return to the locality on the 17th resulted in the capture of 5 worn males, 1 worn and 3 fresh females. Other specimens were seen. Most of these were taken at the flowers of *Solidago graminifolia* which grows along low spots at the side of the road where this cuts the 'moat' or 'lagg' zone of the spruce bog. *S. graminifolia* appears to be an introduced weed in the area. One specimen was caught in the grass lagg on *S. rugosa* and one was caught on *S. squarrosa* on a sandy burn about 200 feet from the edge of the bog. Other specimens were seen in the lagg.

The locality is in a most unlikely area which is swept clean at intervals by frequent fires and, on days when the wind blows from the west or south, is blanketed by smelter fumes from Copper Cliff or Falconbridge. The bog was a climax spruce forest which had been clear-cut at least 10 years ago and the stumps have since been scarred with fire. Young spruce and larch are now reconverging on the centre, which has no pool. The central *Sphagnum* mat supports *Chamædaphne, Kalmia angustifolia, Ledum,* and *Vaccinium oxycoccos,* with some *Carex* and *Maianthemum* towards the exterior. This mat is surrounded by a tension zone of *Sphagnum* or *Carex* cover with *Chamædaphne, Larix, Thuja, Abies, Sorbus, Rubus, Myrica*, and some *Coptis* and *Linnæa.* This is ringed by an alder and grass lagg which consists of dense alder bushes in which occur openings with a tall grass which forms a dense wet peaty turf. In these open spaces are scattered tussocks of *Sphagnum* on the summit of which are plants of *Viola pallens,* a white bog violet. *Solidago rugosa, S. hispida,* a white *Aster,* and *Sorbus* are scattered thinly amongst the grasses and most *Boloria* were on these flowers.

A search of the *Viola* plants produced neither larvæ nor pupal cases although the leaves showed abundant large feeding scars. I think that this is the larval foodplant here, as the violet plant on wet moss seems to be one of the few spots where a permanent colony of *Boloria* could survive the fires. The August 23rd trip was confined to a study of the flora because of rain. A trip on the 30th of August produced no *B. titania* but the flight of the third emergence of *B. selene* was in full swing in exactly the same habitat.

The specimens seem to be fairly typical of *Boloria titania grandis* Barnes & McDunnough although they may be a little larger and darker than average. I think that both *B. selene* and *B. titania* overwinter here as eggs. There must be strong competition between the 3-brooded *B. selene* and the 1-brooded(?) *B. titania.* However, the apparently late flight date here compared with the mid-July of Smokey Falls (Ont.) and the late July-early August of alpine Mount Washington (New Hampshire) may indicate a second brood. If so, a first brood should be looked for here in mid or late June.

It is hoped that these observations will benefit the search for this butterfly in other areas to the south of its previously known range.

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A NEW PINE TIP MOTH (OLETHREUTIDÆ) FROM THE GULF OF MEXICO REGION

by WILLIAM E. MILLER[1]

The pine tip moth treated in this paper has been recognized by taxonomists for more than 30 years as being different in some degree from related moths. During this time, specimens have been identified at the U. S. National Museum as an undescribed "variety" of *Rhyacionia rigidana* (Fernald). Although very similar to *R. rigidana,* the insect is specifically distinct. This southernmost occurring pine tip moth is herein described and named

RHYACIONIA SUBTROPICA Miller, NEW SPECIES

Description of Holotype

Wingspan—18.5 mm. Labial palpus clothed with white scales, most of which have a light-brown medial transverse bar. Face with similar scales. Antennal base covered anteriorly and dorsally with white-tipped brown scales, elsewhere with silk-white scales. Head yellowish white. Collar composed of white-tipped brown scales. Dorsal aspect of thorax cream-colored anteriorly, dirty white posteriorly; ventral aspect silk-white. Anterior part of patagium clothed with brown-barred white scales; rest of patagium similar to dorsal aspect of thorax. Front and middle legs various shades of brown, banded with white. Femur of hind leg clothed with scales varying from dirty white to white with light-brown transverse bars; tibiæ and tarsi, brown with white bands on outer side, white on inner side. Forewing costa brown, interrupted by 10 or 12 white patches. Apical 1/5 of forewing rusty brown, grading nearly to cream-colored toward radius. Brown terminal line and white subterminal line produced by brown-barred white scales. Several small groups of oversized lead- and silver-colored scales just inside termen; similar raised scales of lead, silver, and brown also present in other parts of wing, especially along margins of fasciæ. A narrow cream-colored fascia just proximal to apical area of forewing. The next proximal fascia deep rust in color, divided costally by white patches so as to resemble the letter "Y" (as in Fig. 1). Medial fascia cream-colored: the widest and most prominent of the fasciæ. The next proximal fascia rust and brown. Basal area of forewing cream-colored. Hindwing grayish brown with terminal and subterminal lines similar to those of forewing. Fringes of fore- and hindwings composed of scales of various shades of brown and of various lengths, many tipped with white. Abdomen not seen prior to clearing and mounting. (Abdominal coloration of other specimens of the hypodigm was a dirty, silk-white produced by silk-white scales, many of which had a faintly brownish medial transverse bar.)

The HOLOTYPE female (U. S. National Museum Catalog No. 65012) has label data as follows: "*Pinus,* Valparaiso, Fla., iss. 26 May 1927, E. W. Gemner, ♀ genitalia slide #3, C. H., 4-June-1935." The town of Valparaiso (type locality) is in Okaloosa County, Florida.

[1] Forest entomologist, stationed at East Lansing, Mich., in cooperation with Michigan State University.

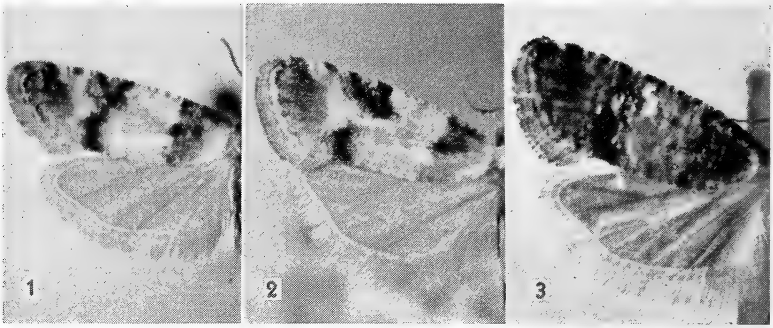


Fig. 1 - wings of a *Rhyacionia subtropica* adult from Florida; fig.2 - wings of a *R. subtropica* adult from Cuba; fig.3 - wings of a *R. rigidana* adult (North Carolina).

Three U. S. National Museum specimens with label data as follows are designated as PARATYPES: "E.E.A. Cuba Ento. No. 10521, Sto. Tomas, P. del Rio, May 10/35, S. C. Bruner, Boring shoots of *Pinus tropicalis,* ♀ genitalia slide #2, C. H., 4-June-1935"; same as Holotype, except "♀ genitalia slide 3.V.58, W.E. Miller"; ♂ same as Holotype except "Issued 14.7.27".

VARIATION

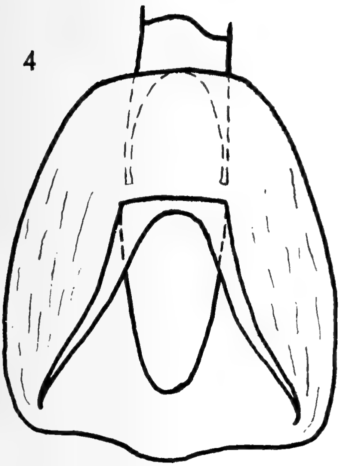
In all, 83 adult specimens of *Rhyacionia subtropica* were examined in this study. Nineteen of them (the ones in best condition) from nine localities were compared with the Holotype to ascertain extent of color variation. Only minor variations were found: The patagium varied in the proportion of cream-colored scales to brown-barred and dirty white scales clothing it. Also, an occasional thorax was more dirty white in appearance than cream-colored. Finally, the "Y" marking on the forewing of the four Cuban specimens seen was broken in the middle in contrast to that of mainland specimens (Figs. 1 and 2).

Curiously, the males exhibited polymorphism in genital structure. There were three sorts of genitalia based on differently shaped valvæ: Some males had valvæ both of which were like that in Fig. 6; some had both like that in Fig.7; and some had one of each. Similar polymorphism was found among *R. rigidana* males, and all three valval combinations were about equally represented in both species (nine slide mounts of *R. subtropica* male genitalia seen and eight of *R. rigidana*).

DIFFERENTIATION

As hinted earlier, *R. subtropica* most nearly resembles *R. rigidana* (Fernald). It differs from *R. rigidana* most importantly in female genital structure, but also in forewing coloration and possibly size. In female genitalia, the ostium bursæ of *R. subtropica* consists of but one fused part (21 slide

4



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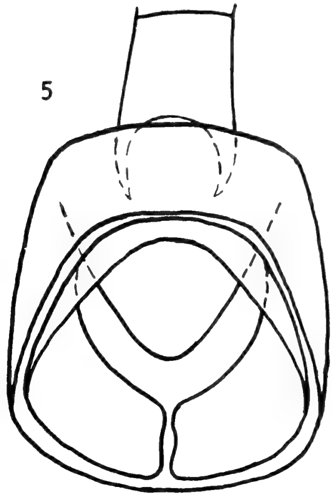

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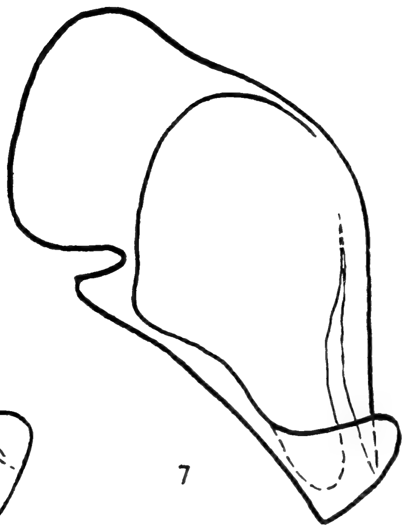

Ostium bursæ of *R. subtropica* (fig.4) and *R. rigidana* (fig.5) ; figs.6 & 7 - valvæ of *R. subtropica* (those of *R. rigidana* are indistinguishable).

mounts seen) while that of *R. rigidana* consists of two parts (11 slide mounts seen), and there are other lesser differences (Figs. 4 and 5). No diagnostic differences in male genitalia were found. Whereas cream-colored scales entirely or almost entirely comprise the medial fascia of the *R. subtropica* forewing, such scales comprise not more than half of the medial fascia of the *R. rigidana* forewing, which has white scales, grayish-brown scales, and white-tipped grayish-brown scales besides. Also, the base of the *R. subtropica* forewing is cream-colored, unlike that of *R. rigidana* (Figs. 1-3).

Wingspan comparisons suggest that *R. subtropica* may be a slightly smaller insect than *R. rigidana.* The wingspans of all spread *R. subtropica* specimens were measured. Twenty-seven males and 31 females had wingspan averaging 14.7 $\pm$ 0.4 mm. ($\pm$ indicates estimate of standard error of the mean) and 16.5 $\pm$ 0.3 mm., respectively. The mean difference of 1.8 mm. between male and female wingspans is statistically significant at the .01 level ($t = 3.7$). The wingspans of 21 *R. rigidana* males from 8 states and of 27 *R. rigidana* females from 11 states averaged 15.4 $\pm$ 0.3 mm. and 16.9 $\pm$ 0.2 mm., respectively. The mean difference of 1.5 mm. between *R. rigidana* male and female wingspans is also significant at the .01 level ($t = 4.5$). The wingspans of *R. subtropica* males and females averaged 0.7 and 0.4 mm. smaller, respectively, than those of *R. rigidana* males and females. This species size difference was tested for significance by the analysis of variance. The F-value was 3.51 with 1 and 102 degrees of freedom. Since the probability of F being this large even though the two species do not differ is between .10 and .05, the difference is not quite significant. A still larger sample will be needed to arrive at a more definite conclusion. This analysis also showed that *R. subtropica* is more variable in size than *R. rigidana,* significant at the .01 level. The variance of the *R. subtropica* male wingspans was 3.55 mm. and that of the female wingspans was 2.99 in contrast to 1.43 and 1.16 respectively of male and female *R. rigidana* wingspans.

Geographic Distribution and Hosts

The known geographic distribution of *R. subtropica* is Pinar del Rio Province (Cuba) north to South Carolina and west along the U. S. Gulf coast to Mississippi (Fig.8). Eleven species and varieties of pines occur in this area (Little, 1953; Little & Dorman, 1954), and four of these were listed on host labels of pinned adults examined in this study. They are Slash Pine, *Pinus elliottii* var. *elliottii* Engelm. (specimens from Florida and Georgia) ; Loblolly Pine, *P. tæda* L. (Florida) ; Longleaf Pine, *P. palustris* Mill. (given only by common name) (Florida and South Carolina) ; and Tropical Pine, *P. tropicalis* Morelet (Pinar del Rio). The range of *P. elliottii* varieties (Little & Dorman, 1954) coincides closely with the known distribution of *R. subtropica.* The insect possibly occurs over a wider range in the U. S., the West Indies, and perhaps also in Central America where pines grow. The writer recommends "Subtropical Pine Tip Moth" as a common name for the insect.

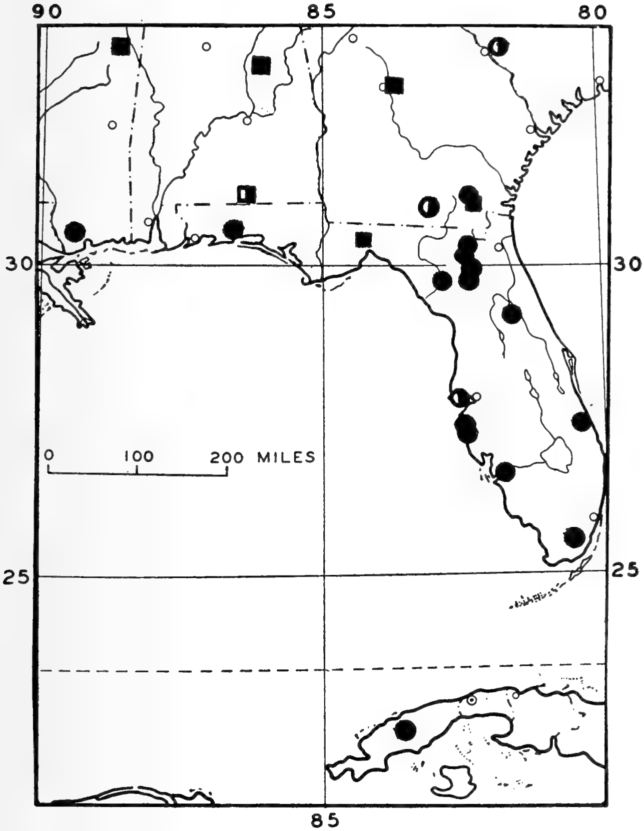

Fig.8 - Distribution of *R. subtropica* records (circles) and nearest *R. rigidana* records (squares). The solid and partially blackened points represent identifications based on female genitalia and male specimens, respectively.

Habits

Rhyacionia subtropica is similar in its ecology to *R. rigidana* and *R. frustrana* (Comstock). The larvæ feed in the tips and current year's shoots of the trees, and pupation takes place in the larval tunnels. Emergence or capture-dates on the labels of 62 pinned adults from 19 localities indicated at least 2 separate moth flight periods as follows: December 7 to March 6 and May 1 to August 5. These periods suggest that one generation develops in late summer and another in the spring.

Remarks

The range of *R. rigidana* overlaps somewhat with the range of *R. subtropica* (Fig.8) and so does that of *R. frustrana*. *R. rigidana* and *R. frustrana* have been confused at times in the past by fieldworkers (Miller &

Neiswander, 1959), and no way to differentiate larvæ of these two species is yet known (MacKay, 1959). *R. subtropica* further complicates the tip moth field recognition problem in the area where all three tip moths occur. The writer has reared *R. subtropica* and *R. frustrana* from the same tree in Mississippi. In another case, two tip moth adults, referred to the writer for identification and said to have been reared from the same tip in South Carolina, proved to be *R. subtropica* and *R. frustrana.*

WAKELEY (1954) noted that a tip moth, after causing damage in Lanier Co., Ga., had been identified in 1929 as *R. rigidana;* very likely it was actually *R. subtropica.* A *R. subtropica* specimen in the U. S. National Museum, collected by WAKELEY in 1929 from Stockton (Lanier Co.), Ga., was found during this study to have been incorrectly identified as *R. rigidana.*

Rhyacionia subtropica was also involved at least partly in the *"R. rigidana"* infestation at Waycross, Ga., briefly described by BEAL, *et al.* (1952) A *R. subtropica* specimen in the U. S. National Museum bearing a label with a 4-digit number was traced, with records on file at the Duke University School of Forestry, to Waycross and to the year and observer mentioned by BEAL *et al. R. subtropica* is the unnamed species which was distinguished from *R. rigidana* by MILLER and NEISWANDER (1959).

ACKNOWLEDGEMENTS

For arranging loans of *R. subtropica* and *R. rigidana* material, the author is indebted to J. F. GATES CLARKE of the U. S. National Museum, A. N. TISSOT of the Florida Agricultural Experiment Station, E. P. MERKEL of the Southeastern Forest Experiment Station, W. H. BENNETT of the Southern Forest Experiment Station, and particularly to C. P. KIMBALL, Sarasota, Florida, who loaned nearly half of the *R. subtropica* specimens seen. Also, R. F. ANDERSON of Duke University provided helpful file data.

Literature Cited

Beal, J. A., W. Haliburton, & F. B. Knight, 1952. Forest insects of the Southeast: with special reference to species occurring in the Piedmont plateau of North Carolina. *Bull. Duke Univ. School For.* 14: 168 pp.

Little, E. L., 1953. Check list of native and naturalized trees of the United States. *U. S. Dept. Agric. Handbook* No. 41: 472 pp.

Little, E. L., & K. W. Dorman, 1954. Slash pine (*Pinus elliottii*), including South Florida slash pine: nomenclature and description. *U. S. Forest Serv., Southeastern Forest Exp. Sta. Paper* 36 : 82 pp.

MacKay, M. R., 1959. Larvæ of the North American Olethreutidæ. *Canad. Ent. Suppl.* 10: 338 pp.

Miller, W. E., & R. B. Neiswander, 1959. The pitch pine tip moth, *Rhyacionia rigidana* (Fernald), and its occurrence in Ohio (Lepidoptera, Olethreutidæ). *Res. Bull. Ohio Agric. Exp. Sta.* 840: 23 pp.

Wakeley, P. C., 1954. Planting the southern pines. *Monogr. U. S. Dept. Agric.* 18: 223 pp.

Lake States Forest Experiment Station, Forest Service,
U. S. Dept. Agriculture, Univ. of Minnesota, St. Paul 1, Minn., U. S. A.

ESPECIALLY FOR FIELD COLLECTORS

(Under the supervision of Fred T. Thorne, 1360 Merritt Dr., El Cajon, Calif., U.S.A.)

BUTTERFLY COLLECTING IN NORTHEASTERN NEW MEXICO

by Charles V. Covell, Jr.

In August, 1951, it was my pleasure to venture West with a group of North Carolina Explorer Scouts to Philmont Scout Ranch, situated just north of Cimarron in Colfax County, New Mexico. This camper's dream, covering 127,000 acres of rugged mountains, features hiking, horsemanship, and various camping skills. My program while there included a seven-day hike with full pack over a trail covering 105 miles through the mountains. Although this situation was a bit impractical for butterfly collecting, I was determined to take as many specimens as I could, not anticipating another trip West for some time. Consequently I was at times the laggard of the group, stopping to collect and paper the catch.

The ground covered varied in altitude from 6,500 feet above Mean Sea Level at the base of operation to 11,600 feet, the height of Clear Creek Mountain. Two mountain streams, Uracca and Rayado Creeks, provided lush valleys through which we passed (we crossed Uracca Creek over 100 times the first day); therefore I found an abundance of fritillaries. I regret that I took no advantage of the higher slopes, as I expected to find little there! (Please remember that I was a fifteen-year-old in my second year as a lepidopterist.) Before and after the actual hike, I was stationed at a base camp at a lower level where Pinon Pine and Scrub Oak were plentiful. Here I was able to do some collecting, getting things I did not see at the higher elevations. Now, through the aid of *Colorado Butterflies* by Brown, Eff and Rotger, I feel that my "take" is adequately determined for presentation here. Because of my lack of concentration upon one given collecting spot during the trek, I feel ill-qualified to comment on distribution in the area except in the case of the few species I found most common. However, I found that my observations regarding these species coincide with those of the authors of *Colorado Butterflies* with respect to the habit and habitats. I used this book solely for my determinations, with some help from W. D. Field of the U. S. National Museum.

My collecting on August 12 and 13, and again on August 19, represented Upper Sonoran life zone. The other dates are mostly in the Transition Zone, with perhaps a bit of Canadian thrown in. The list follows.

August 12: *Papilio multicaudatus* (frequent, but hard to capture)
Limenitis weidemeyeri (frequent)
Speyeria atlantis nikias (with *electa* common in the lower areas)
Pieris protodice
Colias eurytheme (abundant)
Nathalis iole (abundant in lowlands)
Lycæides melissa (abundant)

August 13: *Melitæa pola arachne* (on nearby peak)
Neophasia menapia (in heavy pine woods)
Pieris napi macdunnoughii (with *menapia*)
Euptychia dorothea
Cercyonis œtus charon (common about Scrub Oak thickets)

August 14: *Vanessa cardui*
Polygonia hylas (common in mountain valleys)
Speyeria aphrodite ethne
Speyeria atlantis electa and *nikias*
Nathalis iole
Cercyonis pegala boopis
Cercyonis œtus charon
Apodemia mormo cythera
Lycæna dorcas florus
Lycæna arota schellbachi
Lycæides melissa

August 16: *Polygonia hylas*
Nymphalis milberti
Speyeria atlantis nikias

August 18: *Speyeria atlantis nikias*
Pieris napi macdunnoughii
Lycæna arota schellbachi

August 19: *Vanessa atalanta*
Polygonia hylas
Zerene cæsonia (one specimen)
Lycæna arota schellbachi
Lycæides melissa

Although these twenty-three species far from represent the butterflies flying in that area during those few days, I hope that these notes will be helpful in building records for the state of New Mexico. Despite the myriad of other activities I was engaging in at the time, the butterfly collecting was indeed a thrill to me who was a real greenhorn to lepidopterology as well as to mountain hiking.

Dept. of Entomology, Virginia Polytechnic Institute, Blacksburg, Va., U. S. A.

ERORA LÆTA (LYCÆNIDÆ) IN NEW HAMPSHIRE

by Richard S. Smith

The capture of a specimen of that rarest of eastern butterflies, *Erora læta* Edwards, always provides the opportunity for great rejoicing on the part of the lucky lepidopterist. The species seems to appear most often as a "lone wolf," as was the case with the single record from Pennsylvania by Clench (1956) or the only previous contemporary report from New Hampshire by Hessel (1952). Thus, on June 7, 1960, when the author joined the ranks of the "select," he was quick to reiterate this fact to his wife and to his mother who were collecting with him in north-central New Hampshire. Interest in other species vanished immediately and a thorough search of the area was begun. Contrary to our expectations, in the next ninety minutes, the author took two more specimens and this number was matched by both my wife and mother, for a total of 5 males and 2 females, all in good condition. In addition to this, two others were seen and positively identified.

The specimens were taken in Grafton County, in the township of Benton, New Hampshire, along an infrequently travelled dirt road. This road is crossed repeatedly by a number of streams and winds its way through typical Canadian zone forest at an altitude of about 1800 feet. Beech (*Fagus*) is very abundant, as well as White and Yellow Birch (*Betula alba* and *lutea*) and Balsam Fir (*Abies balsamea*). On this occasion the *E. læta* were flying in the company of *Pieris napi* Linné, *Amblyscirtes hegon* Scudder, and *Carterocephalus palæmon mesapano* Scudder. There were also numerous worn specimens of *Lycænopsis argiolus pseudargiolus* Boisduval & LeConte, and the first *E. læta* was nearly mistaken in flight for one of these.

For the most part, the *E. læta* were found resting on the damp earth of the roadbed; two were taken on small bushes at the side of the road; and a single male while resting on a Beech leaf. Except for the two which were seen but not taken, all other specimens seemed loath to fly and would not even fly up into the net after it was dropped over them.

One of the interesting features of the capture is that *E. læta* have been sought at this locale since 1957, when the road was first collected. The road was initially tried because of the great abundance of Beeches in the adjoining forest, but no *læta* were found in the three previous years. However, the road has proved to be a good source of *P. napi* and provided the author with his first N. H. records of this species. The identical strip of road has been collected several times during June in the past three years—once within six days of this years "epic" visit—and no *læta* have been seen, despite a careful search. There was no sign of *læta* this year on a return trip June 22. It seems reasonable to assume, interpolating from what is known to be true in other animal and insect populations, that *E. læta* would be unable to maintain itself, if a colony produced only a few individuals a year. In a short time natural catastrophe or competitive foes would be likely to result in the disappearance of the species. Thus it appears that the shortage may be in the number of lepidopterists, rather than in the number of Lepidoptera. It is interesting to hypothesize that perhaps *læta* is more common than supposed, but has a very short flight time (as with *Œneis melissa semidea* Say) and/or a very restricted environment (as with *Euphydryas phaeton* Drury). The coupling of these two possibilities would make the species most difficult to find, when few seekers were involved — a thought which should help warm hope and persistence in other collectors.

References

Clench, Harry K., 1956. Two new records of Pennsylvania Lepidoptera. *Lepid. news* 10: 161.

Hessel, Sidney A., 1952. A new altitudinal high for *Erora læta. Lepid. news* 6: 34.

R.F.D. #3, Governors Island, Laconia,, N. H., U. S. A.

CATOCALA ON FIR LOGS

During almost the entire summer of 1959, a jumbled pile of logs, the trimmed trunks of coniferous trees, lay undisturbed in a little clearing beside the road. Their continued presence was due to a convenient labour dispute. It's an ill wind, the saying goes, and if those whose finances were affected by the strike, wished it were over, the insect collector who dwelt near by thought differently. In the hot sun, resinous sap exuded from the logs, and many beetles and some other insects gathered for the feast. Very few Lepidoptera, however, seemed to relish this particular diet.

I was thus taken unawares when a *Catocala* flushed from the log pile and spiralled off. Too late with my net swing, I watched it cross the clearing and climb into the tree tops, then returned home to tell my tale of what did not quite come off. Now I have to explain here that my wife is not a believer in the saying about lightning never striking twice in the same place. Whenever I mention having caught or nearly caught some desirable prize, her immediate reaction is to organize an expedition to the spot where it was last seen. As a rule, my natural response to these suggestions is much tempered by caution. After all, she might find something there, it is better to play safe and encourage rather than deride. But in this case the idea seemed even more ridiculous than usual. Catocalas are always scarce here, they seldom fly in daylight, and as far as I knew fir logs had no particular attraction for them. The one I had seen had certainly gone out of sight, and to top it off she had not even a net. In spite of my comments, off she went. In 20 minutes she was back, she had the moth, she had caught it in a paper cup.

For the scientific record, the species is *Catocala allusa* Hulst, the only one commonly found on Vancouver Island.

Richard Guppy, Wellington, B. C., CANADA

WALTER KARL JOHANN ROEPKE (1882-1961)

On the 7th February 1961 Dutch lepidopterology suffered a severe loss by the decease of Professor Dr. WALTER KARL JOHANN ROEPKE, who died at his home in Wageningen, Holland, at an age of 78 years.

For long years Professor ROEPKE was the leading Dutch lepidopterist. Besides he has been for over thirty years an important figure in the field of general entomology and was well-known far outside this country. His whole long life was chiefly consecrated to entomology, in the last years, to lepidopterlogy only. His enthusiasm, versatillity and energy were remarkable.

ROEPKE was born on 18 September 1882, in Hohensalza (Inowrazlaw), in the province of Posen (now in Poland), from German parents. In 1901 he began the study of biology at the University of Berlin, but soon moved to Zürich, attracted by the great figure of M. STANDFUSS who lectured there. Under this nestor of lepidopterlogy ROEPKE developed his talent further and the influence of this scolar upon the young student was great and of a permanent value. Possibly from that period dates ROEPKE's interest for lepidoptera. He made, as STANDFUSS' assistant, several trips through southern Europe and North Africa, in order to collect material for the classical cross-breeding experiments of STANDFUSS with Saturniidæ and Sphingidæ (A small authentic collection of hybrids of the last family remained for long years with ROEPKE and is now in the Leiden Museum). He inaugurated in 1907.

In 1908 the fervent hope of ROEPKE, to learn the living nature of the Tropics, was fulfilled by his accepting of the appointment of assistant entomologist at the Agricultural Station at Salatiga, Java, in the former Netherlands East Indies. He became Director of The Central Java Experiment Station and then Etomologist at the Institute of Plant Diseases and Pests of Buitenzorg.

His activities were handicapped by World War I and, more seriously, by the symptoms of a tropical disease, the sprew, which soon made his stay in the Tropics not longer possible. A fortunate change was his appointment of Professor at the Agricultural College, Wageningen, where he arrived in 1919 to teach tropical agriculture till 1925, and from 1925 till his retirement in 1953, applied entomology. In these years his new laboratory published over 200 papers, 12 of which were inaugural dissertations.

ROEPKE continued working, in his spare time, on the fauna of Lepidoptera of the East Indian Archipelago, chiefly of Java. Due to his extraordinary energy and in spite of his many other duties, a fine collection of Javenese Lepidoptera (still at the College) and several extensive monographs resulted.

A complete list of his papers will appear in the *Tijdschrift voor Entomologie*. Of the most important monographs may be mentioned here his series "Rhopalocera Javanica, an illustrated survey of the Rhopalocera of Java" (in Dutch), "Heterocera Javanica, fam. Sphingidæ" (with DUPONT), his extensive studies of *Nyctemera* (1949 and 1957), of *Trabala* (1951), of *Delias* (Pieridæ) of New Guinea (1953), and of South Asiatic Cossidæ (1957).

He was an excellent observer and field entomologist. During his Javanese period he noted, bred and studied biologies of a very great number of insects, of which the studies of *Acrocerops cramerella* v. Dev., the cacao moth, and especially the fantastic life history of *Hypophryctis dolichoderella* Roepke (1925) a Tineid larva preying on the brood of *Dolichoderus* ants, are notable.

With ROEPKE we lose one of the last all-round entomologists of his generation. Although obstinately defending his scientifi views, he was a kind and generous colleague and a loyal friend. He will not soon be forgotten. Our sympathy goes to his family.

LYCÆNOPSIS PSEUDARGIOLUS IN LIGHT TRAP

I have seen very few records of butterflies having been caught in light traps. It therefore seems advisable to record such a capture. I have used various types of light in the past few years in catching Neuroptera. Only once in many nights of trapping has a butterfly been taken. On 14 July 1959 I caught a male *Lycænopsis pseudargiolus* (Bvd. & Lec.) identified by my friend A.H. MOECK. The trap was put into operation with the light about 4 feet above the ground in my backyard in Shorewood, a residential surburb of Milwaukee, Wisconsin, at 9:00 P.M. (temp. 65°F.) and was emptied at 12:00 p.m. (temp. 62°F.). Among many other insects was a nearly perfect *L. pseudargiolus*. Its condition suggests that it was in the trap a short time only. The trap was a typical sheet metal funnel trap with two vanes. The light source was a General Electric 6 watt Black Light BL Lamp which radiates most of its energy in the 3500 Angstrom region.

The apparent rarity of capture of butterflies in light traps would seem to indicate that they are attracted to the light from a very short distance only and most likely only when disturbed from their resting spot of the night.

ALVIN L. THRONE, University of Wisconsin-Milwaukee, Milwaukee 11, Wisc., U. S. A.

BUTTERFLIES OF FORMOSA IN COLOUR. By Takashi Shirôzu [In Japanese]. [8] + 482 + [2] pp., 76 coloured pls., 479 text figs. Publisher: Hoikusha Publishing Co., Ltd., 20, 1-chome, Uehonmachi, Higashiku, Osaka, Japan. [Available from E. W. Classey, 4 Church St., Isleworth, Middx., England: price $13.30].

This sumptuous work, unfortunately for us, is mostly in Japanese with the exception of the scientific names and morphological terms which are in Latin. These terms define the parts of the genitalia and are followed by valuable bibliographical references. The genitalia are figured under most of the species. There are also short tables under tribes separating the species by their genitalia. When necessary there are drawings also of the venation, scales, legs, etc. of the insects. Outline maps are provided showing the distribution of all butterflies other than those having a world-wide distribution. The beautiful coloured plates upon which the upper and under sides of both sexes are figured are as fine, if not finer, than anything that has heretofore been seen. A few names are proposed, in which the descriptions are in English (pp. 37 foot note, 128, 378, 381, 448). The immature stages of the insects are not shown.

The main text is followed by a synonymic list of Formosan butterflies and it is gratifying to note that each scientific name is followed not only by the author's name but also by the date of publication. In many cases there are both generic and specific synonymies. The nomenclature appears to be up to date and to follow the *Règles*. The book concludes with an index of generic and specific, but not family names. Since all pages and plates are numbered in Arabic the work is easy for the student to use.

The distribution map (fig.34) for *Papilio machaon* L. shows the range of the insect in Asia but in North America only in southwestern Alaska and the Hudson Bay region. In fact this butterfly has a much larger distribution in North America and is found in suitable localities over the intervening territory. Three recognizable subspecies have been named from this area, but this oversight is a small matter of slight importance to Oriental students for whom the book is primarily intended.

All in all this is not only a beautiful work which many will enjoy because of the excellent plates and figures, but it is also a very scholarly one showing the great industry and wide knowledge of its author. He is a professor in the Biological Laboratory of Kyushu University and well known to American students as an ardent lepidopterist.

While more elaborate than its predecessors, *Coloured butterflies from Korea* by TAMEZO MORI, HIRONOBU DOI and POK SEONG CHO (1934), [Butterflies of Saghalien] by M. HORI and K. TAMANUKI (1937), and *Coloured illustrations of the butter-flies of Japan* (revised by TEISO ESAKI) by MITSOU YOKOYAMA (1955) the four together give one an excellent understanding of the beautiful butterflies that are to be found in these interesting lands. All four should be in lepidopterists' libraries. To an extent they supplant the classical three-volume work of the previous century by JOHN HENRY LEECH on *Butterflies from China, Japan, and Corea* (1892-4).

C. F. DOS PASSOS, Washington Corners, Mendham, N. J., U. S. A.

RECENT LITERATURE ON LEPIDOPTERA

(Under the supervision of Peter F. Bellinger)

F. BIOLOGY AND IMMATURE STAGES

George, John L., & Robert T. Mitchell, "Calculations on the extent of Spruce Budworm control by insectivorous birds." *Journ. Forestry,* vol.46: pp.454-455. June 1948. Estimates that roughly 5% of insects (all stages) are eaten by birds during an outbreak of *Choristoneura fumiferana.* [P.B.]

Gere, G., "Investigations into the laws governing the growth of *Hyphantria cunea* Drury caterpillars" [in English; Russian & German summaries]. *Acta Biol. Acad. Scient. hung.,* vol.7: pp.43-72, 10 figs. 1956. Describes growth of larvæ as measured by changes in weight and dimensions. Larvæ reach maximum weight in middle of last instar; weight declines thereafter, & pupa is only half as heavy. Part of increase & most of decrease in weight are due to changes in water content. Development of larvæ is retarded if they are reared in isolation. [P.B.]

Gerhardinger, Klaus, "Über die Einfluss unterschiedlicher atmosphärischer Druckverhältnisse bei Rhescyntinæ" [in German]. *Zeitschr. Wiener ent. Ges.,* vol.35: pp.89-99, 4 figs. 1950. Pupæ of *Graellsia isabellæ* kept at altitudes below 1000 m. die or produce weak adults; increased atmospheric pressure apprently deleterious. [P.B.]

Gerris, V., "Kweek van *Melitæa cinxia* L." [in Dutch; English summary]. *Ent. Berichten,* vol. 15: pp.401-403, 4 figs. 1955. Describes rearing.

Gibbs, Alfred J., "*Gurleya* sp. (Microsporidia) found in gut tissue of *Trachea secalis* (Lepidoptera)." *Parasitology,* vol.43: pp.143-147, 15 figs. 1953. Describes life cycle of parasite. [P.B.]

Ginet, R., "La grotte de la Balme (Isère); topographie et faune" [in French]. *Bull. mens. Soc. linn. Lyon,* vol.21: pp.4-17, 27-31, 2 maps. 1952. Records *Hoffmanophila pseudospretella* breeding, & *Blabophanes* sp. hibernating, in cave. [P.B.]

Glauert, L., "A strange 'ant-friend' caterpillar." *Western Austral. Nat.,* vol.1: p.153. 1948. A cyclotornid moth reared from larva taken from nest of *Iridomyrmex detectus.* [I.C.]

Glushenkov, N., "New data on the biology of the Bollworm and measures for its control" [in Russian]. *Khlopkovodstvo,* vol.5, no.6: pp.57-59. 1955. *Heliothis armigera.* [Not seen].

Goater, Barry, "Autumn moths at elder berries." *Ent. Rec. & Journ. Var.,* vol.69: pp.46-47. 1957. Records various adult noctuids feeding on overripe berries. [P.B.]

Götz, Bruno, "Der Einfluss von Tageszeit und Witterung auf Aussschlüpfen, Begattung und Eiablage des Springwurmwicklers *Sparganothis pilleriana* Schiff." [in German]. *Zeitschr. angew. Ent.,* vol.31: pp.261-274, 10 figs. 1949. Determines limits and optima in time of day, temperature, and humidity, for emergence, mating, and egg-laying. [P.B.]

Goleman, Denzil Lyle, "Biological study of the European Corn Borer in Boone Country [sic!], Iowa." *Iowa State Coll. Journ. Sci.,* vol.30: pp.367-369. 1956.

Goodchild, H. H. "Sudden exodus" *Countryman,* Burford, vol.53: pp.543-544, 1 fig. 1956. Emergence of parasitic wasps from *Pieris brassicæ* larvæ. [P.B.]

Goodson, A. L., "*Hydræcia hucherardi* Mab. and its foodplant the Marsh Mallow (*Althæa officinalis*)." *Ent. Gaz.,* vol.6: pp.66-67, 1 fig. 1955.

Goodson, A. L., "Notes on collecting the larvæ of *Hydræcia hucherardi* Mabille." *Ent. Gazette,* vol.7: pp.27-28. 1956. Discovery of larvæ in roots of *Althæa officinalis.* [P.B.]

Grabe, Albert, "*Cacæcia unifasciana* Dup. (Tortricidæ)" [in German]. *Zeitschr. Lepid.,* vol.1: pp.99-100. 1951. Describes early stages; foodplant *Populus pyramidalis.* [P.B.]

Grabe, Albert, "*Capua reticulana* Hb. (Tortricidæ) an ausländischen Pflanzen" [in German] *Zeitschr. Lepid.,* vol.2: p.44. 1952. Sp. feeding on exotic *Rhus typhina.* Notes on *Rhus*-feeding Microlepidoptera. [P.B.]

Grabe, Albert, "Lebt die Raupe von *Philea irrorella* Cl. versteckt?" [in German]. *Zeitschr. Lepid.,* vol.2: p.148. 1952. Larvæ live exposed, on *Bryum.* [P.B.]

Grabe, Albert, "Seltsamer Verpuppungsplatz von *Dicranura vinula* L." [in German]. *Zeitschr. Lepid.,* vol.2: p.140. 1952. Pupa found on knife handle, 10 m. from nearest possible foodplant. [P.B.]

Grabe, Albert, *Sphinx ligustri* L. als Spatzenfutter" [in German]. *Zeitschr. Lepid.* vol.2: p.120. 1952. *Passer domesticus* attacking adult on tree trunk. [P.B.]

Gradwell, G. R., "*Hebia flavipes* (R.-D.) (Dipt., Tachinidæ), a parasite of the Feathered Thorn Moth *Colotois pennaria* (L) (Lep., Selidosemidæ)". *Ent. mo. Mag.,* vol.87: p.253, 1 fig. 1951. New host record. [P.B.]

Gradwell, G. R, "*Batodes angustiorana* (Haw.) (Lep., Tortricidæ) on oak." *Ent. mo. Mag.,* vol.93: p.190. 1957.

Gradwell, G. R., "Hosts of three species of *Eulophus* Geoffroy (Hym., Chalcidoidea), one new to science and another new to Britain." *Ent. mo. Mag.,* vol.93: pp.140-142, 2 figs. 1957. Larvæ ectoparasitic on lepidopterous larvæ (records from Noctuidæ, Notodontidæ, Geometridæ, Lymantriidæ). [P.B.]

Grandi, Guido, "Gli insetti a regime specializzato ed i loro 'adattamenti morfologii' " [in Italian]. *Atti Accad. naz. Lincei, Mem. Cl. Sci. fis. mat. nat.,* ser.8, vol.5, Sezione III[a]: pp.1-59, 25 pls. 1955. Includes general discussion of mining lepidopterous larvæ, & descriptions & figures of spp. of *Lithocolletis, Phyllocnistis, Gracilaria,* & some other genera, to illustrate morphological adaptations to mining habit. [P.B.]

Graves, P. P., "Repeated mating of Irish *Pieris napi.*" *Entomologist,* vol.83: pp.274-275. 1950. Records ♀ mating with 2nd ♂ after laying eggs. [P.B.]

Green, J., & W. Wilkinson, "Mites on insects of Skokholm Island." *Ent. mo. Mag.,* vol.87: pp.143-146. 1951. Including red mites on larvæ of *Zygæna trifolii.* [P.B.]

Greenbank, D. O., "The role of climate and dispersal in the initiation of outbreaks of the Spruce Budworm in New Brunswick." *Canad. Journ. Zool.,* vol.34: pp.453-476, 4 figs. 1956. Describes weather conditions favorable to development of *Choristoneura fumiferana.* Climatic conditions (a series of dry, sunny summers) preceding outbreaks may have favored the latter by producing greater numbers & higher fecundity through favorable effect on developing larvæ & also on foodplant (balsam fir). [P.B.]

Grégoire, Charles, "Studies by phase-contrast microscopy on distribution of patterns of hemolymph coagulation in insects." *Smiths. misc. Coll.,* vol.134, no.6: 35 pp., 1 pl., 4 figs. 1957. Including *Megalopyge lunata;* incomplete coagulation originating with development of cytoplasmic meshwork between hemocytes. [P.B.]

Gregor, František, "Erfahrungen mit der Kontrolle und Prognose des Eichenwicklers (*Tortrix viridana* L.) in Mähren" [in Czech; German & Russian summaries.] *Folia Zoologica,* vol.5: pp.1-16, 4 figs. 1956. Describes biology, distribution, & control of the sp. in Moravia. Very important study in applied forest entomology. [J.M.]

von Griesheim, Ilse, "Vorkommen und Zucht von *Anthocharis damone* in Sizilien" [in German]. *Ent. Nachrichtenbl.,* Burgdorf, vol.3: pp.104-106. Dec. 1949. Describes larva. Notes on distribution of this local sp. and on its habitat on Mt. Etna. [P.B.]

Grison, Pierre, "Sur la détermination de l'optimum thermique chez un insecte, le Bombyx cul brun (*Euproctis phæorrhæa* Don.)" [in French]. *C. R. Soc. Biol.,* vol. 141: pp.1207-1209. 1947 At 25° C. mortality is lowest & final weight is greatest for weight of food consumed. [P.B.]

Grison, P., & R. Roerich, "Comparaison du développement des chenilles d'*Operophtera brumata* L. (Lep. Geometridæ) et *Euproctis phæorrhæa* Don. (Lep Liparidæ) à differentes températures constantes" [in French]. *Bull. Soc. ent. France,* vol.54: pp. 12-16, 1 fig. 1949. *O. brumata larvæ* develop more rapidly at all temperatures; minimum mortality at 10° C.; total amount of food consumed decreases with increasing temperature. *E. phæorrhæa* has optimum at 25° C.; amount consumed increases with increasing temperature. Experiments on spring larvæ; not strictly comparable, since former hatches in spring & latter in fall. [P.B.]

Grison, Pierre, "Effets de la qualité de l'alimentation sur divers caractères physiologiques de deux lépidoptères" [in French]. *C. R. Acad. Sci.,* Paris, vol.242: pp.414-416. 1956. Prolonged development & reduced mortality & fertility in *Euproctis phæorrhæa* & *Malacosoma neustria* fed on aged leaves only. [P.B.]

Gulička, J., J. Jamriška, & L. Korbel, "Zweiter Beitrag zur Kenntnis der Bionomie des Weissen Bärenspinners (*Hyprantria cunea* Drury) in Südslowakei" [in Slovak; Russian & German summaries]. *Biológia,* Bratislava, vol.9: pp.35-59, 6 figs. 1954. On the food plants, parasites, and biology of this species in S. Slovakia. [J.M.]

de Gunst, J. H., "[Identification of the *Corypha* palms which flowered in the Hortus Bogoriensis during 1953 to 1955]. Appendix. Notes on some of the insects caught on the *Corypha* inflorescences." *Ann. bogorienses,* vol.2: pp.147-148. 1956. Records *Delias belisama* & *Hyblæa puera* at flowers. These palms flower only once in a life of 50 years or more. [P.B.]

Györfi, J., "Die Schlupfwespen und der Unterwuchs des Waldes" [in German]. *Zeitschr. angew. Ent.,* vol.33: pp.32-47. 1951 Considers that well-developed undergrowth in woodlands favors large populations of parasitic wasps, since many important parasites attack larvæ feeding on herbs and and shrubs as well as pests of trees. Lists numerous hosts of *Ichneumon disparis, Pimpla instigator, Theronia atalantæ, Apanteles spp.,* etc., and the foodplants of these hosts, most of which are Lepidoptera. [P.B.]

Gyôta, Tetsuo, "Short notes on the life history of *Melitæa phœbe scotosia* Butler (Nymphalidæ)" [in Japanese]. *New Entomologist,* vol.1, no.1: pp.36-40, 3 figs., 1 table. 1952. Foodplants *Cirsium* sp. and *Serratula coronata.* [T.I.]

Hadley, B. L., jr., "The Spring Canker-worm." *Penn. Forests & Waters,* vol.4: p.32, 7 figs. 1952. Figures of stages of *Paleacrita vernata.* [P.B.]

Härdtl, Heinrich, "Untersuchungen über die Fauna der *Taraxacum*-Arten" [in German]. *Beitr. Ent.,* vol.3: pp.69-95. 1953. Lists spp. attacking *T. officinale* or *T. koksaghyz,* including some 75 Lepidoptera (mainly Noctuidæ). [P.B.]

Haftorn, Svein, "Contribution to the food biology of tits especially about storing of surplus food. Part III. The Willow-tit (*Parus atricapillus* L.)." *Kon. norske vidensk. Selsk. Skrifter,* 1956, no.3: 80 pp., 26 figs. 1956. Sp. eats adult Lepidoptera; also eats larvæ, especially of Geometridæ, which may be stored for later consumption. [P.B.]

Haggett, G., "*Euphyia luctuata* Schiff (*lugubrata* Staud): a recent British record and notes on its life history." *Ent. Gaz.,* vol.3: pp.27-30, 1 pl. 1952. Third British record. All stages described and figured; reared on *Epilobium.* [P.B.]

Haggett, G., "An original account of rearing *Luceria virens* Linn." *Ent. Gaz.,* vol.4: pp.319-321, 2 pls. 1953. Reared on *Poa annua,* and *Dactylis glomerata* (less successful); all stages figured. [P.B.]

Haggett, G., "The egg and pupa of *Minucia lunaris* Schiff., and *Colobochyla salicalis* Schiff., (Lep: Plusiidæ)." *Ent. Gaz.,* vol.4: pp.266-268, 4 figs. 1953. Also describes egg of *Herminia barbalis.* [P.B.]

Haggett, G., "An account of rearing *Thalera fimbrialis* Scop." *Ent Gaz.,* vol.5: pp. 95-102, 1 pl., 2 figs. 1954. Describes all larval instars and pupa; foodplant yarrow. [P.B.]

Haggett, G., "The pupa of *Hada nana* Hufn. (*dentina Esp.*)" *Ent. Gaz.,* vol.5:pp. 223-224, 1 fig. 1954. Noctuidæ.

Haggett, G., "Further observations on *Calophasia lunula* Hufn." *Ent. Gaz.,* vol.6: pp.152-154, 1 fig. 1955. Describes egg and early instars; records molts; foodplants *Linaria* spp. [P.B.]

Haggett, G., "Note on the larva of *Chloroclystis debiliata* (Lep. Geometridæ)." *Entomologist,* vol.88: pp.212-213. 1955. Biology; on bilberry. [P.B.]

Haggett, G., & A. J. Wightman, "Field notes on *Hydræcia hucherardi* Mabille with description of the egg." *Entomologist,* vol.89: pp.67-70, 1 fig. 1956. Also records parasite; notes on adult behaviour. [P.B.]

Haggett, G., "A descriptive note on *Xanthorhoe biriviata* Bkh. (Lep: Geometridæ)". *Ent. Gazette,* vol.8: pp.167-170, 1 fig. 1957. Describes larva & pupa. [P.B.]

Haggett, G., "An account of rearing *Lithophane lapidea* Hübner, with descriptions of the egg, larva and pupa." *Entomologist,* vol.90: pp.287-295. 1957. Foodplant *Cupressus macrocarpa.* [P.B.]

Haggett, G., "Larvæ of the British Lepidoptera not figured by Buckler." *Proc. Trans. south London ent. nat. Hist. Soc.,* 1955: pp.152-163, 3 pls. 1957. First part of a projected series; descriptions & colored figures of larvæ of *Arenostola fluxa, Sedina buettneri, Oria musculosa, Chilodes maritima, Eupithecia millefoliata, E. extensaria, E. intricata arceuthata.* Notes on distribution & biology. List of spp. whose larvæ are needed for description & illustration. [P.B.]

Haggett, G., "Notes on some larvæ of the genus *Apamea* Treitschke (Lep:Caradrinidæ)." *Ent. Gaz.,* vol.8: pp.223-225, 1 fig. 1957. Distinguishes mature larvæ of *A. sordens, A. infesta, A. crenata, A. characterea,* & *A. obscura* on pattern characters. [P.B.]

Haggett, G., "The habitat and habits of *Rhizedra lutosa* Hübn. (Lep. Noctuidæ)." *Entomologist,* vol.90: pp.184-185. 1957. Larvæ feed in reed rhizomes, especially where drainage is good and reeds are stunted. [P.B.]

Hall, David M., "The use of *Bacillus thuringiensis* Berliner to control the Western Grape Leaf Skeletonizer." *Journ. econ. Ent.*, vol.48: pp.675-677. "1955" [1956]. Colonies of larvæ of *Harrisina brillians* (Zygænidæ) were sprayed with suspensions of spores of the bacillus. Considerable mortality was noted, but control was not sufficient to justify its use instead of insecticides. [W.C.]

Halleppanavar, N. L., "Two new eggs parasites of *Virachola isocrates*. Fb." *Science & Culture,* vol.23: p.253. 1957. Hymenopterous parasites of this lycænid pest of pomegranate. [P.B.]

Hama, Eiichi, "In the life-history of *Anthocaris cardamines isshikii* Matsumura in [Mt.] Yatsugatake (Pieridæ)" [in Japanese]. *New Entomologist,* vol.1, no.1: pp. 22-31, 4 figs. 1951.

Hammond, H. E., "*Cucullia,* Schrank: *absinthii,* Linn: (Lep: Agrotidæ). The Pale Wormwood Shark. The British status of the species, with particular reference to the Midlands." *Ent. Gaz.,* vol. 2: pp. 191-197. 1951. Describes early stages, biology (foodplants *Artemisium absinthium, A vulgaris*), distribution. [P.B.]

Hammond, H. E., "A list of previously unrecorded foodplants of lepidopterous larvæ, with additional notes on preferences, etc." *Ent. Gaz.,* vol. 3: pp. 59-68. 1952. Foodplants listed for some 70 spp. reared to imago; 25 other spp. listed with foodplant which permitted full larval growth though the imago was not allowed to emerge. Macroheterocera only. [P.B.]

Hammond, H. E., & Kenneth G. V. Smith, "On some parasitic Diptera and Hymenoptera bred from lepidopterous hosts; Part I, with a description of *Frontina læta* Mg., (Dip: Larvævoridæ)." *Ent. Gaz.,* vol. 4: pp. 273-279, 1 fig. 1953. List by parasite species; including apparently definite records of parasitization by a muscid and a phorid. [P.B.]

Hammond, H. E., & Kenneth G. V. Smith, "On some parasitic Diptera and Hymenoptera bred from lepidopterous hosts. Part II. Misc. records of Phoridæ, Larvævoridæ (Dipt.), Braconidæ, Ichneumonidæ, and Eulophidæ (Hym.)". *Ent. Gaz.,* vol.6: pp. 168-174, 1 fig. 1955. Includes some new records, mostly of parasites of Noctuidæ and Geometridæ. [P.B.]

Hammond, H. E., & Kenneth G. V. Smith, "On some parasitic Diptera and Hymenoptera bred from lepidopterous hosts. Part III. Records of Tachinidæ (Dipt.), Braconidæ, Ichneumonidæ, Encyrtidæ, Pteromalidæ, Eulophidæ and Scelionidæ (Hym.)." *Ent. Gazette,* vol. 8: pp. 181-189. 1957. Numerous records of parasites of British Lepidoptera. [P.B.]

Harcourt, D. G., R. H. Backs, & L. M. Cass, "Abundance and relative importance of caterpillars attacking cabbage in eastern Ontario." *Canad. Ent.,* vol.87: pp.400-406, 1 fig. 1955. *Pieris rapæ* most important at all seasons, though less numerous than *Plutella maculipennis* (much smaller) on later crops. *Trichoplusia ni* a minor pest. [P.B.]

Hare, Edgar J., "*Euphyia luctuata* Schiff.: some further observations." *Ent. Gaz.,* vol.4: pp.163-164. 1953. Supplementary to the paper by Haggett [*Ent. Gaz.,* vol.3: pp.27-30].

Harper, John L., "Biological flora of the British Isles. *Ranunculus acris L.* (*R. acer auct. plur.*)." *Journ. Ecol.,* vol.45: pp.289-342, 11 figs. 1957. Lists numerous insects visiting flowers, including *Micropteryx calthella,* feeding on pollen. Larvæ of *Trigonophora flammea, Agrochola lychnidis, Ceramica psi, Triphæna orbona, Phlogophora empyrea, Cnephasia langana, C. interjectana,* & *C. pasiuana* feed on *Ranunculus* ssp. [P.B.]

Harper, John L., & W. A. Wood, "Biological flora of the British Isles. *Senecio jacobæa* L." *Journ. Ecol.,* vol.45: pp.617-637, 2 figs. 1957. Includes list of 32 Lepidoptera feeding on this plant; records parasites reared from *Hypocrita jacobææ* & *Homæosoma nimbella.* Records 15 ssp. visiting flowers. [P.B.]

Hartley, P. H. T., "Animal camouflage." *Endeavour,* vol.7: pp.97-103, figs. 1948. Discussion and illustration of the main types of animal camouflage, with some examples from the Lepidoptera. [P.B.]

Harville, John P., "Ecology and population dynamics of the California Oak Moth, *Phryganidia californica* Packard." *Microentomology,* vol.20: pp.83-166, 6 pls. 1955. It is concluded that density-independent factors, especially cold winters, are more important than density-dependent factors in altering the numbers of this sp. [J.T.]

Hayashi, Keijiro, "Collecting *Zephyrus* eggs in winter, and breeding thereof (1) - (3) (Lycaenidæ)" [in Japanese]. *Shin Konchu,* vol.5, no.1: pp.31-34, 4 pls., 2 figs.; no.2: pp.12-15, 4 pls., 2 figs, 1 table; no.3: pp.35-40, 4 pls., 7 figs, 2 tables.

1952. Collecting tiny eggs of Theclini during winter is a fascinating technique recently developed in Japan. Many young hobbyists are engaged in the sport. The author Hayashi is one of the prominent leaders of this school. These papers disclose eggs, larvæ, and pupæ of 21 Theclini completely. There remain only 2 spp. unfigured: one, *Iratsume orsedice,* was published in *Shin Konchu,* vol.4. no.12, 1951, and the other, *Neozephyrus hisamatsuanus,* has not yet been studied. Foodplants: *Neozephyrus smaragdinus* on *Prunus; N. taxila* on *Alnus; N. ataxus* on *Cyclobalanopsis; Favonius fujisanus* on *Fagus*; *Iratsume orsedice* on *Hamamelis; Thecla jonasi,* aphidivorous on *Quercus; Coreana ibara* on *Fraxinus; Artopoetes pryeri* on *Ligustrum;* all others on *Quercus* and/or *Cyclobalanopsis.* [T.I.]

Heddergott, H., "Zur Biologie und Bekämpfung des Erdbeerwicklers *Acleris* (*Acalla*) *comariana* Zell." [in German; English summary]. *Zeitschr. Pflanzenkrankh.,* vol. 62: pp.220-235, 18 figs. 1955. Describes all stages & biology; foodplant strawberry. [P.B.]

Heddergott, H., "*Cnephacia argentana* Cl. (Lep., *Tortricidæ*) als Schädling on Fichtenkulturen" [in German; English summary]. *Zeitschr. angew. Ent.,* vol.40: pp. 332-342, 7 figs. 1957. Describes all stages & biology; destructive in spruce stands. [P.B.]

Hedges, Alfred., "A remarkable case of convergence in the pupa and cocoon of two agrotid moths." *Ent. Rec. & Journ. Var.,* vol.66: pp.129-131, 2 pls. 1954. *Anarta cordigera* & *Hadena bombycina* both have spined pupæ which can move actively up or down in their tubular cocoons. [P.B.]

Heimpel, A. M., "The pH in the gut and blood of the Larch Sawfly, *Pristophora erichsoni* (Htg.), and other insects with reference to the pathogenicity of *Bacillus cereus* Fr. and Fr." *Canad. Journ. Zool.,* vol.33: pp.99-106, 1 fig. 1955. Records pH in blood & in parts of gut of larvae of *Malacosoma disstria* & *Bombyx mori.* The gut in these spp. is too acid to permit normal multiplication of the pathogen, except perhaps during starvation. [P.B.]

Hennig, Rolf, "Die tierischen und pflanzlichen Schädlinge unserer wichtigsten fremdländischen Holzarten" [in German; English summary]. *Zeitschr. Pflanzenkrankh.,* vol.61: pp.255-269. 1954. Summary of enemies of exotic trees grown in Germany. Includes records of *Dendrolimus pini* on *Pseudotsuga taxifolia* & *Picea sitchensis; Grapholitha pactolana* on *P. sitchensis; Dioryctria abietella, D. splendidella, Evetria buoliana, Dioryctria pini, Panolis flammea,* & *Lymantria monacha* on *Pinus strobus; Evetria duplana, E. turionana,* & *E. buoliana* on *P. murrayana*; *D. pini* & *Cnethocampa pityocampa* on *P. nigra; Coleophora laricella* & *Grapholitha diniana* on *Larix leptolepis; Gracilaria complanella* & *Grapholitha amplana* on *Castanea sativa; Tortrix viridana* & *Euproctis chrysorrhœa* on *Quercus borealis; Nepticula sericopeza* on *Robinia pseudoacacia.* [P.B.]

Henson, W. R., & R. F. Shepherd, "The effects of radiation on the habitat temperature of the Lodgepole Needle Miner, *Recurvaria milleri* Busck (Gelechiidæ: Lepidoptera)." *Canad. Journ. Zool.,* vol.30: pp.144-153. 1952. Wind, orientation of needles, shade, and other factors affect mine temperatures and presumably result in differences in rate of development. [P.B.]

Hepper, F. N., "Biological flora of the British Isles. *Silene nutans* L." *Journ. Ecol.,* vol.44: pp.693-700, 3 figs. 1956. Records *Hadena* spp., *Coleophora leucapenella, C. silenella,* & *C. otitæ* feeding on seeds or (last sp. only) on leaves. [P.B.]

Hering, Erich Martin, "Schwedische Miniaturen" [in German]. *Opusc. ent.,* vol.16: pp.81-88, 2 figs. 1951. Records *Nepticula confusella* mining *Betula pubescens; N. plagicoletta, Cosmopteryx scribaiella,* & *C. lienigiella in Phragmites communis; Lithocolletis dubitella* in *Salix caprea.* [P.B.]

Hering, Erich Martin, "Veränderungen in pflanzlichen Geweben unter dem Einfluss minierender Insekten-larven" [in German]. *Svensk Bot. Tidskr.,* vol.45: pp.42-71, 1 pl., 12 figs. 1951. Describes reactions of plant tissue to activity of mining larvæ, including some 30 spp. of Lepidoptera. [P.B.]

Herpin, René, "Notes d'entomologie agricole" [in French]. *Mem. Soc. nation. Sci. math. natur. Cherbourg,* vol.44: pp.65-69. 1950. Records *Vanessa cardui* on artichoke; *Hydrœcia micacea* on potato. [P.B.]

Herter, Konrad, "Über die Orientierung der 'Springböhnen'" [in German]. *Biol. Zentralbl.,* vol.69: pp.565-579, 18 figs. 1955. Describes methods of locomotion of *Carpocapsa saltitans* larvæ removed from *Sebastiana* capsules and supplied with artificial glass 'jumping beans'. Reactions to light and temperature are also described. [P.B.]

Heslop, I. R. P., "*Apatura iris* imago attacked by birds: with some observations on the status and future of this species." *Ent. Gaz.,* vol.6: pp.175-177. 1955. Records jays and a magpie attacking adult; thinks increase in bird life in Britain is responsible for change in habits of butterfly, which has become less apt to settle in exposed spots. [P.B.]

Heslop, I. R. P., "The breeding log of an *Apatura iris* in 1954." *Ent. Gaz.,* vol.6: pp.69-85, 3 figs. 1955. Detailed account of rearing last-instar larva (on *Salix cuprea*) and of the process of pupation. [P.B.]

Heslop, I. R. P., "Pupa of *Apatura iris* attacked by larva of *Cosmia trapezina.*" *Entomologist,* vol.89: p.106. 1956.

Heslop, I. R. P., "Hibernating habit of larva of *Apatura iris* Linn." *Entomologist,* vol.90: pp.42-43. 1957. Spins on leaf or stem of *Salix cuprea;* leaves are attached to plant by silk. [P.B.]

Heslop-Harrison, J. W., "The foodplants of *Abraxas grossulariata* Linn." *Ent. Rec. & Journ. Var.,* vol.69: pp.48-49. 1957. Records local populations of this polyphagous sp. which refused *Calluna vulgaris* or *Erica cinerea,* the preferred foodplants of other populations. [P.B.]

Hibbs, Edwin Thompson, "An investigation of European Corn Borer populations as related to corn planting dates." *Ohia State Univ. Abs. doct. Diss.,* vol.63: pp.113-116. 1952. Abstract; *Pyrausta nubilalis.*

Hicks, S. D., "Another insect on *Rhus.*" *Coleopt Bull.,* vol.6: p.29. 1952. *Epipaschia superatalis,* feeding on poison ivy. [P.B.]

Hierhold, Emil, "Beobachtungen bei einer Zucht von *Aglia tau* L." [in German]. *Ent.Nachrichtenbl.,* vol.3, no.3: pp.1-2. 1956. Describes rearing; one probably unfertilized egg hatched, but larva died. [P.B.]

Hill, Alex R., "A survey of insects associated with cultivated raspberries in the east of Scotland." *Ent. Mo. Mag.,* vol.88: pp.51-52. 1952. Records of Lepidoptera include Arctiidæ, Noctuidæ, Lymantriidæ, Geometridæ, Œcophoridæ, Hyponomeutidæ, Plutellidæ, Micropterygidæ, Incurvariidæ. [P.B.]

Hoy, J. M., "The biology and host range of *Neoplectana leucaniæ,* a new species of insect-parasitic nematode." *Parasitology,* vol.44: pp.392-399, 5 figs. 1954. Collected from *Leucania acontistis, Crambus simplex;* will also attack larvæ of *Oxycanus cervinata, Persectania ewingi.* [P.B.]

Hoyt, Charles P., "Notes on larvævorid flies reared from *Prodenia litura* Fab. and *Othreis fullonia* (Clerck) larvæ in American Samoa." *Proc. Hawaiian Ent. Soc.,* vol.15: pp.419-421. 1955.

Huggins, H. C., "Notes on Microlepidoptera." *Ent. Rec. & Journ. Var.,* vol.63: pp.181-182, 221-222, 250-251, 300-301; vol.64: pp.25-26, 50-51, 84-85, 120-121, 177-178, 211-213, 250-251, 285-286, 319-320, 345-346; vol.65: pp.14-15, 50-51, 85-86, 116-117, 137-138, 176-178, 213-215, 255-256, 287-288, 320-321, 360-361; vol.66: pp.18-19, 54-55, 82-83, 115-117, 150-152, 167-168, 196-197, 226-227, 252-253, 271-272, 293-294. 1951-1954. A guide to collecting British spp., with valuable information on foodplants & habits. [P.B.]

Huggins, H. C., "A few notes on *Cirrhia ocellaris* Bork." *Ent. Rec. & Journ. Var.,* vol.65: pp.347-348. 1953. Rearing methods & variation. [P.B.]

Huggins, H. C., "A note on *Spatalistis bifascianna* Hüb." *Ent. Rec. & Journ. Var.,* vol. 65: pp.132-134. 1953. Probable foodplant: oak. [P.B.]

Huggins, H. C., "Clearwings in Essex." *Ent. Rec. & Journ. Var.,* vol.66: pp.210-212: 1954. Notes on biology of *Sesia apiformis* & some other Ægeriidæ. [P.B.]

Huggins, H. C., "The Wood Leopard Moth on the Essex coast." *Ent. Rec. & Journ. Var.,* vol.66: pp.162-164. 1954. Habits of *Zeuzera pyrina;* the introduced Mountain Ash is strongly favored as foodplant. [P.B.]

Huggins, H. C., "A parasite of *Nephopteryx abductella* F. R." *Entomologist,* vol.89: p.121. 1956. Hymenoptera.

Hughes, Kenneth M., "An annotated list and bibliography of insects reported to have virus diseases." *Hilgardia,* vol.26: pp.597-629. 1957.

Husson, Roger, "Les ennemis naturels de l'*Ennomos quercinaria* Hfn. lors de sa recente pullulation en Saare" [in French]. *Ann. Univ. saraviensis,* vol.5: pp.40-44. 1956. Records 10 parasites & a virus disease. [P.B.]

Husson, R., F. Stauder, & J. Daum, "Über ein Massenauftreten von *Ennomos quercinaria* Hfn. (Lepidoptera) in den Waldungen des Saarlandes in den Jahren 1952 und 1953" [in German; French & English summaries]. *Ann. Univ. Saraviensis,* vol.2: pp.289-304, 6 pls., 2 figs., 1 map. 1953. Describes biology of this sp., which swarmed on oaks & beeches in 1952-53 in Saare. Figures all stages. [P.B.]

Hutchins, Ross E., "Flight speed of certain insects as shown by wind tunnel tests." *Journ. Mississippi Acad. Sci.,* vol.4: pp.109-110. 1953. Records speed of 'sulphur butterfly' (*Colias; Phœbis?*) as 7 m.p.h. [P.B.]

Hutchins, Ross E., "The jump in the jumping bean." *Natural History,* vol. 65: pp. 102-105, 9 figs. 1956. Biology of *Laspeyresia saltitans*; normal jumping of larva in seedpod is said to constitute random mechanism for shifting fallen pod to a spot sheltered from heat. [P.B.]

Hyde, George E., "A further note on *Apatura iris* Linn." *Ent. Rec. & Journ. Var.,* vol.66: pp.98-100. 1954. Biology, in Britain.

Hyde, George E., "A new moth in southern England." *Discovery,* vol.17: p.493, 3 figs. 1956. Figures of egg, pupa, & adult of *Hydræcia hucherardi.* [P.B.]

Hyde, G. E., "A story of disappointment." *Ent. Rec & Journ. Var.,* vol.69: pp.79-80. 1957. Account of partially successful rearing of *Heliophobus albicolon* and *Heliothis dipsacea.* [P.B.]

Imadachi, Gentaro, et al., "Preliminary notes on the life history of *Arhopala ganessa loomisi* Pryer (Lycænidæ)" [in Japanese]. *Shin Konchu,* vol.6, no.13: pp.28-30. 1953. Foodplant: *Quercus gilva.* [T.I.]

Inoue, Hiroshi, "On winter flying *Alsophila* (Geometridæ)" [in Japanese]. *Shin Konchu,* vol.2, no.2: pp.16-20, 4 figs. 1949.

Inoue, Hiroshi, "A list of feeding plants of the Japanese Geometridæ" [in Japanese; English summary]. *Bull. Takarazuka Insectarium,* no.74: 20 pp. 1950. Lists foodplants of 147 spp. (many only from records for European races). Foodplant index. [P.B.]

Inoue, Masasuke, "*Parnassius glacialis* (Papilionidæ)" [in Japanese]. *Shin Konchu,* vol.5, no.4: 3 pp., frontispiece. 1952. Including 11 photos of eggs, larvæ, & pupæ, with short notes by K. Hayashi. Foodplant: *Corydalis* sp. [T.I.]

Inoue, Masasuke, & Keijiro Hayashi, "Photographic album of butterflies in life" [in Japanese]. *Shin Konchu,* vol.5, no.9 (special issue): 24 pp., frontispiece in color, 40 pls. 1952. Life histories of 116 spp., including *Parnassius eversmanni daisetsuzana, Œneis daisetsuzana, Pararge deidamia, Boloria thore, Neozephyrus ataxus, Thecla* (*Shirozua*) *jonasi,* etc. A very fine book. [T.I.]

Ishihara, Tamotsu, "Some notes on the eggs of three *Parnassius*-butterflies (Papilionidæ)." *Trans. Kansai ent. Soc.,* vol.15, part 1: pp.23-26, 2 figs. 1950. Carefully describes eggs of *P. glacialis, P. stubbendorfii,* & *P. nomion,* and gives a key. [P.B.]

Ishii, Tei, "Natural enemy of butterflies" [in Japanese]. *Shin Konchu,* vol.4, no.4: pp.7-9, 3 figs. 1951.

Ishii, Susumu, "Jumping of the larvæ of *Zizeeria maha* Kollar (Lycænidæ)" [in Japanese]. *Insect Ecol.,* vol.4, no.11: p.93. 1952. First instar larvæ jumped as far as 10 cm., by drawing head and tail together. [T.I.]

Ishimura, Kiyoshi, "Life history of *Maculinea euphemus* Hübner in Japan (Lycænidæ)" [in Japanese]. *Insect Ecology,* vol.4, no.10: pp.27-34, 1 pl. 1952. Foods: *Sanguisorba* in first 3 instars, and *Myrmica* (ant) eggs in the last instar. Confirms report of T. A. Chapman (1919) & adds more information. [T.I.]

Ishiwara, Seiichi, "Life-history of *Acosmeryx castanea* Rothschild et Jordan (Sphingidæ)" [in Japanese]. *Shin Konchu,* vol.4, no.13: pp.2-8, 11 figs. 1951. Foodplant: *Cissus japonica.* [T.I.]

Ishiwara, Seiichi, "Life history of *Theretra oldenlandiæ* Fabricius (Sphingidæ)" [in Japanese]. *Shin Konchu,* vol.5, no.12: pp.8-10, 4 figs. 1952. Foodplant: *Cayratia japonica* (Vitaceæ). [T.I.]

Ishiwara, Seiichi, "Life history of *Theretra oldenlandiæ* Fabricius (Sphingidæ)" [in Japanese]. *Shin Konchu,* vol. 6, no.10: pp.23-25, 4 figs. 1953. Foodplants: *Ampelopsis, Cayratia, Vitis* (Vitaceæ). [T.I.]

Issekutz, L., "Der Weinstockschädling *Theresimima ampelophaga* Bayle-Barelle in Ungarn (Lepidopt., Zygænidæ)" [in German]. *Zeitschr. Wiener ent. Ges.,* vol.42: pp. 33-43, 56-61, 75-79, 4 pls. 1957. Detailed description of biology; also maps distribution. [P.B.]

Iwabuchi, Fumito, "Ecological notes on the larva of *Parnassius glacialis* Butler" [in Japanese]. *Collecting & Breeding,* vol.13: pp.331-332, 1 fig. 1951. Foodplant: *Corydalis* sp. [T.I.]

Iwase, Taro, "Notes on the life-history of Japanese Plebejinæ (Lycænidæ)" [in Japanese]. *Bull. Takarazuka Insectarium,* no.41: pp.1-8. 1948. 17 spp. discussed. [T.I.]

Iwase, Taro, "Ants, ant-cows and lycænid larvæ" [in Japanese]. *Bull. Takarazuka Insectarium,* no.48: pp.1-17, 6 figs. 1948. *Feniseca, Spalgis, Taraka, Liphyra, Lachnocnema, Megalopalpus, Euliphyra, Aslauga,* & *Maculinea* are discussed. [T.I.]

Iwase, Taro, "How to identify *'Zephyrus'* larvæ (Lycænidæ)" [in Japanese]. *Shin Konchu,* vol.3, no. 7/8: pp.12-15, 5 figs. 1950.

Iwase, Taro, "Life-history of *Maculinea euphemus* Hübner in Europe" [in Japanese]. *Insect Ecol.,* vol.3: pp.47-52, 4 figs. 1950. Japanese version of Dr. Chapman's papers (1919, 1920). [T.I.]

Iwase, Taro, "Entomophagous Lepidoptera" [in Japanese]. *Bull. Takarazuka Insectarium,* no.75: pp.1-18, 6 figs. 1950. Chiefly Microlepidoptera; with an addendum on "Entomophagous Lepidoptera in Japan," enumerated in English with their prey. [T.I.]

Iwase, Taro, "Notes on the life-history of Japanese butterflies (1) — (5)" [in Japanese]. *Bull. Takarazuka Insectarium,* no.50: 20pp. (Papilionidæ, Pieridæ, Satyridæ), 1948; no.53: 20 pp. (Danaidæ, Libytheidæ, Nymphalidæ), 1949; no.55: 18 pp. (Lycænidæ), 1949; no.56: pp.1-12 (Hesperiidæ), 1949; no.57: pp.1-7 (bibliography & addenda), 1949. Many figures. The first comprehensive serial work in this field. [T.I.]

Iwase, Taro, "How to identify *Argynnis* larvæ (Nymphalidæ)" [in Japanese]. *New Entomologist,* vol.1, no.1: pp.3-12, 3 figs. 1951. Key for 9 spp. in Japan. [T.I.]

Iwase, Taro, "Lessons from here and there (1) — (3)" [in Japanese]. *Trans. lep. Soc. Japan,* vol.2: p.15, 2 figs.; p.19, 2 figs; p.33, 2 figs. 1951. Larvæ & pupæ of *Zerynthia, Euthalia,* & *Caligo,* all unfamiliar to Japan. [T.I.]

Iwase, Taro, "Lessons from here and there (4)" [in Japanese]. *Trans. lep. Soc. Japan,* vol.3, p.6, 2 figs. 1952. Larva & pupa of American *Megathymus,* unfamiliar to Japan. [T.I.]

Iwase, Taro, "Lessons from here and there (6), (7)" [in Japanese]. *Trans. lep. Soc. Japan,* vol.4: p.6, 3 figs.; p.19, 3 figs. 1953. Pinnacle of eggs and sword-shaped horned pupa of *Papilio demolion* (Java), and monkey-faced pupæ of *Spalgis* and *Feniseca.* [T.I.]

Iwata, Kunio, "Biology of ichneumon parasites on bag-worms in Japan, I." *Trans. Kansai ent. Soc.,* vol.15, part 1: pp.35-47, 5 figs. 1950. Parasites of *Cryptothelea formosicola, C. minuscula,* & *Canephora asiatica.* Figures anterior ends of larvæ. [P.B.]

Jacobson, L. A., "Effects of starvation on larvæ of the Pale Western Cutworm, *Agrotis orthogonia* Morr. (Lepidoptera: Phalænidæ)." *Canad. Journ. Zool.,* vol.30: pp.194-200, 4 figs. 1952. Mortality porportional to size of larvæ & inversely proportional to temperature, but individual differences are marked. Importance of starvation in control is discussed. [P.B.]

Jäckh, Eberhard, "Schutzvorrichtung zum Bau des Verpuppungskokons bei Arten der Gattungen *Bucculatrix* Z. und *Lyonetia* Hb. (Lep., Lyonetiidæ)" [in German]. *Zeitschr. wiener ent. Ges.,* vol.40: pp.118-121, 206, 4 pls. 1 fig. 1955. Larvae of *B. ulmella* seen to erect 'palisade' of silk bristles around cocoon site (isolated larvæ excepted); larvæ of *L. clerckella* built loose net of silk at one end of cocoon site. Structures supposed to protect larva against disturbance during cocoon spinning [P.B.]

Jakob, Otto, "Die Zucht von *P. apollo* ex ovo im schlesischen Flachland" [in German]. *Ent. Nachrichtenbl.,* Burgdorf, vol.2: pp.49-50. 1948. Describes rearing *Parnassius apollo* & *P. delius* on *Sedum album* & *S. maxima.* [P.B.]

Jakob, Otto, "Sommerschlaf verschiedener, bekannter Tagfalter" [in German]. *Ent. Nachrichtenbl.,* Burgdorf, vol.2: p.31. 1948. On beginning of hibernation of *'Vanessa'* spp. & *Gonepteryx rhamni* immediately after spring eclosion. [P.B.]

Jakob, Otto, "Das Einsammeln bzw. die Zucht der Raupe con *Lim. populi*" [in German]. *Ent. Nachrichtenbl.,* Burgdorf, vol.2: pp.87-88. 1949. Notes on biology of *Limenitis populi.* [P.B.]

Jakob, Otto, "Das Vorkommen und die Aufzucht der Raupe ex ovo von *Pl. matronula*" [in German]. *Ent. Nachrichtenbl.,* Burgdorf, vol.3: pp.31-32. Describes rearing *Pericallia matronula* on *Taraxacum officinale.* [P.B.]

Janković, Lj., "Contribution to the knowledge of Gypsy Moth (*Lymantria dispar* L.) 1950" [in Serbian; English summary]. *Acad. Serbe Sci. XXXI, Inst. Ecol. Biogeogr.,* no.4: pp.139-147. 1953. Virgin ♀♀ no longer able to attract ♂♂ after 3 days but lay infertile eggs. In copulation ♂ usually on right side of ♀. Of 100 ♀♀, at death 40 had laid all eggs; remainder had from 1 to 31 unlaid eggs. [C.R.]

Janmoulle, E., "Note complémentaire sur *Gelechia rosalbella* Fol." [in French]. *Lambillionea,* vol.55: pp.85-86. 1955. Complementary note on life history of larva of *G. rosalbella.* [P.V.]

Janmoulle, E., & L. Sarlet, "Remarques sur la faune belge (suite)" [in French]. *Lambillionea,* vol.55: pp.100-101. 1955. Notes on *Pieris rapæ* & Geometridæ, principally in winter; records of 4 rarely recorded micros. [P.B.]

Jansson, Anton, "Studien über schwedischen Chalcididen. 2. Aus minierenden Kleinfliegen und Kleinschmetterlingen geschlüpften Arten" [in Swedish; German summary]. *Opusc. ent.,* vol.17: pp.1-10. 1952. Records parasites reared from mining spp. of *Eriocrania, Lithocolletis, Phyllocnistis, Nepticula,* & *Dyseriocrania.* [P.B.]

Jansson, Anton, "Studier över svenska chalcidider. 3. Kläckta arter" [in Swedish; German summary]. *Ent. Tidskr.,* vol.73: pp.178-182. 1952. Includes notes on parasites of *Pachnobia rubricosa* and *Eupithecia innotata.* [P.B.]

Jansson, Anton, "Studier över svenska chalcidider. 4. Kläckta arter 2" [in Swedish; German summary]. *Ent. Tidskr.,* vol.75: pp.255-265, 1 fig. 1954. Records of parasites of *Eupithecia* spp., *Catoptilia syringella,* undetermined psychid. [P.B.]

Jarvis, F. V. L., "Larval diapause in *Apatura iris* (Linn.)" *Ent. Rec. & Journ. Var.,* vol.66: pp.212-217, 237-240. 1954. Describes egg & larval stages. Wintering diapause takes place during 3rd (of 5) instar; the diapausing larva develops a protective color pattern which varies with the background. Onset & termination of diapause are described. [P.B.]

Jeffers, William Aloysius, "Influence of atmospheric humidity during the prepupal and pupal stage of the Southern Armyworm, *Prodenia eridania,* using air-dried peat moss as a pupation medium." *Ohio State Univ. Abs Masters' Theses,* no.71: p.117. 1954. Abstract.

Jenkins, L., & G. W. Thomas, "European Corn Borer attacking cotton in Missouri." *Journ. econ. Ent.,* vol.49: pp.270-271. 1956. *Pyrausta nubilalis* attacking cotton stems & bolls. [W.C.]

Jinta, Ryutaro, "Oviposition of *Satyrus dryas bipunctatus* Motschulsky (Satyridæ)" [in Japanese]. *Shin Konchu,* vol.3, no.10: pp.22-23, 1 fig. 1950. Drops eggs among grasses like European *Eumenis.* [T.I.]

Jinta, Ryutaro, "Hibernation of (adult) *Curetis acuta paracuta* de Nicéville (Lycænidæ)" [in Japanese]. *Shin Konchu,* vol.4, no.13: pp.17-18, 4 figs. 1951.

Jinta, Ryutaro, "Life-history of *Polytremis pellucida* Murray (Hesperiidæ)" [in Japanese]. *Shin Konchu,* vol.4, no.1: pp.12-14, 3 figs. 1951. Foodplant: *Pleioblastus chino.* [T.I.]

Johansen, Carl A., "History of biological control of insects in Washington." *Northwest Sci.,* vol.31: pp.57-59. 1957. Notes on naturally occurring parasites of *Malacosoma* spp., *Argyrotænia citrana, Archips argyrospila, Carpocapsa pomonella,* & *Bembecia marginata.* Records of introduction of parasites for control of various insects. [P.B.]

Johnson, G. F., "On rearing *Brachionycha nubeculosa* Esper." *Ent. Rec. & Journ. Var.,* vol.66: pp.102-103. 1954.

Johnson, J. H., "Larval coloration of *Deilephila elpenor.*" *Ent. Rec. & Journ. Var.,* vol. 64: pp.145-146. 1952. Data on color change from green to brown in reared brood. [P.B.]

Johnson, J. H., "Sexual selection in *Lasiocampa quercus* L. f. *callunæ* Palmer." *Ent. Rec. & Journ. Var.,* vol.65; pp.258-259. 1953. Reports ♀ refusing to mate with some 40 ♂♂ before accepting one. [P.B.]

Jones, Verna, & P. W. Richards, "Biological flora of the British Isles. *Saxifraga oppositifolia* L." *Journ. Ecol.,* vol.44: pp.300-316, 2 figs. 1956. Larval foodplant of *Orphne tenebrariá* (in Alps). [P.B.]

de Jong, D. J., "Preliminary investigations on apple and pear leaf rollers" [in Dutch; English summary]. *Meded. Direct. Tuinbouw,* vol.14: pp. 131-150, 14 figs. 1951. Biology & control of *Capua reticulana.* [P.B.]

de Jong, J., "Early worminess in apple" [in Dutch; English summary]. *Meded. Direct. Tuinbouw,* vol.19: pp.100-104, 10 figs. 1956. Biology of *Pammene argyrana.* [P.B.]

Judd, W. W., "*Cacœcia melaleucana* Walker (Lepidoptera; Tortricidæ) and its hymenopterous parasites reared from *Trillium gradiflorum* (Michx.) Salisb." *Trans. Amer. Micr. Soc.,* vol.71: pp.125-128. 1952. Records 1 braconid and 2 ichneumonid parasites. [P.B.]

Judd, W. W., "*Dicymolomia julianalis* Walker (Lepidoptera: Pyralidæ) and its ichneumonid parasite, *Cremastus gracilipes* Cushman, reared from *Typha latifolia* at London, Ontario." *Ent. News,* vol.65: pp.73-75. 1954.

Judd, W. W., "Four species of leaf-tying moths and their dipterous and hymenopterous parasites reared from mayapple, *Podophyllum peltatum* L." *Trans. Amer. micr. Soc.,* vol.73: pp.401-404. 1954. Records *Macrobotys æglealis, Hyponomeuta multipunctella, Archips melaleucana, A. purpurana.* [P.B.]

Judd, W. W., "Grasshoppers (Acrididæ) and caterpillars (Arctiidæ) impaled on thorns by shrikes in the vicinity of London, Ontario." *Ent. News,* vol.66: pp.225-229, 5 figs. 1955.

Judd, W. W., "*Hyponomeuta multipunctella* Clemens (Lepidoptera: Hyponomeutidæ) and its dipterous and hymenopterous parasites." *Trans. Amer. micr. Soc.,* vol.74: pp. 265-267. 1955. Foodplant probably *Euonymus;* 3 parasites recorded. [P.B.]

Julliard, Charles, "Le parasitisme des chrysalides de *Vanessa urticæ* en Valais et au Saentis [in French]. *Mitt. Schweiz. ent. Ges.,* vol.25: pp.49-55. 1952. Records various parasites and discusses factors affecting rate of parasitization. Also speculates on causes of variation in pupal color, and reports toxicity of butterfly meconium to chrysalids & their parasites. [P.B.]

Kaç, Arnold, "Poznámky k speciální akci hubení můry osenní" [in Czech; Russian summary]. *Ochrana Rostlin,* vol.19/20: pp.87-88. 1948. Some remarks on the control of *Agrotis segetum* in Bohemia. [J.M.]

Kalandadse, L. P., "Development of the pest insect fauna on the tea plant in the USSR" [in Russian; English summary]. *Ent. Obozrenie,* vol.35: pp.637-647. 1956. Lepidoptera attacking tea include *Parametriotes theæ* (also on camellias) and a variety of general feeders (especially Tortricidæ). [P.B.]

Zimmerman, Berthilde, "Beitrag zur Kenntnis des Entwicklungszyklus des Apfelwicklers, *Cydia pomonella* L., mit besonderer Berücksichtigung der zweiten Generation" [in German]. *Zeitschr. angew. Ent.,* vol.39: pp.259-301, 20 figs. Phenology of all stages in Bonn, Germany; control measures. [P.B.]

Znoiko, N. V., "Vrediteli semyan zheltoy akatsii" [in Russian; Insects injurious to Caragana]. *Ent. Obozrenie,* vol.32: pp.49-55. 1952. Observations in the south of the European part of the USSR. Among other insects, the injury by *Etiella zinckenella* is described. [N.O.]

Zoebelein, Gerhard, "Der Honigtau als Nahrung der Insekten. Teil I" [in German]. *Zeitschr. angew. Ent,* vol.38: pp.369-416, 16 figs. 1956. Records *Epiblema tedella, Phalonia hartmanniana, Laspeyresia strobilella, Atolmis rubricollis, Lithosia deplana, Mamestra fulminea,* & *Melitæa aurinia* (adults) feeding on sugary secretion of certain Homoptera. [P.B.]

Zwölfer, Helmut, "Zur Kenntnis der Parasiten des Tannentriebwicklers *Choristoneura* (*Cacœcia*) *murinana* Hb. Teil I" [in German]. *Zeitschr. angew. Ent.,* vol.39: pp. 387-409, 5 figs. 1956. Lists numerous parasites & analyzes their frequency & contribution to mortality in early stages. [P.B.]

Zwölfer, H., & M. Kraus. "Biocœnotic studies on the parasites of two fir- and two oak-tortricids" [in English; German summary]. *Entomophaga,* vol.2: pp.173-196, 3 figs. 1957. Study of parasites of *Cacœcia murinana, Eucosma rufimitrana, Archips xylosteana,* & *Tortrix viridana,* and of interrelationships between hosts, parasites, & hyperparasites, in an area near Ribeauville, France. [P.B.]

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Yamafuji, K., H. Omura, & M. Miura, "On the transoximase" [in English; German summary]. *Enzymologia,* vol.16: pp.75-80. 1953. In *Bombyx mori.* [P. B.]

Yamafuji, K., M. Eto, & F. Yoshihara, "Uric acid in nuclear preparations from Silkworms" [in English; German summary]. *Enzymologia,* vol.17: pp.297-299, 1 pl. 1956.

Yamafuji, K., K. Hirayama, & A. Miyata, "Depolymerization of desoxyribosenucleic acid by virus inducer and Silkworm enzyme" [in English; German summary]. *Enzymologia,* vol.17: pp.352-358, 3 figs. 1956.

Yamafuji, K., K. Hirayama, & M. Sato, "Desoxyribonuclease in Silkworms treated with virosis inductors" [in English; German summary]. *Enzymologia,* vol.18: pp.22-27. 1957.

Yamafuji, Kazuo, & Katsuhide Hirayama, "Nucleases and proteases in Silkworms in the early stage of viral infection and chemical induction" [in English; German summary]. *Enzymologia,* vol.18: pp.120-124. 1957.

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ADDITIONS TO THE RHOPALOCERA OF AFGHANISTAN WITH DESCRIPTIONS OF NEW SPECIES AND SUBSPECIES

by COLIN W. WYATT

In 1960 I collected in three different mountain ranges in Afghanistan, in the Koh-i-Baba Mts. during June, the Shiva Mts. in northern Badakhshan during the last half of July, and the Afghan Hindu-Kush in early August. I also had two days in the Paghman Mts. at the end of August. In these areas three main faunal divisions meet, that of Iran, mostly desert and semi-desert species, that of Turkestan with a normal continental mountain climate, and that of the Karakoram and the extension of the Himalayan Divide in N. Pakistan. The climate of Afghanistan strongly affects the latter two divisions, both having what we would consider normal rainfall. In Afghanistan, even in the high mountains, it does not rain for about five months. In 3½ months I had a shower of a few drops for about 5 minutes very late on one evening only.

The Koh-i-Baba Mts. form an isolated massif in the center, running up to about 17,000 ft., and contains several endemic species. CLENCH and SHOUMATOFF of the Carnegie Museum have worked on certain late summer material from here, but no spring material has previously been obtained. The Shiva Mts. are connected up with the glaciated peaks of Afghan Darwaz and are only separated from the Pamirs by the River Oxus, with whose fauna they have much in common. The Hindu-Kush is a vast range with many sub-ranges, and generally speaking forms the western boundary of the Chitral and Karakoram fauna, although a few species come over. A few Pamir elements come south into it, and a very few endemic Afghan forms come eastwards to it.

Descriptions and comments follow, on taxonomically important finds.

PAPILIO ALEXANOR HAZARAJATICA Wyatt, NEW SUBSPECIES

This species has not hitherto been recorded from Afghanistan, although it is known from the south side of the border, north of Quetta in Baluchistan. This area is not palæarctic, and other forms from both areas show quite marked differences. I took the species freshly emerged on the nothern slope of the Koh-i-Baba Mts., unfortunately only males.

HOLOTYPE ♂: Joshanak Valley, S. of Band-i-Amir, W. Koh-i-Baba Mts., 9500 ft., 14 June 1960.

While superficially of the same size and coloration as the typical form, this race is at once distinguished as follows:—

Forewing: Black marginal band very narrow, about half the width of all other races. As a result, the yellow band between it and the submarginal is extremely wide and even, with only the faintest trace of black scaling along the veins. The submarginal band differs from all other races in being much wider near the base than at the apex, the exact opposite to the normal, with a large inward bulge between M_1 and M_3 heavily powdered with yellow scales. Central cell band normal, but center strongly powdered with yellow scales. Black bar at end of cell narrow, Length of forewing 33 mm.

Hindwing: — Basal and innermarginal black much as in type, narrower than in *maccabæus* Stgr. and even than in *orientalis* Rom. Central band strongly defined, much as in type. End cell spot small and light, not reaching to end of cell. Submarginal band greatly widened basally from M_3, and strongly powdered basally with yellow. Marginal lunulæ large and evenly curved. Anal spot very small, the upper blue half being much larger than the lower orange half, which is even more reduced than in *orientalis*. Dividing black bar strongly defined. Tail shorter than in all other races.

Underside normal, except for width of bands, etc.

HYPERMNESTRA HELIOS ARIANA Wyatt, NEW SUBSPECIES

New record for Afghanistan, though this species also has been recorded with *P. alexanor* from same areas in Baluchistan, as *balucha* Mre., from which *ariana* is distinct.

HOLOTYPE ♂: Bamian, N. of Koh-i-Baba Mts., 8,300 ft., 4-7 June 1960.

ALLOTYPE ♀: Bamian, N. of Koh-i-Baba Mts., 8,300 ft., 4-7 June 1960.

This fine race stands between *bushirica* O. B-H. and *persica* Neub., but is larger than both, and also larger than *balucha*. While not quite as strongly marked as *persica*, it is more so than *maxima* Gr. Grsh., especially in the ♂.

Forewing: Costal spots very heavily surrounded with black. Discal spots large and almost equal in size. Red in costal spots well developed. Compared to *balucha* the antemarginal band is longer, while the end cell spot is as large as the middle spot. There is a strong tendency towards *fasciata*-markings in the female. Ground color creamy white. Length of forewing in ♂ 25 mm., in ♀ 27 mm. on average.

Hindwing: Ocelli well developed and almost always red-centered, but with strong black surrounds. This is hardly ever the case with either *bushirica, persica,* or *christophi* O. B-H.

Underside with rich greenish-yellow markings and large pink spots, including anal spots, within the normal range of variation; the characteristic of this form is however the very noticeable silvery sheen, or shine, on all white areas, which is most unusual.

Out of a series of 56, 2 have spots yellow, 2 have costal spots f. w. and ocelli h. w. all black, 3 have ocelli h. w. only all black, 1 has costal spots only all black. All males.

Parnassius charltonius voigti O. Bang-Haas

OTTO BANG-HAAS described this race in *Horæ Macrolepidopterologicæ* I from 7 ♀♀, taken on the An-Suchas Pass in the Paghman Mts. just north of Kabul. In May 1959, in *Parnassiana Nova* XXVI, CURT EISNER described a single male as the presumable allotype of *voigti,* which he had obtained from the Oberthür Collection and which bore only the locality: "Afghanistan".

I took a series of 10 ♂♂ and 4 ♀♀ on the Kotandar Pass in the Paghman Mts., which is probably synonymous with the An-Suchas Pass. They are, in any case, topotypes. I could find no trace of the An-Suchas Pass on any map, even military, nor did any local people know of it. However, both Kotandar Passes, (on same divide but separated by a small peak), lead into the Surkh Valley, as shown on the map, so "An-Suchas" can probably be interpreted as "leading to Surkh".

All my males differ in almost all respects from EISNER's male, and in my opinion his male, if indeed it really came from Afghanistan, probably came from the mountains of Darwaz close to the Pamirs, since it appears to me to be most closely related to the Pamir forms *vaporosus* Avin. and *romanovi* Gr. Grsh. The greatest discrepancies between EISNER's ♂ and mine are the wing-shape (mine are much squarer), size of cell spots, reduced and black costal ocellus on h. w., the *fasciata*-band.

My specimens appear superficially (except for ground color) closest to *wernickei* Kotzsch, which is understandable as this is geographically the nearest race, but show very strong differences, which is natural in view of the isolation of the Paghman Mts.

This race, *voigti,* is immediately noticeable in the male for the narrowness of the submarginal and costal bands on forewing, coupled with the exaggeratedly large cell spots and the heavy adumbration at base of wing. All markings stand out more, and are more contrasting, than in *wernickei,* while the ground color is whiter and the scaling far denser. I thus feel justified in describing the male of *voigti* here, and of making one of my series the allotype, in view of the fact that mine are topotypical and also of the great discrepancies in appearance between EISNER's male and my series. For this, I hope my very good friend CURT EISNER will forgive me!

ALLOTYPE ♂: Kotandar Pass, Paghman Mts., Kabul, 10-12,500 ft., 26-28 August 1960.

Forewing: Cell spots disproportionately large, and usually joined beneath by a strong black scaling along lower vein of cell. Marginal glass-band well developed and reaching to inner margin. Submarginal band narrow and sinuous, narrower than in any of the neighboring races except *romanovi,* usually ending at M_1, but with a grey submarginal spot separated from it in the interneural space below. *Fasciata*-band always well developed, but seldom forming a heavy black triangle below cell like the Indian races, while the hindmarginal spot is usually recognizable as a diffuse spot rather than as the end of a band. Strong dusting of black scales along inner margin from base to hindmarginal spot. Basal black dusting very strong and coming so close to cell as to strongly reduce the width of the basal white bar by cell. Ground color creamy-white, very densely scaled. Length of forewing: 31 mm.

Hindwing: Marginal glass-band clear, about 1 mm. wide, and continuous, though black scaling is sparse at veins. Submarginal band narrow and very thinly scaled, appearing grey as against the normal black. Blue ocelli four to five in number, through the fifth is usually a mere black dot. The black of these ocelli is reduced to an outer half-moon only, the inner half being thickly scaled a very pale blue, paler than usual, and appearing almost to fade into the grey submarginal band. Central ocellus small, almost round, with extremely heavy black surround, especially below, where it is so thick as to give the ocellus a slightly oval appearance. Small white center. Costal ocellus in 6 out of 10 males small and all black, and while three others show a very tiny red center to it, only one out of the 10 can be said to have a normal red costal ocellus. Anal spots always without red, although on 2 a few red scales can be seen with a lens. Innermarginal black strongly developed, reaching to, and sometimes enclosing, the end of the cell. *Siegeli*-spot beneath strong, usually also scaled with black on upper side of wing. The cell beneath is completely surrounded with black, and closed by a very heavy black bar.

PARNASSIUS TIANSCHANICUS SHIVA Wyatt, NEW SUBSPECIES

This race belongs to the *superba* group and stands between *superba* Gr. Grsh. and *maureri* Avin. It is the smallest known *tianschanicus* race, almost 50% of the 90 specimens taken being the same size as the *jacquemontii* flying a bit higher up. They were taken below the so-called Kars Pass in the Shiva Mts. of N. Badakhshan, almost on the borders of Darwaz, about 2 miles west of the S. W. end of the Lake Shiva, which is marked on most maps. It is extremely variable in both size and color; I took 12 very strong f. "nigricans", some almost completely black.

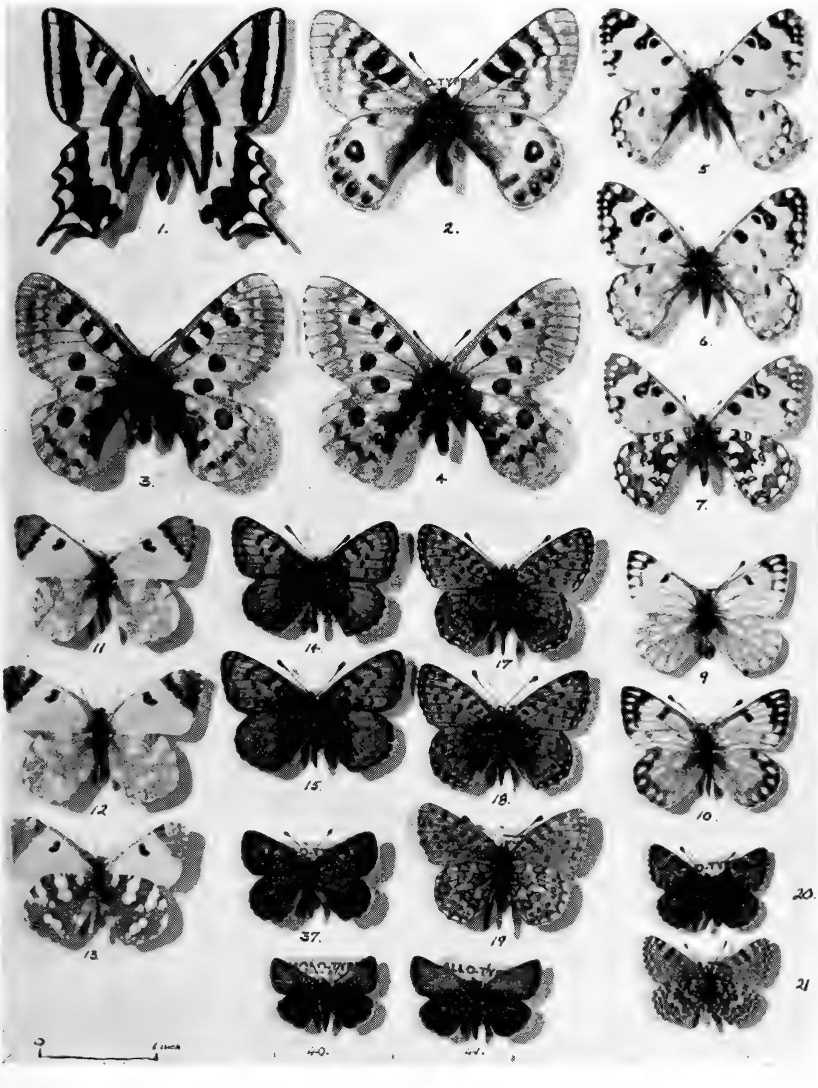
HOLOTYPE ♂: Kars Pass, Shiva Mts., N. Badakhshan, 11,000 ft., 23-25 July, 1960.

ALLOTYPE ♀: same data as Holotype.

Forewing: Whole wing covered with a very characteristic grey powdering. Wide marginal glass-band to inner margin. Very light submarginal band, which in most cases fades imperceptibly into the general grey discal powdering. It often ends at M_2, and is sometimes obsolescent. Very little basal black. Usually 3 red spots, but hindmarginal spot often black.

Hind wing: Very light marginal and submarginal bands, the marginal especially indistinct and often appearing to merge into general grey powdering. Small anal ocelli almost invariably black. Only 5 ♀♀ show traces of red in basal anal ocellus.

Length of forewing in largest ♂ 35 mm., in smallest 27 mm.; ♀♀ average 34 mm., ♂♂ 31 mm.



1) *Papilio alexanor hazarajatica* ♂ Holotype; 2) *Parnassius charltonius voigti* ♂ Allotype; 3) P. tianschanica shiva ♂ Holotype; 4) same, ♀ Allotype; 5) *Hypermnestra helios ariana* ♂ Holotype; 6) same, ♀ Allotype; 7) same, ♂ Paratype, underside; 9) *Synchloe callidice hazara* ♂ Holotype; 10) same, ♀ Allotype; 11) *Zegris fausti lucullus* ♂ Holotype; 12) same, ♀ Allotype; 13) same, ♂ Paratype, underside; 14) *Melitæa shandura apsara* ♂ Holotype; 15) same, ♀ Allotype; 17) *Boloria hegemone houri* ♂ Holotype; 18) same, ♀ Allotype; 19) same, ♂ Paratype, underside; 20) *Melitæa kuchi* ♂ Holotype; 21) same, ♂ Paratype, underside; 37) *Lycæna æolus* ♀ Holotype; 40) *Thymelicus lineola kushana* ♂ Holotype; 41) same, ♀ Allotype. [Numbers 8, 16 are omitted.]

ZEGRIS FAUSTI LUCULLUS Wyatt, NEW SUBSPECIES

New record for Afghanistan. This race is the same size as the typical form, but has a very noticeably larger red apical patch to forewing, which makes it outstandingly beautiful. This is chiefly due to a strong reduction of the black bar beneath the apical patch, at times only a thin pencilling. Cell spot smaller than in type.

HOLOTYPE ♂: Band-i-Amir, Hazarajat, N. of Koh-i-Baba Mts., 95-10, 500 ft., 9-11 June 1960.

ALLOTYPE ♀: Band-i-Amir, Hazarajat, N. of Koh-i-Baba Mts., 95-10, 500 ft., 9-11 June 1960.

The female is closer to the typical form, but contrary to the male has *less* red in apex than the typical female, and with a generally larger blackish apex. Basal black bar of apex narrower, as in male.

Beneath, the white spots of hind-wing are distinctly smaller than in the type, especially those along inner margin. The extended darker areas are a rich yellowish-green, smoother in color and with fewer striations, greener than type. Apical pink spot to forewing is both narrower and shorter than in type, with distally a strong powdering of green and black scales.

SYNCHLOE CALLIDICE HAZARA Wyatt, NEW SUBSPECIES

While I took as expected the normal-sized *hinducucica* Vrty. in late July in the Hindu-Kush, I never expected to find the species in early June in a definitely sub-alpine and semidesert area of low hills, the northern foothills of the Koh-i-Baba Mts. I only found it on the long summit ridges, flying over hot stones and sage brush, a most extraordinary habitat for this species.

HOLOTYPE ♂: Band-i-Amir, Hazarajat, N. of Koh-i-Baba Mts., 11,400 ft., 9-11 June 1960.

ALLOTYPE ♀: same data as Holotype.

Apart from very small size, the characteristics of this race are the strongly pointed forewing in both sexes, the greatly reduced submarginal bands, and reduced cell spots. These bands in male are very faint, and the lowest spot is not really a spot, but a thin line of not very solid color. In the female the hindmarginal black spot is so reduced as to be barely indicated, while on the hindwing the marginal white spots are smaller, and the black along the veins more extensive. The basal black dusting is very greatly reduced, and there is none at end of cell.

Length of forewing: male 20 mm.; female 20 mm.

MELITÆA SHANDURA APSARA Wyatt, NEW SUBSPECIES

This extremely rare species was originally described by EVANS from the high mountains of Chitral. It is a very high altitude scree and moraine species, and in habitat and habits greatly resembles the nearctic *M.*

damœtas. I took the typical form at about 14,300 ft. in the Hindu Kush Mts., but I also took a few specimens of a strikingly different race in the Shiva Mts.

HOLOTYPE ♂ : above Kars Pass, Shiva Mts., N. Badakhshan, 12,500-14,000 ft., 22-24 July 1960.

ALLOTYPE ♀ : same data as Holotype.

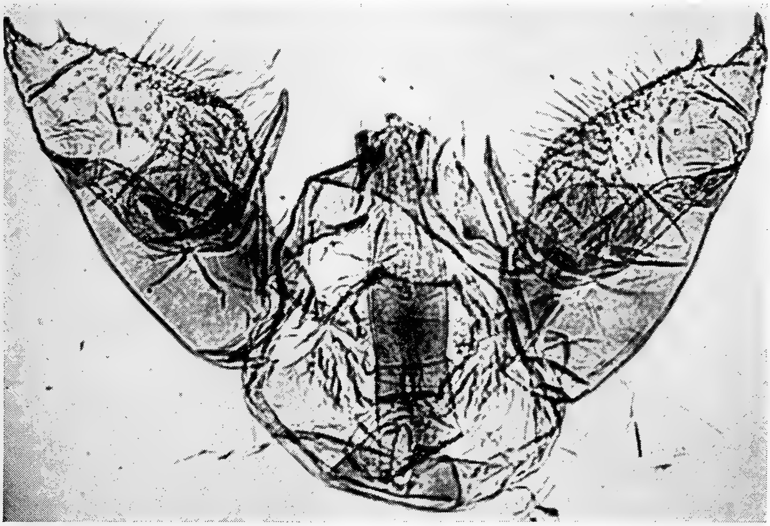
This race is of a deeper yellow than the type, and all black markings are strikingly reduced, especially on forewing, where the central band of spots is barely a third the size of that of the type. The black scaling obscuring the yellow basal areas is greatly reduced, so that these stand out strongly. The marginal band is so reduced that the antemarginal yellow spots form almost a band. The hindwing more closely approaches the type, but the submarginal band is very strongly reduced, especially towards the apex; in some males it is obsolescent, and practically lacking in the female.

The underside shows little difference other than in size of spots, but is much more yellow than in the type.

Length of forewing: ♂ 20 mm.; ♀ 22 mm.

MELITÆA KUCHI Wyatt, NEW SPECIES

This beautiful little species at first sight appears like a miniature *lutko mimetica,* which may perhaps partially explain why I took so few specimens and no females. It occurs at higher altitudes and emerges later.



Male genitalia of *Melitæa kuchi.*

HOLOTYPE ♂: Band-i-Amir, Hazarajat, N. of Koh-i-Baba Mts., 11,500 ft., 9-11 June 1960.

This species is more uniform and slightly darker in color than *lutko mimetica,* and the costal spots are reduced in size. There is a strong marginal band, especially towards the apex, which is proportionately much heavier than in *lutko.* On the hindwing, the marginal band is less dentate, as is the more strongly defined submarginal band of spots. While the black basal scaling is heavier, the black spots which *lutko mimetica* shows at outer end of the cell are here to all intents and purposes non-existent. Generally speaking the species is much more neatly and regularly marked than *lutko.*

On the underside the same applies as to forewing spotting, except that the discal and hindmarginal spots are absent. The hindwing is very similar to that of *l. mimetica,* but all markings are neater, the black edging to the bands is greatly reduced, and there are much larger white markings basally.

Length of forewing: 14 mm.

BOLORIA HEGEMONE HOURI Wyatt, NEW SUBSPECIES

I most unexpectedly came across this species freshly emerged at about 14,300 ft. in the Hindu Kush Mts., flying on almost completely barren old moraines, in company with *Melitæa shandura.* Having no previous field experience of the species, I cannot say whether this is its normal habitat, but it is so much higher than my typical series from Turkestan, that I doubt it. Due to the very different wing shape we may be dealing with a new species, related to *hegemone* as *B. græca* is to *B. pales,* but I shall have to leave further examination to a later date.

HOLOTYPE ♂: Bala Quran, Anjuman Valley, Hindu Kush Mts., Afghanistan, 14,300 ft., 4 August 1960.

ALLOTYPE ♀: same data as Holotype.

In this form the forewing is concave towards the outer angle, while in typical *hegemone* it is normally rounded. The spotting is as in *hegemone,* but all spots are larger and more distinct, with the exception of the fourth antemarginal spot which is smaller, thus giving a characteristic feature. Hindmarginal spot large, and two well-formed spots below cell. Basal black dusting almost absent. All lunulæ in marginal band are whitish, contrasting strongly with the main ground color; this occurs on both wings, and is most striking and unusual. The hindwing is also as in *hegemone* but squarer, with distinct anal angle and all spots larger except those of the margin which, however, is much heavier at apex and clearly encloses here a long, whitish-yellow spot. Basal black dusting greatly reduced, showing large yellow areas, but the outer basal black spots are larger. There is a marked black line along the inner margin on the male. Light spots in marginal band whitish as on forewing.

The female resembles the male, with much less difference between the sexes than in *hegemone* type.

On the underside the spotting is proportionately as above, but the apical area of forewing has the ground color a pale straw-color, contrasting with rest of wing; in *hegemone* from Turkestan the ground color beneath is unicolorous. On the hindwing there is a greenish tinge about the base, and all the markings which in *hegemone* are brown are here a light orange, while the submarginal pale band is more suffused with the pale straw-color. The light, whitish markings of *hegemone* are here not only distinctly whiter, but silvery.

Length of forewing: ♂ 22 mm.; ♀ 22 mm.

PARARGE EVERSMANNI SHIVA Wyatt, NEW SUBSPECIES

HOLOTYPE ♂ : Shiva Mts., N. E. Badakhshan, 9,000 ft., 20 July 1960.
ALLOTYPE ♀ : same data as Holotype.

Noticeably smaller than the typical form and much less heavily marked in female, so that the two sexes are very similar. Markings similar to type, but marginal black of all wings reduced. Black cell spot considerably thinner and of almost even width throughout, *not* extended into cell along upper vein as in type. This also applies to female, though less obviously.

Beneath, pattern similar to type but whole coloration is paler. On forewing all black markings are smaller and neater, border narrower below apex and color of apex much lighter, a pale brownish grey. Hindwing, pattern similar, but whole wing is of a general pale grey appearance, as against brown in the type. Median band very light yellowish-grey, strikingly bordered with very dark brown. In type this border is hardly visible. Outer edge of band less jagged, and lacks the sharp white "tooth" jutting in towards cell, this being replaced by an indentation, which is often distributed evenly over the interneural space below as well. Base pale grey. All white markings stand out far less than in type.

Length of forewing: ♂ 22 mm.; ♀ 24 mm.

Karanasa voigti O. Bang-Haas

This species was described by OTTO BANG-HAAS in *Horæ Macrolepidopterologicæ* I: p.50, from one unique female, as a race of *K. huebneri* Feld. AVINOFF and SWEADNER, in "The Karanasa Butterflies", *Annals Carnegie Museum* 32: p.47, classify it as a good species, in the *bolorica* group. *K. voigti* and its race *nigrocellata* Av. & Sw. is only known from the two isolated but adjoining ranges of the Paghman and Koh-i-Baba Mts., which show several faunistic affinities.

HEYDEMANN (*Zeits. wien. ent. Ges.* 39: 394) described one of two males taken by DELERE in Nouristan, N. E. Afghanistan, as the allotype of "*huebneri*" *voigti*. However, it is clear from both his description and illustration that this male is either a *pamira* or *bolorica* form, and I would classify it under *bolorica hodja* Av. & Sw. This form flies in a closely adjacent area of the Hindu Kush, and I took a series myself in the same range as the Nouristan part of the Hindu Kush, with which HEYDEMANN's male agrees, although from the illustration his is more brightly marked, but he remarks that his two males differ. This may well be the case, as his were almost certainly taken on the S. E. slope, while mine were on the N. W. slope. I took a series of topotypes of *K. voigti* in the Paghman Mts., one male of which I therefore describe as the true allotype of the species.

ALLOTYPE ♂: Kotandar Pass, Paghman Mts., Kabul, 12,000 ft., 27 August 1960.

Forewing: Band a dirty orange-yellow, fading imperceptibly into a dirty pale yellow immediately below apical ocellus, which bears a minute white pupil. Paler in cell, with a tendency to form a pale orange smear at end of cell. Outer edge of yellow band slightly scalloped. Usually two ocelli, but the lower is often reduced in size, and in one of my males is absent.

Hindwing: Marginal band very wide, wider than in *bolorica*. Yellow band a uniform dirty orange, becoming obscured towards anal angle. Outer edge very strongly dentate, the marginal band projecting inwards along the veins in long, sharp teeth. Inner edge evenly curved except for indentation opposite end of cell. Whole basal half of wing evenly colored.

Underside: The great characteristic of the male *voigti* as against all other *Karanasa* known to me, is the very unicolorous underside of the hindwing. The normal light inner edging to the central band, which is so distinct in *pamira* and to a lesser degree in *bolorica*, is so strongly suffused with brown that the entire band is rather inconspicuous. *The white scaling is absent from the veins*, in complete contradistinction to HEYDEMANN's figure. This is a most noticeable feature. There is sometimes traces of it only on the marginal band, and along the submedian, but none on the inner three-quarters of the wing. The powdering of black scales is very light and even, so that the wing appears very smooth in color and not brightly variegated as in the other species. Black striations reduced to a minimum, being few even in basal area. Edges of marginal band lightly but definitely outlined in greyish brown. In some specimens there is a general reddish-brown tone to the entire hindwing.

Forewing beneath has light band straw yellow, deeper in lower half with discal and basal area very evenly pale brown, lighter in cell which bears a few faint striations. Faint darker bar to close cell, but outer edge of median band has to all intents and purposes no dark border (*cf.* HEYDEMANN's figure). The same applies to marginal band, which is very narrow, pale greyish-brown, only weakly dentate along inner edge and only extremely faintly outlined by hair-like darker brown edging. Dark striations at base few and faint.

Length of forewing: 23 mm.

KARANASA PAMIRA KOTANDARI Wyatt, NEW SUBSPECIES

The most amazing *Karanasa* form described is *K. p. haslundi* Av. & Sw. from the Koh-i-Baba Mts., which I took just emerging in late June. I was surprised to find a similar form in August in the Paghman Mts., in spite of the close affinities of these two ranges. Unfortunately I only took males.

HOLOTYPE ♂: Kotandar Pass, Paghman Mts., Kabul, 11-12,500 ft., 25-28 August 1960.

Very close to *haslundi*, but smaller. Coloring is identical on upperside. Compared to *haslundi*, the inner edge of marginal band is very strongly dentate, projecting in large, even triangles into the deep orange-brown of the band, Veins across red band outlined in black. Single very large ocellus with minute white pupil. Hindwing unicolorous dark brown, although the pattern of the marginal band beneath shows through more distinctly than in *haslundi*.

Underside hindwing uniformly duller, central pale band strongly adumbrated with dark scales so that it is very indistinct, the white outer half more grey than in *haslundi.* White scaling along veins very greatly reduced and not noticeable, especially in basal half of wing. Marginal band very wide, the inwardly projecting teeth only thinly bordered with dark brown. The general appearance is duller and more uniform than *haslundi.* This appears to be a parallel development to that of *voigti v. supra.* Forewing also duller, marginal band a pale grey-brown, very lightly bordered with dark inwardly. Much pale scaling at apex. Central area of wing a dirty orange-brown, not a rich glowing brownish-red as in *haslundi,* darker towards base. There are no black lines on outward edge of median band, so that it is not divided in two as in *haslundi.*

Length of forewing: 25-26 mm.

KARANASA PAMIRA TWOMEYI Wyatt, NEW SUBSPECIES

This race is very close to *alpherakyi* Avin. from the E. Pamirs, but was taken in a sub-range of the Hindu-Kush well to the west and south of the Pamirs. About 120 miles further north I took the very different *K. p. kafir* Av. & Sw. in the Shiva Mts. of N. Badakhshan. Flying with *twomeyi* I took *K. bolorica hodja* Av. & Sw.

HOLOTYPE ♂: Bala Quran, Anjuman Valley, Hindu Kush, 11,000 ft., 3-6 August 1960.

ALLOTYPE ♀: Bala Quran, Anjuman Valley, Hindu Kush, 11,000 ft., 3-6 August 1960.

Male forewing: Marginal band narrow and very slightly dentate on inner edge. Basal area evenly dark grey-brown, but with a tendency in some males to be suffused with yellowish basally. Lighter in cell, with suffuse orange spot at end. Band ochreous, very variable; usually distinctly paler along inner edge, an ivory-yellow, but this color sometimes suffuses outwards across whole band. Outer half usually orange except around apical ocellus. All ocelli with faint white pupils, except occasionally in lower ocellus when this is reduced in size.

Male hindwing: Marginal band moderately dentate, less than in *kafir* but similar to the *bolorica* forms. Basal half of wing uniformly greyish-brown. Band pale ivory-yellow, but often suffused with orange in outer half. Very variable in width, and in one specimen the outer lower two-thirds of band are obscured with brown scaling from the marginal band. Inner and outer edges moderately dentate.

Female forewing: Marginal band narrow, with tendency towards obsolescence towards inner angle, and often suffused with orange scaling from band in center. Whole basal area of wings strongly suffused with orange, with yellowish scaling at base. Median band very variable, but usually appears merely as a suffused darker outer edging to basal orange suffusion, although always strongly marked at cell. Ocelli smaller than in most *Karanasa* females, faintly white pupilled.

Female hindwing: As in male but slightly wider and more suffused with orange, or at times with reddish-brown.

Underside of both sexes similar, although in female the central pale band is more obscured and the general tone of wing paler and more uniform, with black markings less distinct. Male forewing: Narrow marginal band, wider at inner angle, pale grey with very thin but distinct inner black border, moderately dentate. Band as on upperside but duller. Basal area almost concolorous with band, but with the median band faintly indicated in grey or orange-grey; in male this is distinctly separated from light band, but in female very indistinct. Very few basal striations in male, more in female. Hindwing: general tone greyish-brown (warmer in female), with pale marginal band which is darker towards fringe and inwardly bordered with thin dark brown line, moderately dentate. Central band with paler inner half sometimes fairly distinct; in male, and usually in female, this is suffused with grey-brown. Median band pale, only rarely standing out distinctly, lightly edged with dark on both sides. Base pale grey with many fine, and a few larger striations, in some males barely different in color to median band, and in female the same. Veins pale ochreous grey.

Length of forewing: ♂ 26 mm.; ♀ 28 mm.

Karanasa bolorica hodja Avinoff & Sweadner

This race was described in "The Karanasa Butterflies" by AVINOFF and SWEADNER (*Annals Carnegie Museum* 32: p.52) from 5 males collected in the Chodja Mahomet Range, N. E. of the Hindu Kush. The female was unknown. This summer I took a series of both sexes in the range immediately opposite the Chodja Mahomet, just across the narrow valley. In climate the two ranges are identical, and also apparently in composition, and harbor other restricted species in common, so I hereby designate one female as the allotype of *K. bolorica hodja.*

ALLOTYPE ♀; Bala Quran, Anjuman Valley, N. E. Hindu Kush Mts., Badakhshan, 11-12,500 ft., 3-6 August 1960.

Upperside as in the male, except that the bands are all of a deeper and more uniform orange except around the apical ocellus. Underside similar to the male, but more washed-out looking. On the forewing the outer edge of the median band is only extremely faintly and interruptedly delineated by a faint brown hairline, while on hindwing the markings are less clear cut, the black edgings to marginal and median bands fainter, while the hindwing as a whole has the appearance of being faintly but evenly dusted with dark scales.

Length of forewing: 23 mm.

PARALASA ASURA Wyatt, NEW SPECIES

This new species and the next fall slightly out of the normal facies of the genus, and would remind one of the genus *Argestina* Riley, were it not for the marked sexual dimorphism.

HOLOTYPE ♂: Bala Quran, Anjuman Valley, Hindu Kush, 13,000 ft., 3-6 August 1960.

ALLOTYPE ♀: Bala Quran, Anjuman Valley, Hindu Kush, 13,000 ft., 3-6 August 1960.

Male above deep sooty black. Apical ocellus indistinguishable except for small white pupil, which is larger than in the next described species. Forewing distinctly elongated, fringes checkered with white. Hindwing sooty black, scarcely scalloped, anal lobe slight. Fringes checkered with white. Beneath, forewing blackish brown suffused with dark chestnut down to M_1 and extending well into cell. Very large black apical ocellus with large white pupil. Marginal dark area very wide, strong yellow ring round ocellus. Hindwing dark grey-brown, strongly powdered with yellowish scales. Faint trace of median band, and six distinct but small *white* submarginal dots.

Female as in male, but with large pale chestnut suffusion on disk from end of cell, where it is cut off sharply, down to M_1, where it is still some 4 mm. wide. Apical ocellus small, black and without pupil, surrounded by a wide and very diffuse yellow ring. Hindwing dark greyish-brown, not scalloped, anal lobe vestigial. Fringes to both wings mainly grey, with only faint powdering of white between veins on hindwing, and hardly at all on forewing. Beneath similar to male but paler, and with more extended and paler suffusion. Small apical ocellus white-pupilled and surrounded by a large and clear yellow ring. Hindwing strongly powdered with yellow scales, dull wide unicolorous median band fairly well indicated, submarginal row of white dots very faintly indicated indeed, except for the apical and post-anal dots. Base dark, same color as median band.

Antenna with shaft ringed with white, knob black with faint grey area on lower (or costal) side of knob above, which becomes a white patch underneath.

Length of forewing: ♂ 25 mm.; ♀ 27 mm.

PARALASA SHAKTI Wyatt, NEW SPECIES

This species flies together with *P. asura* at its lowest levels, but is more frequent 2,000 ft. higher. While superficially very similar except in size, the two species can at once be distinguished by the antennæ.

HOLOTYPE ♂: Bala Quran, Anjuman Valley, Hindu Kush, 14,000 ft., 3-6 August 1960.

ALLOTYPE ♀: Bala Quran, Anjuman Valley, Hindu Kush, 14,000 ft., 3-6 August 1960.

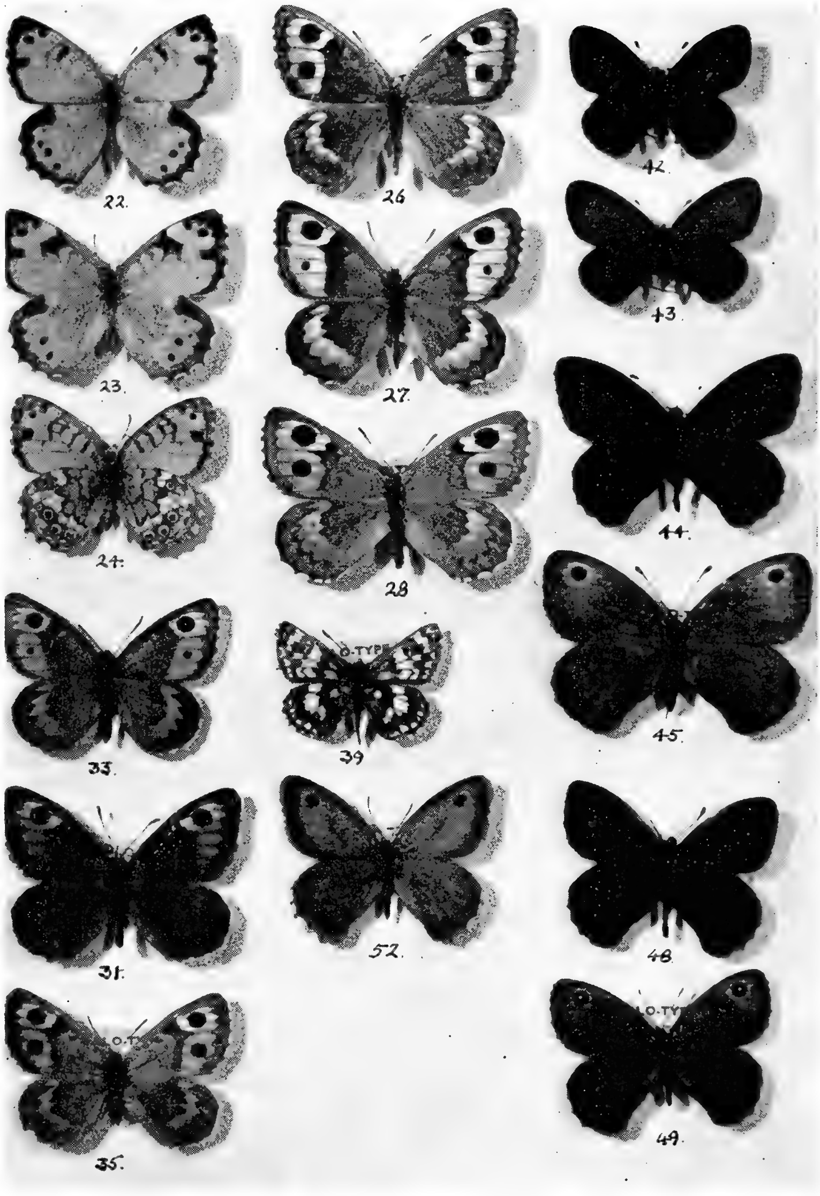
Male very square, upperside uniformly sooty black, against which the small apical ocellus can scarcely be distinguished except by its minute white pupil. Outer margin of hindwing very slightly scalloped, strong anal lobe. Fringes black, but checkered with white in central area of hindwing. A few white hairs can be seen with the lens between the veins on the forewing fringe.

Beneath, forewing blackish-grey suffused with deep chestnut brown in outer central area. Widely dark along hindmargin, moderately wide marginal band of ground color. Apex evenly dusted with yellow scales, and a strong pale yellow ring round the small apical ocellus. Hindwing beneath dark grey, uniformly dusted with yellow scales and with a very faintly indicated submarginal row of six *yellowish* dots. Median band is non-existent, but there is a slightly stronger yellowish dusting of scales in what would be the area beyond its lower half.

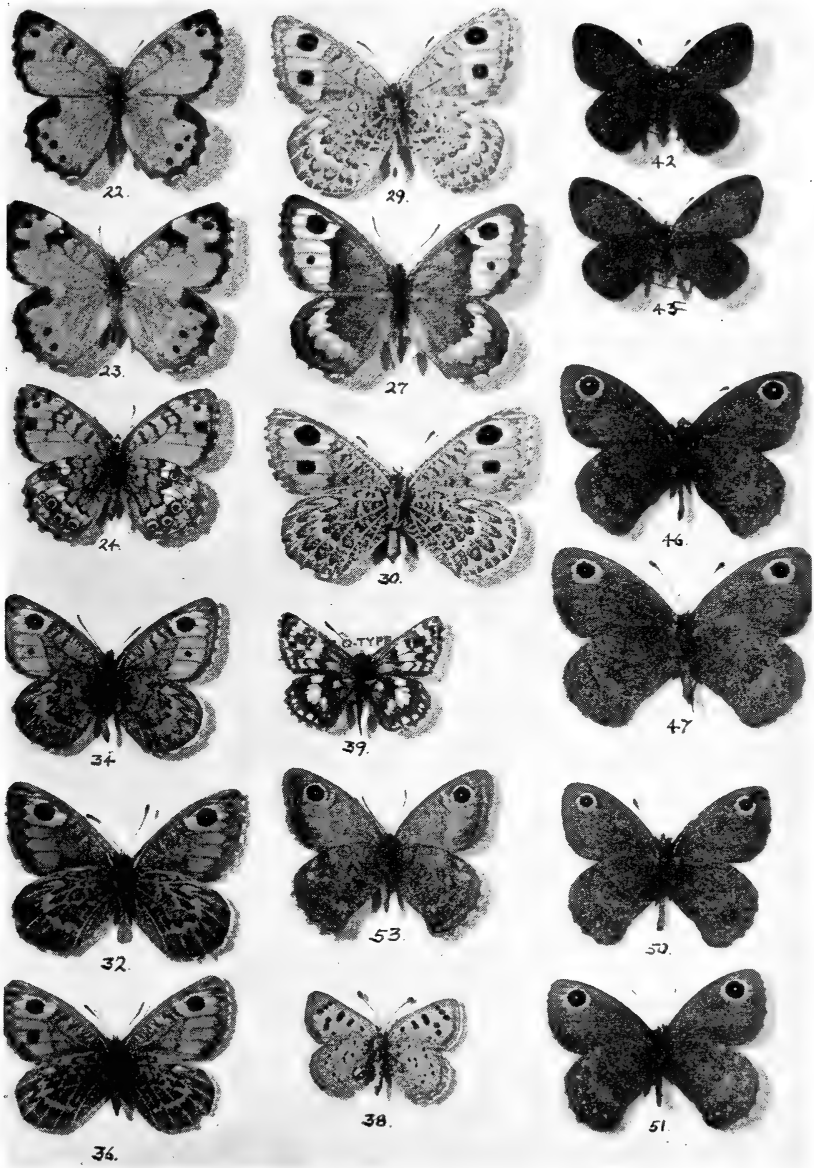
Female a dark blackish-brown with medium-sized apical ocellus, white pupilled, set in a small deep chestnut-brown patch which is suffused downwards to M_2 and faintly edged with yellow above. Hindwing dark blackish-brown, barely scalloped. Fringes of both wings greyish-white, blackish opposite ends of veins. Beneath as in male, but ocellus larger with strong pupil. Ground color paler, with chestnut suffusion lighter and extending to base of cell. Hindwing strongly powdered with yellowish, traces of median band fairly obvious, small yellow costal dot and distinct marginal row of six yellow dots, of which the anal one is double. Fringes beneath distinctly checkered.

Antenna with shaft black, knob black above and reddish beneath, with no trace of paler coloring.

Length of forewing: ♂ 22 mm.; ♀ 23 mm.



Plates 2 and 3: 22) *Pararge eversmanni shiva* ♂ Holotype UP; 23) same, ♀ Allotype UP; 24) same, ♂ Paratype UN; 26) *Karanasa pamira twomeyi* ♂ Holotype UP; 27) same, ♂ Paratype UP; 28) same, ♀ Allotype UP; 29) same, ♂ Holotype UN; 30) same, ♀ Allotype UN; 31) *K. pamira kotandari* ♂ Holotype UP; 32) same, ♂ Holotype UN; 33) *K. voigti* ♂ Allotype UP; 34) same ♂ UN; 35) *K. bolorica hodja* ♀ Allotype UP; 36) same ♀ UN; 38) *Lycæna æolus* ♀ Holotype UN; 39) *Ramburia antonia shivaensis* ♂ Holotype UP; 42) *Lyela amirica* ♂ Holotype UP; 43) same, ♀ Allotype UP; 44) *Paralasa*



asura ♂ Holotype UP; 45) same, ♀ Allotype UP; 46) same, ♂ Holotype UN; 47) same, ♀ Allotype UN; 48) *Paralasa shakti* ♂ Holotype UP; 49) same, ♀ Allotype UP; 50) same, ♂ Holotype UN; 51) same, ♀ Allotype UN; 52) *Hyponephele shivacola* ♂ Holotype UP; 53) same ♂ UN. [UP= upperside, UN=underside. Number 25 is omitted; figures 37, 40, 41 are on Plate 1; figures 22, 23, 24, 27, 39, 42, 43 are duplicated on Plates 2 and 3. These unfortunate sources of confusion were caused by reorganization of plates when certain improved photos were prepared.]

HYPONEPHELE SHIVACOLA Wyatt, NEW SPECIES

Unfortunately this species was only taken, very fresh, in the male sex. It appears to be very close to *H. susurrans* Cl. & Sh.

HOLOTYPE ♂: Shiva Mts., 9,000 ft., 21 July 1960.

Forewing entirely a rich chestnut orange, extending to base. A wide and dark marginal band, slightly wider at base and also opposite the apical ocellus, which is small and unpupilled. Costa widely dark brown. Brand long and thin, reaching from bar of cell to submedian. Fringe grey, slightly darker at veins. Hindwing unicolorous dark greyish-brown, margin fairly strongly dentate. Fringe wide, pale grey with dark central line. Thin darker line also on ground color at base of fringe.

Forewing beneath as above, but apical ocellus large and white pupilled, surrounded by yellow ring. Discal area light chestnut orange, much lighter than above, with basal half darker. Thin brown bar from cell almost to costa. Outer angle very darkly suffused with blackish. Hindmarginal area very deep greyish-brown. Fairly wide marginal band of pale greyish brown, evenly edged internally and externally with a thin black line, straight except for angle in space above M_1. Outer edge of orange discal area suffused with brown towards marginal band.

Hindwing a rich greyish-brown beneath, the median band being both edged and suffused with chestnut-brown. Outer edge wavy. Light yellowish-grey patch at costa, two more in spaces above cell, and two large patches below M_1 and the submedian. Largish yellowish suffusion towards apex. Traces of paler marginal band, this becoming a definitely contrasting yellowish-grey towards anal angle. One small, white-pupilled anal ocellus. Base hardly distinguishable from median band, striated with fine black lines.

Length of forewing: 23 mm.

LYELA AMIRICA Wyatt, NEW SPECIES

This curious new species comes closest to *L. macmahoni* Swinhoe from Baluchistan, but is very different. After a comparison with other closely allied species I am of the opinion that it is a retrogressive, primitive alpine form of the genus.

HOLOTYPE ♂: Band-i-Amir, Hazarajat, 9500-11,000 ft., 9-11 June 1960.

ALLOTYPE ♀: Band-i-Amir, Hazarajat, 9500-11,000 ft., 9-11 June 1960.

Upperside uniformly black without any markings. Forewing without apical ocellus and with entire disc of wing flushed a rich chestnut-brown, slightly paler and more extended towards margin in female, reaching to base of wing in both sexes. Faint black bar to forewing cell in female. Antenna spatulate.

Underside exactly the same, except that all black areas are evenly but sparsely dusted with yellow scales, this being especially noticeable in the female; the underside of hindwing is absolutely unicolorous in both sexes, without any traces whatsoever of bands, ocelli or other markings. The great majority of my series of 79 have no apical ocellus on underside of forewing, although this does appear on underside only, very small and inconspicuous, in about 30% of the females and 10% of the males. It has no yellow surround whatsoever.

Length of forewing: ♂ 17 mm., ♀ 18 mm.

The species reminds one superfically of a miniature *Erebia discoidalis* on the upper side. The rich red-brown forewing does not show up on the plates. It frequents a varied habitat, from grassy slopes around the passes in the northern spurs of the Koh-i-Baba Mts., to stony slopes at its lowest altitude which are sparsely covered with spiny plants. I never met it on flat ground.

LYCÆNA ÆOLUS Wyatt, NEW SPECIES

This species appears superficially both above and below amazingly like the North American *L. snowi*, and frequents similar habitats, namely old moraines and scree slopes almost devoid of vegetation, at very high altitudes. I only took two females.

HOLOTYPE ♀: Bala Quran, Anjuman Valley, Hindu Kush Mts., Afghanistan, 14,300 ft., 4 August 1960.

Forewing deep golden orange, strongly adumbrated with black scales, especially towards apex and below cell. Below cell also finely powered with bright irridescent purple scales. These give a barely perceptible shimmer to the wing, but are clearly seen with a lens. The golden orange is everywhere extended clearly along the veins. Very large discal spot and smaller cell spot. Three large equal-sized round costal spots, two median spots and traces of a third more inwardly set beneath them. Normally wide black margin. Fringes white. Hindwing as above, but so entirely irrorated with black that the gold only shows clearly along the veins as far as the cell, and as a narrow submarginal stripe. A black discal bar and four black median spots, of which the third is strongly inset. Anal angle moderately scalloped, fringes white.

Beneath an overall soft dove-grey, but disc of forewing suffused with pale orange yellow, especially towards outer angle. Fine dark-grey marginal line, also an inner-marginal line, heavily marked in three lowest spaces, but fading out before apex. Apex dove-grey. Spotting as above. Hindwing with hairlike dark-grey marginal line and row of marginal black spots, fine and elongated. Median band of small black spots normal to the genus, but very small. Double discal spot, small spot in cell. Slightly curved line of 3 spots behind cell, two basal spots.

RAMBURIA ANTONIA SHIVAENSIS Wyatt, NEW SUBSPECIES

I was very surprised to meet with this species, very locally and in small numbers, which is I believe a new record for Afghanistan. It flew, always singly, in the approaches to the Shiva Mts., on steep stony slopes and gullies with a semi-desert type of vegetation. As both sexes are similar I illustrate only the male.

HOLOTYPE ♂: Shiva Mts., Badakhshan, 6500-8000 ft., 19-27 July 1960.

ALLOTYPE ♀: Shiva Mts., Badakhshan, 6,500-8,000 ft., 19-27 July 1960.

Similar in size to typical form, but all white markings larger. A very strongly developed marginal row of white spots, especially the two above M_1. Five white costal spots all, but especially the lower two, much longer than in type, and with the veins noticeably less black. Strong white bar to cell. Median white spot elongated. A distinct feature is the white hindmarginal spot; in the type this shows as a large square white spot bordered outwardly by two minute white dots one above the other; in *shivaensis* it appears as one very large oblong spot, twice as long as wide, divided by a thin, angled black line. In the female, however, this is not the case and the two outer spots are absent or only faintly indicated. However, in the female all other white spots are larger and stronger than in type or *gigantea*.

Spot above hindmarginal spot very large and long. In this race these two spots, plus the large white cell spot, give the appearance of a solid white band right across wing. Usual basal indications of two white spots, but very faint in female.

Hindwing has large and distinct white marginal spots; central white spot enormously enlarged and practically incorporating the spots above and below it, the upper of which is only faintly separated from the costal spot, so that the four spots appear as a broad white band.

Beneath, the central white band is very wide and conspicuous, strongly bordered with black. Thin dark marginal band, which does not appear at all in the type and only as a few dots in *gigantea*. Basal yellow band wide, strong basal black spot. Unfortunately none of my specimens is very fresh, so that it is not possible to say whether the strong greyish color of the underside bands, showing only the faintest traces of yellow, is the normal coloration.

Length of forewing: ♂ 17 mm.; ♀ 16 mm.

THYMELICUS LINEOLA KUSHANA Wyatt, NEW SUBSPECIES

HOLOTYPE ♂ : Shiva Mts., N. Badakhshan, 8,500 ft., 21 July 1960.
ALLOTYPE ♀ : Shiva Mts., N. Badakhshan, 8,500 ft., 21 July 1960.

Male deep orange-yellow with wide black margin to forewing which runs inwards along veins for 1-2 mm., and hindmargin strongly blackish. Hindwing almost uniformly dark brown, with only the faintest trace of an orange suffusion in center. In one male hindwing is entirely dark brown. Antenna black above overall, but shaft beneath yellow to halfway up knob. Palpus evenly yellow and black above, whitish beneath at base. Brand short and faint.

Beneath, forewing orange-yellow, slightly paler towards apex, base and hindmargin widely black. Hindwing greenish-yellow, orange at costa and yellow-orange below M_1.

Female as in male, but forewing black margin half the width, although the black scaling along veins is greater, up to 2½ mm. long. Darkish suffusion at base of wing and along hindmargin. Strong black bar to cell. Hindwing as in male, but golden suffusion in center very much larger and more noticeable, although wing still appears as having a blackish ground color suffused gold. Black along veins and black smudge at end of cell. Beneath as in male, but main ground color strongly powdered with pale grey.

Length of forewing in both sexes: 12 mm.

Cobbetts, Mavins Road, Farnham, Surrey, ENGLAND

A NEW SUBSPECIES OF *AGATHYMUS MARIÆ* FROM MEXICO (MEGATHYMIDÆ)

by Don B. Stallings, J. R. Turner, Viola N. Stallings

In Mexico, particularly in the state of Coahuila, we find a number of populations of the *Agathymus mariæ* (Barnes & Benjamin) complex, with each population having some characters of its own that separates it from other populations. Each population appears to be isolated to a certain degree, with the isolating medium not always being of a geographical nature. There is, or has been until recently, some exchange of genes between these populations as revealed by certain rather unique characters that may be carried by more than one population.

This has been one of the most exciting problems that we have found among the Megathymidæ. We describe in this paper one of the populations from Mexico that has more characters differing from typical *Agathymus mariæ* than any of the other populations. It will become evident, on study of the description, that this population has a number of characters that indicate that it has reached full speciation, and it well may be that our final conclusions will determine it to be a full species. There are, however, a number of indications that point to its being a subspecies, and we so designate it in this paper with the thought that if a change should become necessary it would be better to raise the name, rather than demote it.

In the area south of Allende, Coahuila, Mexico, we find these populations in direct competition with populations of the *Agathymus estelleæ* (Stallings & Turner) complex—both populations using the same food plant. We have repeatedly found larvæ of both in the same plant. The drama of this battle for survival we will present in a subsequent paper.

AGATHYMUS MARIÆ MICHENERI

Stallings, Turner, & Stallings, NEW SUBSPECIES

Female. Upper surface of primaries: deep brownish-black with some orange-brown hairs and scales at base; spot 1 (cell spot) roughly square, with upper part projected inward a short distance; spots 2, 3, & 4 (subapical spots) rectangular and of even size, spots 2 and 3 being set inward a little more than spot 4; spots 5 & 6 (submarginal spots) about square and set just outside outer edge (extended) of discal band; spots 7, 8, & 9 discal band) forming a straight line on their outer margin; spot 7 extending inward to a point, being triangular in shape; spot 8 rectangular, extending inward as far as spot 7; spot 9 toothed inwardly with tip of tooth in line with inner margin of spots 7 and 8; spots 7 and 8 entending inward to confluence with cell spot; all 9 spots bright pale orange; fringes checkered brownish-black and smoke.

Under surface of primaries: dull brownish-black with apex and outer margin lightly overscaled with white; all spots of upper surface represented but much lighter, with spots 2, 3, & 4 being almost white; outer edge of spots 7 and 8 set inward from outer edge of spot 9.

Upper surface of secondaries: deep brownish-black with orange-brown hairs and scales at base; a well defined discal band of spots the same color as spots on upper surface of primaries; fringes light yellow-white, faintly checkered with brownish-black.

Under surface of secondaries: dull brownish-black, completely overscaled with white; discal band faintly represented as slight increase in white over-scaling.

Abdomen brownish to black above and brownish-black beneath, overscaled beneath with white. Thorax brownish-black with orange-brown overscaling above and heavy white overscaling beneath. Palpus white with some gray intermixed. Antenna black, with very narrow white rings.

Length of forewing: 26 mm. to 21mm.; average 24.5 mm. Measurements of Holotype: forewing, apex to base 25 mm., apex to outer angle 15.5 mm., outer angle to base 18 mm.; hindwing, base to end of vein Cu_1 19 mm.

Male. Upper surface of primaries: deep brownish-black with some orange-brown hairs and scales at base; spot 1, a dot of color with a streak extending inward; spots 2, 3, & 4, minute, with spot 4 out of line, outwardly, with spots 2 and 3; spots 5 & 6 minute, and well outside outer margin (extended) of discal band; spots 7 & 8 usually rounded, spot 9 twice as wide as 7 and 8 with the added width extending inward so that the three spots appear to form an "L"; all spots same color as in female; fringes a bit lighter than in female; distinct yellow-orange scales along entire costal margin.

Under surface of primaries: dull brownish-black with apex and outer margin overscaled with white; all spots, of upper surface except 5, represented but smaller and lighter, with spot 5 usually absent, and spots 2, 3, & 4 usually white.

Upper surface of secondaries: similar to female, with spots smaller and fringes more yellow.

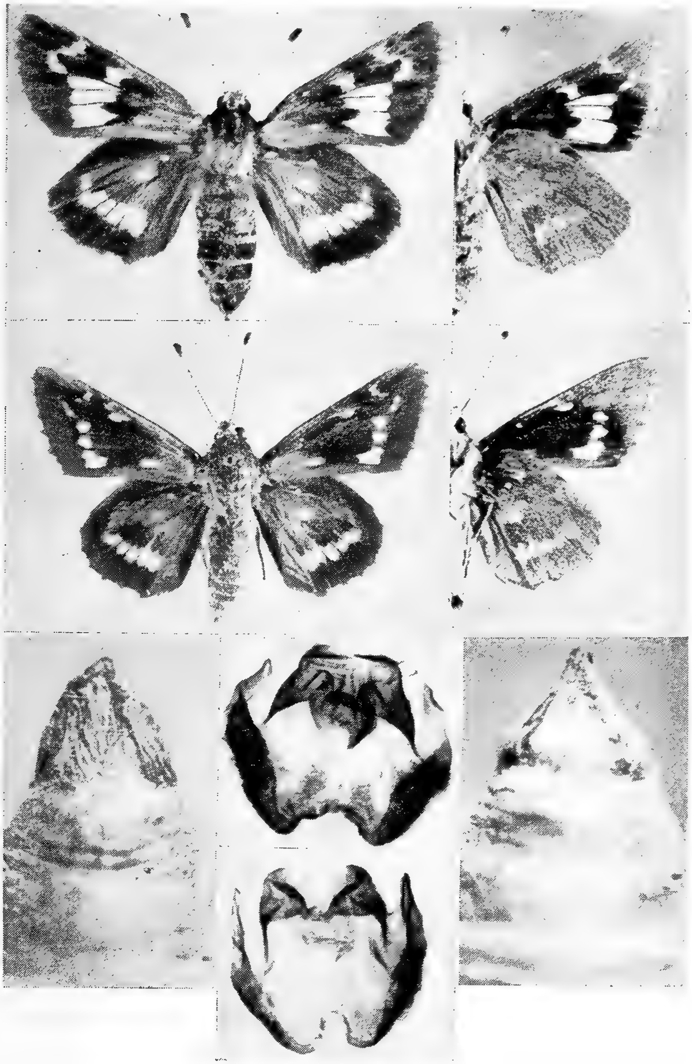
Under surface of secondaries: similar to female with discal band more clearly defined by white overscaling.

Abdomen, thorax, palpus, and antenna similar to those of female.

Length of forewing: 24 mm. to 19mm., average 23 mm. Measurements of Allotype: forewing, apex to base 24 mm., apex to outer angle 14.5 mm., outer angle to base 18 mm.; hindwing, base to end of vein Cu_1 17.5 mm.

Described from 29 specimens (17 males and 12 females) collected 15 to 20 miles south of Allende, Coahuila, Mexico, on Highway 57 (formerly Hwy. 75) at Klm. 89 at an elevation of 1300 feet, emerging from pupæ Sept. 26 to Oct. 16, 1957, 1958, and 1959. Collected by Dr. & Mrs. R. C. TURNER, Dr. J. R. TURNER, DEE, JACK, VIOLA N. and DON B. STALLINGS. Five specimens from Monclova, Coahuila (el. 2400 ft.), examined and found typical but not made a part of the type series. Larvæ were collected and preserved for study in 1959 by C. L., P. SHELDON, and ERIC REMINGTON, along with the clan of the authors.

HOLOTYPE: female, Oct. 6, 1957, and ALLOTYPE, male, Oct. 9, 1958, are in the collection of the authors.



Top row: *Agathymus mariæ micheneri,* HOLOTYPE, upper side to left; under side to right. 2nd row: ALLOTYPE, upper side to left; under side to right. 3rd row: cremaster of *A. m. micheneri* to left; ♀ genitalia of *A. m. micheneri* upper center; ♀ genitalia of *A. m. mariæ* (El Paso, Texas) lower center; cremaster of *A. m. mariæ* (El Paso, Texas) to right.

Food plant: *Agave lecheguilla* Torr. The type locality is an area of low hills in the Coahuila desert. The eggs are hemispherical in shape, 1.8 mm. in diameter at the base and 1.5 mm. high. They are bright green in color, with just a hint of blue, and have a minute micropylar dimple in the apex. Larvæ in the last instar are a bright blue, similar to typical *A. mariæ*. The larvæ feed in the leaf and caudex of the plant. Their exit hole is usually on the upper side of the leaf, with the trap door being round, 7 mm. in diameter, and light tan (almost white) in color. The larval cavity has an overall length of 74 to 85 mm., with 30 to 50 mm. of this length in the caudex.

A. m. micheneri is distinguished from typical *A. m. mariæ* by the following characters:

1. All spots are bright pale orange; *mariæ* spots are pale yellow and dull.
2. The ground color is almost black; *mariæ* ground color is much paler, with much more brown.
3. The overscaling appears as a dark pearl gray, due to the white lying over the almost black ground color; *mariæ* overscaling appears as a pale tan due to the white lying over a more brownish ground color.
4. Spots 1 & 7 join in the female; *mariæ* usually has these spots separated.
5. Spots 7, 8, & 9 form an "L" in the male; *mariæ* does not show the "L" effect.
6. In the female on the under surface of the primaries the outer edge of spots 7 & 8 are set inward from the outer edge of spot 9; *mariæ* has the outer edge of 7, 8, & 8 in line.
7. The egg is bright green with a hint of blue; the *mariæ* egg (Hueco Mts., Texas) is green with a tint of brown, 2 mm. in diameter and 1.5 mm. high, with a more definite dimple at the apex.
8. The female genitalia have a broad shallow indentation at the base; *mariæ* (El Paso, Texas) has a narrow, deep indentation at the base.
9. The female genitalia have the upper center part long and well developed; *mariæ* has the upper center part short and less developed.
10. The cremaster of the pupa case is broad and relatively blunt; in *mariæ* (El Paso, Texas) it is narrow and pointed.

This insect is named in honor of Dr. CHARLES D. MICHENER of the University of Kansas, who has given us much valuable help in our studies of the Megathymidæ.

Caldwell, Kansas, U. S. A.

PALATABILITY OF NORTH AMERICAN MODEL AND MIMIC BUTTERFLIES TO CAGED MICE

by JANE VAN ZANDT BROWER and LINCOLN P. BROWER

During August and September of 1954, preliminary experiments were conducted to investigate the palatability of model and mimic butterflies to individually caged *Peromyscus leucopus* (Rafinesque), a deer mouse. This work was carried out in the Great Smoky Mountains of Tennessee and North Carolina, where the presumably unpalatable *Battus philenor* (Linné) and some of its supposed mimics were relatively abundant. Among the butterflies tested were: *B. philenor,* model; *Papilio troilus* Linné and *Limenitis astyanax* (Fabricius), mimics; and the male of *P. glaucus* Linné, the male of *Speyeria diana* (Cramer), *S. aphrodite* (Fabricius), and *S. cybele* (Fabricius), here called non-mimetic butterflies (*i. e.,* butterflies which are not involved in mimicry, either as models or mimics).

The *Peromyscus* were obtained by trapping in the Great Smoky Mountains at an altitude of about 4,500 feet. The laboratory diet of the mice consisted of sunflower seeds, nut meats, and lettuce.

All of the butterflies were caught daily as adults along North Carolina route 284 between Dellwood and Mount Sterling, or along the Davidson River road in Pisgah National Forest. Both male and female butterflies were used, unless otherwise noted.

For each experiment from five to nine living, fluttering butterflies were placed in each mouse cage at about 11:00 p.m. The proportions of models, mimics, and non-mimetic butterflies varied from one experiment to another. The butterflies were left overnight in the mouse cages, and the remains were recorded the following day according to three categories: (1) left — if a butterfly was intact and alive, or dead but not bitten; (2) killed — if a butterfly was killed by a mouse, but not eaten; (3) eaten — if all that remained of a butterfly were wings and legs. The data for each butterfly species given to two mice are on Tables 1 and 2.

Other data were not comparable because there was more than one mouse per cage; however, the records show that 9 *B. philenor,* 3 *P. troilus,* and 8 non-mimetic butterflies were eaten, and none left or merely killed, in a cage of an adult male and a juvenile *P. leucopus.*

These limited findings suggest that *P. leucopus* feeds rather indiscriminantly upon butterflies; the presumed unpalatability of *B. philenor* was not borne out in these tests, although the results show some indication that *B. philenor* was less palatable to Mouse No. 2 than the other

Table 1. REACTION OF MOUSE NO. 1 TO BUTTERFLIES.

Butterfly Species	Left	Killed	Eaten	Total
B. philenor	0	0	17	17
P. troilus	0	0	6	6
L. astyanax	0	0	2	2
S. diana (male)	0	0	3	3
S. aphrodite	0	0	2	2
S. cybele	0	0	3	3
P. glaucus (male)	0	0	2	2

Table 2. REACTION OF MOUSE NO. 2 TO BUTTERFLIES.

Butterfly Species	Left	Killed	Eaten	Total
B. philenor	3	1	10	14
P. troilus	0	0	6	6
L. astyanax	0	0	2	2
S. diana (male)	0	0	5	5
S. aphrodite	0	0	1	1
S. cybele	0	0	4	4
P. glaucus (male)	0	0	1	1

butterflies were. That mimicry is effective in the *B. philenor* complex was demonstrated subsequently with Florida Scrub Jays, *Cyanocitta cœrulescens cœrulescens* (Bosc), as caged predators (Brower, 1958).

MERRIAM (1893) and WEBSTER (1902) noted that mice (*Onychomys*) have been reported to eat the presumably distasteful *Danaus plexippus* (Linné), the Monarch, which overwintered on an island in Aransas Bay off the coast of Texas. In September 1954, in New Jersey, we obtained some experimental evidence that *D. plexippus* is also palatable to *P. leucopus*. The same four mice ate a total of 18 adults, 14 full grown larvæ, and 3 pupæ of *D. plexippus*, whereas none were left or only killed.

Although mice have seldom been considered as possible predators of butterflies, the evidence presented here indicates that *P. leucopus* will eat them. However, the nocturnal habits of mice and their correlated lack of color vision would seem to make their participation as selective agents in mimicry unlikely.

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References

Brower, J. VZ., 1958. Experimental studies of mimicry in some North American butterflies. Part II. *Battus philenor* and *Papilio troilus, P. polyxenes,* and *P. glaucus*. *Evolution* 12: 123-136.

Merriam, C. H., 1893. *Danais archippus* eaten by mice. *Insect life* 5: 270.

Webster, F. M., 1902. Mice destroying insects. *Ent. news* 13: 277-280.

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A CHECK LIST OF THE ITHOMIIDÆ. I. TRIBES TITHOREINI AND MELINÆINI

by RICHARD M. FOX

For the benefit of those working casually with the ithomines, the major classification is here summarized, along with the first installment of a check list of species and subspecies. Major classification of this family of butterflies was detailed in Part I of my monograph (1956), as was the tribe Tithoreini. Some emendations and additions have been recorded (1960a). The tribe Melinæini was discussed in Part II (1960b). For generic synonymy, see Fox 1940 and d'Almeida 1942; the presentation of the ithomines in "Seitz" by HAENSCH (1909) is replete with blunders in usage of generic names, in assignment of species to genera and in specific identification.

FAMILY ITHOMIIDAE REUTER

These insects are not especially close to the Danaidæ, but show many morphologic affinities with the primitive Satyridæ and to the main stem of the Nymphalidæ. There are two subfamilies.

SUBFAMILY TELLERVINAE FRUHSTORFER

The sole genus, *Tellervo* Kirby, is found in the insular tropical belt from Cape York, Australia, north through New Guinea, and from Celebes to the Solomon group. All material examined belongs to the strongly polytypic *T. zoilus*.

SUBFAMILY ITHOMIINAE KIRBY

The many species all are Neotropic. Males may be recognized at once by the presence of the "hair pencil", a tuft of long scales placed longitudinally along and over the radius of the hind wing. The many genera fall into eight series, designated as tribes.

(1) Tribe TITHOREINI Fox, 1940, comprising the genera *Roswellia, Athesis, Patricia, Eutresis, Olyras, Athyrtis, Tithorea* and *Elzunia.*

(2) Tribe MELINAEINI Clark, 1948, with the single genus *Melinæa.*

(3) Tribe MECHANITINI Fox, 1956, including *Xanthocleis, Mechanitis, Sais* and *Scada.*

(4) Tribe Napeogenini Fox, 1956, comprising *Hyalyris, Hypothyris, Rhodussa, Napeogenes* and *Garsauritis.*

(5) Tribe Ithomiini Zerny & Baier, 1936, with *Ithomia, Pagyris, Miraleria* and *Placidula.*

(6) Tribe Oleriini Fox, 1940, including *Hyposcada, Oleria, Æria* and a manuscript genus (Fox & Forbes).

(7) Tribe Dircennini d'Almeida, 1941, comprising *Callithomia, Dircenna, Velamysta, Ceratinia, Hyalenna, Episcada* and *Pteronymia.*

(8) Tribe Godyridini d'Almeida, 1941 (= *Thyridini* d'Almedia, 1941), with *Thyridia, Epityches, Godyris, Dygoris, Pseudoscada, Hymenitis* (or *Greta*), *Hypoleria, McClungia, Hypomenitis, Veladyris* and *Heterosais.*

The tribes are listed above in general phylogenetic sequence, and the same is true of the sequence of genera within each tribe. A linear presentation is not the best way to illustrate phylogeny, as we all know. In any event, this is the sequence in which I propose treating the family in subsequent parts of the monograph.

In the following list, absolute synonyms are not especially marked, but biological synonyms such as aberrants, populational variants are indicated as "ab.".

Tribe Tithoreini Fox

1. Genus *Roswellia* Fox, 1948.
    - 1.1a *Roswellia acrisione acrisione* (Hewitson), 1869. Eastern Ecuador and northernmost Peru.
    - 1.1b *Roswellia acrisione deflavata* (Niepelt), 1928. Rio Caqueta in Amazonian Colombia.
2. Genus *Athesis* Doubleday, 1847.
    - 2.1a *Athesis clearista clearista* Doubleday & Hewitson, 1847. Northern Venezuela.
    - 2.1b *Athesis clearista colombiensis* Kaye, 1918. (= *bassleri* Fox, 1941.) Colombia.
    - 2.1c *Athesis clearista vitrala* Kaye, 1918. Eastern Ecuador into Northern Peru.
3. Genus *Eutresis* Doubleday, 1847.
    - 3.1 *Eutresis dilucida* Staudinger, 1885. (= *pethoë* Gillott, 1925.) High tropical forests in Costa Rica.
    - 3.2a *Eutresis hypereia theope* Godman & Salvin, 1877. Costa Rica.

3.2b *Eutresis hypereia hypereia* Doubleday & Hewitson, 1852. Venezuela and Amazonian Colombia.

3.2c *Eutresis hypereia hyspa* Godman & Salvin, 1879. (= *antioquensis* Staudinger, 1885.) Rio Cauca valley of Colombia and western Ecuador.

3.2d *Eutresis hypereia banosana* Fox, 1956. Eastern Ecuador and upper Rio Putumayo in Colombia.

3.2e *Eutresis hypereia imitatrix* Staudinger, 1876. Northern Bolivia to central and eastern Peru.

4. Genus *Patricia* Fox, 1940.

4.1a *Patricia dercyllidas dercyllidas* (Hewitson), 1877. Eastern Ecuador and northernmost Peru.

4.1b *Patricia dercyllidas hazelea* Fox, 1956. Eastern Ecuador.

4.2 *Patricia oligyrtis* (Hewitson), 1877. Eastern Ecuador into northernmost Peru.

4.3a *Patricia demylus demylus* (Godman & Salvin), 1879. (= *hewitsonii* Srnka, 1885.) Eastern Ecuador.

4.3b *Patricia demylus gemellus* Fox, 1960. Bolivia.

5. Genus *Olyras* Doubleday, 1847.

5.1a *Olyras crathis staudingeri* Godman & Salvin, 1897. Costa Rica.

5.1b *Olyras crathis montagui* Butler, 1870. Rio Putumayo south through eastern Ecuador into northern Peru.

5.1c *Olyras crathis crathis* Doubleday & Hewitson, 1847. Northern Venezuela.

5.1d *Olyras crathis sticheli* Haensch, 1905. Rio Ucayali, Peru.

5.1e *Olyras crathis weeksi* Fox, 1956. Ecuador, probably western.

5.2 *Olyras theon* Bates, 1866. Mexico, Guatemala, Honduras.

5.3a *Olyras insignis insignis* Salvin, 1869. Costa Rica and Panama.

5.3b *Olyras insignis præstans* Godman & Salvin, 1897. Amazonian Colombia.

5.3c *Olyras insignis translucens* Hewitson, 1872. Western Ecuador.

6. Genus *Athyrtis* Felder & Felder, 1862.

6.1a *Athyrtis mechanitis mechanitis* Felder & Felder, 1862. (= *distincta* Haensch, 1905, ab.) Amazonian Colombia, higher altitudes.

6.1b *Athyrtis mechanitis oberthuri* Srnka, 1885. (= *similis* Tessmann, 1928, ab.) Rio Pachitea, in east central Peru.

6.1c *Athyrtis mechanitis salvini* Srnka, 1884. (= *amanga* Haensch, 1909, ab.) Bolivia, Peru and the Rio Jurua valley of Brazil.

7. Genus *Tithorea* Doubleday, 1847. (= *Hirsutis* Haensch, 1909.)

7.1a *Tithorea tarricina duenna* Bates, 1864. Mexico, Guatemala, Honduras.

7.1b *Tithorea tarricina pinthias* Godman & Salvin, 1878. (= *monosticta* Godman & Salvin, 1897, ab.) Guatemala, Honduras, Costa Rica, Panama.

7.1c *Tithorea tarricina tarricina* Hewitson, 1857. (= *hecalesina* Felder & Felder, 1865, ab. = *parola* Godman & Salvin, 1898, ab., = *obscurata* Haensch, 1909, ab.) Colombia.

7.1d *Tithorea tarricina bonita* Haensch, 1903. (= *macasica* Niepelt, 1915, ab.) Eastern Ecuador to Department of San Martin, Peru.

7.1e *Tithorea tarricina tagarma* Hewitson, 1874. (= *anachoreta* Thieme, 1902, ab.) Chanchamayo of Peru.

7.2a *Tithorea harmonia salvadoris* Staudinger, 1885. Mexico, San Salvador and Guatemala.

7.2b *Tithorea harmonia hippothous* Godman & Salvin, 1879. Honduras.

7.2c *Tithorea harmonia helicaon* Godman & Salvin, 1879. Costa Rica.

7.2d *Tithorea harmonia irene* (Drury), 1782. (= *umbratilis* Bates, 1866.) Panama.

7.2e *Tithorea harmonia furia* Staudinger, 1884. Venezuela and northern Colombia.

7.2f *Tithorea harmonia furina* Godman & Salvin, 1898. (= *flacilla* Godman & Salvin, 1898, ab.) Rio Putumayo north through central and southern Colombia and along the Cordillera Merida of Venezuela.

7.2g *Tithorea harmonia deltana* Fox, 1956. Orinoca delta, Venezuela.

7.2h *Tithorea harmonia megara* (Latreille), 1819. (= *flavescens* Kirby, 1887.) Trinidad.

7.2i *Tithorea harmonia harmonia* (Cramer), 1777. (? = *mopsa* Linné, 1767, = *mopsa* Fabricius, 1781, ? not Linné.) Venezuelan Guiana, British, French and Dutch Guiana, Para west in the Amazon and its northerly tributaries.

7.2j *Tithorea harmonia cuparina* Bates, 1862. Rio Cupari, Brazil.

7.2k *Tithorea harmonia manabiana* Fox, 1956. Western Ecuador.

7.2l *Tithorea harmonia hermias* Godman & Salvin, 1898. (= *hermina* Haensch, 1903, ab., = *napona* Haensch, 1909, ab.) Eastern Ecuador and sorthwestern Peru.

7.2m *Tithorea harmonia martina* Fox, 1956. Department of San Martin, Peru.

7.2n *Tithorea harmonia egaensis* Butler, 1873. Middle Rio Marañon and Rio Huallaga, Peru.

7.2o *Tithorea harmonia neitha* Hoppfer, 1874. (= *melanina* Haensch, 1905, ab., = *brunnea* Haensch, 1905, ab.) Chanchamayo region of Peru, Rio Jurua in Brazil.

7.2p *Tithorea harmonia pseudonyma* Staudinger, 1894. (= *assimilis* Haensch, 1905, ab., = *lateflava* Haensch, 1909, ab., = *mira* Neustetter, 1929, ab.) Southern Peru, northern and eastern Bolivia, Mato Grosso of Brazil, Paraguayan Chaco.

7.2q *Tithorea harmonia pseudethra* Butler, 1873. Southeastern Paraguay, Minas Gerais and Sao Paulo, Brazil.

7.2r *Tithorea harmonia caissara* Zikan, 1941. Sierra da Contareira, Brazil.

8. Genus *Elzunia* Bryk, 1937.

8.1a *Elzunia humboldtii humboldtii* (Latreille), 1811. (= *flavomaculata* Staudinger, 1885, ab.) Northern and central Colombia.

8.1b *Elzunia humboldtii albomaculata* (Haensch), 1903. (= *coxeyi* Fox, 1941.) Eastern Ecuador.

8.1c *Elzunia humboldtii judsoni* Fox, 1956. Southern Colombia.

8.2a *Elzunia cassandrina cassandrina* (Srnka), 1885. Southern Colombia through eastern Ecuador into northern Peru.

8.2b *Elzunia cassandrina microguttata* (Röber). 1927. Northern Colombia.

8.3a *Elzunia bonplandii bonplandii* (Guérin), 1841. Eastern cordillaras of Colombia.

8.3b *Elzunia bonplandii descandollesi* (Staudinger), 1885. (= *latreillei* Staudinger, 1885, ab.) Cauca valley, Colombia.

8.4 *Elzunia tamasea* (Hewitson), 1873. (= *lugubris* Haensch, 1909, ab.)

8.5 *Elzunia atahualpa* Fox, 1956. "Northeastern Peru; Bassler", probably Rio Putumayo, Colombia.

8.6a *Elzunia regalis regalis* (Stichel), 1903. (= *faba* Weymer, 1909.) Colombia. "Muzo" and "Bogota" are the only localities on specimens seen and probably represent the places where the material was purchased; the insects themselves may have come from anywhere within several hundreds of miles of these towns.

8.6b *Elzunia regalis joiceyi* (Kaye), 1918. Cauca valley, Colombia.

8.7 *Elzunia pavonii* (Butler), 1873. Western Ecuador. The locality on the holotype, "Panama", is an error.

Tribe Melinaeini Fox

9. Genus *Melinæa* Hübner, 1816.

9.0 *Melinæa mneme* (Johansson), 1763. (= *mediatrix* Weymer, 1890, = *mauensis* Weymer, 1890, ab.) Venezuelan, British, Dutch and French Guiana, Para in Brazil and the Amazon valley as far up as Teffé, including most of the principal tributaries.

9.1a *Melinæa lilis flavicans* Hoffmann, 1924. Guerrero and Vera Cruz in Mexico.

9.1b *Melinæa lilis imitata* Bates, 1864. (= *tachypetis* Felder & Felder, 1865, = *telchinia* Boisduval, 1870.) Isthmus of Tuantepec, Mexico, to Costa Rica.

9.1c *Melinæa lilis parallelis* Butler, 1873. Panama and northwestern Colombia.

9.1d *Melinæa lilis ezra* Fox, 1939. Santa Marta mountains, Colombia.

9.1e *Melinæa lilis lilis* Doubleday & Hewitson, 1847. Coastal hills and mountains of eastern Venezuela.

9.1f *Melinæa lilis sola* Kaye, 1925. (= *lateapicalis* Hall, 1935, ab., = *limitata* Hall, 1935.) Trinidad and adjacent Venezuelan coast.

9.1g *Melinæa lilis messatis* (Hewitson), 1855. Caribbean and Amazon drainage of central and southern Colombia.

9.1h *Melinæa lilis erica* Bargmann, 1929. Pacific drainage of Colombia.

9.1i *Melinæa lilis dodona* Hopffer, 1874. Bolivia.

9.2 *Melinæa ethra* (Latreille), 1820. Southeastern Brazil.

9.3 *Melinæa scylax* Salvin, 1871. (= *ribbei* Weymer, 1875.) Guatemala through Panama into the lower Cauca valley in Colombia.

9.4a *Melinæa satevis satevis* (Doubleday & Hewitson), 1847. Bolivia.

9.4b *Melinæa satevis crameri* Godman & Salvin, 1898. (= *mneme,* Cramer, 1779, not Johansson, = *incisa* Kaye. 1925, ab.) British and Dutch Guiana.

9.4c *Melinæa satevis aurantia* Forbes, 1942. Monagas, Venezuela.

9.5a *Melinæa idæ idæ* (Felder & Felder), 1862. Panama to Peru, in and east of the Andes.

9.5b *Melinæa idæ vespertina* Fox, 1945. Western Ecuador.

9.6a *Melinæa egina egina* (Cramer), 1777. (= *ludivica* Cramer, 1779.) Venezuelan Guiana, British, Dutch and French Guiana, Para and up the Amazon valley into eastern Colombia and eastern Peru.

9.6b *Melinæa egina paraiya* Reakirt, 1866. Southeastern Brazil.

9.6c *Melinæa egina agricola* Hall, 1936. "Ega", the locality on the holotype is doubtful; probably from much further up the valley of the Amazon or its tributaries.

9.7 *Melinæa mnemopsis* Berg, 1897. (= *boliviana* Weymer, 1907.) Bolivia.

9.8a *Melinæa mælus madeira* Moulton, 1909. Rio Madeira, Brazil.

9.8b *Melinæa mælus purusana* Riley, 1919. (= *purusana* Aurivillius, 1929, abs. syn. and homon., = *romani* Bryk, 1937.) Lower and Middle Rio Purus, Brazil.

9.8c *Melinæa mælus brunnea* Riley, 1919. Upper Rio Purus, Brazil.

9.8d *Melinæa mælus mayi* d'Almeida, 1951. Upper Rio Jurua, Brazil.

9.8e *Melinæa mælus cydon* Godman & Salvin, 1879. (= *pardalis,* Druce, 1876, not Bates.) Amazon drainage in Colombia, Peru and northern Bolivia, and some of adjacent Brazil.

9.8f *Melinæa mælus mælus* (Hewitson), 1860. (= *pardalis* Bates, 1862.) Rio Putumayo in Colombia and Brazil, and along the Amazon nearly to the mouth.

9.9a *Melinæa mæonis borealis* Hall, 1935. Merida range, Venezuela.

9.9b *Melinæa mæonis mæonis* Hewitson, 1869. (= *strigilis* Weymer, 1890, = *æquatoriensis* d'Almeida, 1951.) Rio Ortegasa, Rio Caqueta in Amazonian Colombia, to eastern Ecuador.

9.9c *Melinæa mæonis zamora* Haensch, 1909. Rio Ucayali, Peru.

9.10a *Melinæa marsæus marsæus* (Hewitson), 1860. Obidos to Teffé, Brazil.

9.10b *Melinæa marsæus rileyi* Fox, 1942. (= *lucifer* Staudinger, 1885, not Bates.) Lower Rio Putumayo, northeastern Peru and on the Amazon as far as Sao Paulo de Olivençia.

9.10c *Melinæa marsæus macaria* Godman & Salvin, 1898. Rio Caqueta and upper Rio Putumayo, Amazonian Colombia.

9.10d *Melinæa marsæus clara* Rosenberg & Talbot, 1914. Southern Peru to San Antonio on the Rio Madeira in Brazil.

9.11a *Melinæa phasiana manga* Haensch, 1909. Teffé, Brazil.

9.11b *Melinæa phasiana phasiana* Butler, 1870. (=*divisa* Staudinger, 1885, = *acræna* d'Almeida, 1951.) Rio Ucayali, Urubamba in Peru and Rio Jurua in Brazil.

9.12a *Melinæa mænius mænius* (Hewitson), 1860. Obidos to Teffé on the Amazon.

9.12b *Melinæa mænius hicetas* Godman & Salvin, 1879. Rio Napo in Ecuador to the Marañon and Ucayali in Peru.

9.12c *Melinæa mænius cocana* Haensch, 1903. Rio Caqueta in Colombia to northeastern Peru. Possibly only an aberration.

9.12d *Melinæa mænius tarapotensis* Haensch, 1909. Tarapoto and Huayabamba, Peru.

9.12e *Melinæa mænius juruænsis* d'Almeida, 1943. Rio Jurua, Brazil.

9.12f *Melinæa mænius pothete* d'Almeida, 1945. Matto Grosso, Brazil.

9.13a *Melinæa menophilus menophilus* (Hewitson), 1855. (= *ishka* Butler, 1870, = *flavosignata* Staudinger, 1885, ab., = *hicetas,* Staudinger, 1885, not Godman & Salvin, = *egesta* Godman & Salvin, 1898, ab.) Amazonian Colombia, some of eastern Ecuador, northern and central Peru.

9.13b *Melinæa menophilus zaneka* Butler, 1870. (= *dora* Streker, 1876, = *maculosa* Haensch, 1903, ab., = *discurrens* Haensch, 1909, ab.) Eastern Ecuador in Napo-Pastaza and Santiago-Zamora areas, where *M. m. menophilus* is not found.

9.13c *Melinæa menophilus orestes* Salvin, 1871. (= *chincha* Druce, 1876. = *magnifica* Haensch, 1905, ab.) Central Peru, Rio Jurua, upper Rio Madeira and upper Rio Purus in Brazil.

9.14a *Melinæa mothone messenina* Felder & Felder, 1865. Upper Rio Negro in Brazil, perhaps into Amazonian Colombia.

9.14b *Melinæa mothone mothone* (Hewitson), 1869. (= *cydippe* Salvin, 1871.) Rio Putumayo in Colombia through eastern Ecuador and central Peru to Bolivia.

9.15a *Melinæa comma isocomma* Forbes, 1948. Upper Rio Negro, Rio Caqueta in Colombia.

9.15b *Melinæa comma simulator* Fox, 1960. Napo-Pastaza district, eastern Ecuador.

9.15c *Melinæa comma comma* Forbes, 1927. Chanchamayo, Peru.

9.16a *Melinæa thera thera* Felder & Felder, 1865. Itabapoana, Rio, Brazil.

9.16b *Melinæa thera eratosthenes* Hall, 1935. French Guiana.
9.17a *Melinæa lucifer lucifer* Bates, 1862. Sao Paulo de Olivençia, Brazil.
9.17b *Melinæa lucifer lutzi* Fox, 1942. Upper Rio Marañon, Peru.
9.17c *Melinæa lucifer eryx* d'Almeida, 1951. Upper Rio Jurua, Brazil.

References Cited

d'Almeida, R. F., 1942. Alguns tipos de generos da ordem Lepidoptera. 1a nota: Rhopalocera, fam. Mechanitididæ. *Papeis avulsos, Dept. Zool.*, São Paulo, Brasil 2: 179-196.

Fox, R. M., 1940. A generic review of the Ithomiinæ. *Trans. American ent. soc.* 66: 161-207, 4 pls.

..............., 1956. A monograph of the Ithomiidæ (Lepidoptera), Part 1. *Bull. American mus. nat. hist.* 111: 1-76, 75 text fig., 9 pls. [With keys and bibliography.]

..............., 1960a. A postscript on the ithomine tribe Tithoreini. *Journ. New York ent. soc.* 68: 152-156, 1 fig. [Reorganizes synonymy of *Patricia*, gives a revised key; adds one subspecies of *Tithorea harmonia*.]

..............., 1960b. A monograph of the Ithomiidæ (Lepidoptera), Part II. *Trans. American ent. soc.* 86: 109-171, 28 text figs., 4 pls. [With keys and bibliography.]

Haensch, R., 1909. Familie: Danaidæ. In A. Seitz, *Grossschmetterlinge der Erde*, Stuttgart. Vol. 5: 113-171, pls. 31-41.

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The stylized Lepidoptera on the covers of volumes 14 and 15 were drawn by William Vars, of the Department of Zoology of Yale University.

VARIATION IN *PLEBEJUS ICARIOIDES* (LYCÆNIDÆ) I. FOODPLANT SPECIFICITY

by JOHN C. DOWNEY and WOODSON C. FULLER

The importance of ecology in the evolution of species has been accepted and stressed by biologists. Abundance and distribution of organisms is usually considered in studies of speciation. The evolution of food-plant specificity and the influence of the foodplant in phytophagous insects, however, has received comparatively little attention. DETHIER (1953, 1954), REMINGTON (1952), REMINGTON and PEASE (1955), and others, have called attention to the importance of this subject. REMINGTON and PEASE (1955:4) have suggested that lepidopterists can add much to our knowledge of insect-food plant relations with "the guidance of the experimental method and comparative observation." Knowledge of "biological" or "foodplant races" of insects is but one aspect which provides us with much data on which to base taxonomic and evolutionary conclusions. As more data are accumulated, the greater is our assurance that the conclusions are founded on criteria consistent with the conceptual model of major evolutionary factors. A concerted effort by lepidopterists would elevate foodplant associations from a mere catalog of observations to a useful tool.

The purpose of this paper is to record the known foodplants of the butterfly *Plebejus* (*Icaricia*) *icarioides* (Bdv.) along with some pertinent observations on specificity, distribution, and other factors which may have effects on variation within the insect. The study is based both on an extended collecting trip throughout western North America made by both authors in 1959, and earlier studies by DOWNEY. We are grateful to Dr. DAVID B. DUNN, University of Missouri, for his kindness in determining the foodplants herein reported.

P. icarioides comprises a polytypic array of numerous discontinuous populations occupying most of the continent of North America west of the Central Great Plains region. Within this area the majority of populations are in the Canadian and Transition life zones of MERRIAM. Because of this restriction, the elevation at which they live generally is higher in the south and lower in the north. Populations can be found from sea level (Vancouver Island, B. C.; San Francisco and Morro Bay, Calif.) to over 10,000′ in elevation (White Mountains, Calif.; Wasatch Mountains, Utah; Weston Pass, Colo.). The species is further restricted to the distribution of the plant genus *Lupinus* on which the larvæ feed.

Newcomer (1911) has accurately described the complete life cycle of *P. icarioides* under the name *Lycæna fulla* Edw. Comstock and Dammers (1935) also described the life cycle of southern California representatives of this species (=*Plebejus icarioides evius* Bdv.). The reader is referred to these works for detailed descriptions and drawings of the egg, the larval stages, and the pupa.

Since its original description in 1852, no less than twenty-four names have been applied to this single species or portions of it; twelve subspecies are still commonly mentioned in the literature. In a later paper, the senior author will discuss the taxonomy of the species, and attempt to show the artificiality of the subspecies concept in this species. The many names used however, give indication of the variability of the different populations. Hovanitz (1937) described the species as a *Rassenkreis* (a circle of races) and called attention to its complexity. He further suggested some environmental (habitat restriction) and physiological (foodplant differences) causes of the subspeciation. Although the main emphasis of his work was on synonomy and the fixation of the type localities for the three subspecies included, his hypothesis on the cause of the subspeciation offers a distinct challenge for further work.

During field observations in nine western states and two Canadian provinces, the butterfly was never collected where lupine plants were not discovered within fifty yards of the site of capture. The majority of specimens were collected in direct association with the plant. In most localities, the presence of more than one species of lupine prevented the use of adult association as a criterion of host specificity. Consequently, no lupine was classified as a host plant unless either females were observed ovipositing on the tissues, or eggs or larvæ were found on the plant. Often when the eggs alone were discovered, thorough inspection of the plant revealed characteristic larval damage which verified the utilization of the plant as a food source by the butterfly. Other lupines in the locality of a host lupine also were searched and collected to determine if they were also being utilized, and as insurance that the eggs on the first lupine were not deposited just as an oviposition response. Table 1 gives the species of the genus *Lupinus* which serve as host plants of listed populations of the butterfly. These include published sources and new records established in this study.

The distribution of many of these species of lupine is sympatric (see Jepson, 1951, and Dunn, 1955). However, never more than one species of *Lupinus* was found to be a host plant in any one locality during one season. The nearest approach to two hosts in one area at one time occurred at Austin Summit, Nevada, and involved a hybrid as mentioned below. Two instances were noted which may indicate a change in food plant in one locality over several years time. The usefulness of this observation is somewhat mitigated by difficulties in the taxonomy of the lupine. Hovanitz (1937) reported that the population from Twin Peaks, San Francisco, California was feeding on *L. variicolor* Steud. Downey found this population in 1954 and 1955 feeding on *L. albifrons* Bth. var. *collinus* Hel. Williams (1908) states that *P. icarioides* larvæ from "about the [environs] of San Francisco" fed on *L. micranthus* Dougl., and "could not be induced to eat other legumes." There is some question as to the population affinities of the larvæ studied by Williams, but they were probably not from the beach populations, since he referred to *Lycæna pheres* in the same paper. This name was used at that time for what we now believe to be a unique (and perhaps extinct) beach population of *P. icarioides*. Possibly the San Francisco populations from higher elevations utilize all three lupines: *L. variicolor* Steud., *L. albifrons* Bth., and *L. micranthus* Dougl. However, it is our opinion that the few small populations left in this vicinity feed only on *L. albifrons* Bth.

Samples of host lupine from Pequop Summit, Elko County, Nevada, were identified in 1956 by D. Dunn as *L. arbustus calcaratus* (Kell.) Dunn. The 1959 population from exactly the same locality was feeding on *L. holosericeus* Nutt. *ex* Torr. & Gray. Dunn informs the authors, however, that the latter is a poorly defined taxon. The latter species was not present in the small plant sample taken in 1955 from the area.

Occasionally two or more lupine species which are known to be host lupines in other areas occur together. In all such cases the butterfly selected only one host. Since this has a bearing on the specificity of the populations involved, the following examples are given.

As can be noted on Table 1, *Lupinus latifolius* Agardh. is the only known host plant of *P. icarioides* at Boggs Lake, Lake County, California. Also common in this locality, but not used as a host plant by the butterfly is *L. albifrons* Benth. The latter species is a host plant for populations in Berkeley (Berkeley Hills) and San Francisco (Twin Peaks), California. *L. latifolius* is also a host plant at Fawn Lodge near Weaverville, Trinity County, California, and at Shawnigan Lake, Vancouver Island, British Columbia. Barnes and McDunnough (1919) state that Blackmore noted that the *icarioides* population at Goldstream, Brit. Col., utilizes *columbianus* (Heller), which is now considered a variety of *latifolius*. Just across the Strait of Juan de Fuca in Washington, the population on Hurricane Ridge in the Olympic Mountains feeds on *Lupinus glacialis*

Table 1. *LUPINUS* HOST PLANTS OF VARIOUS POPULATIONS OF *PLEBEJUS ICARIOIDES*

Species of *Lupinus*	Host localities	Reference and year noted
albifrons Benth.	Berkeley, CALIF.	1955
albifrons var. *collinus* Greene	Twin Peaks, San Francisco, CALIF.	1954, 1955
andersonii S. Wats.	Mt. Conness, CALIF.;	Montgomery*, 1959
	Diamond Lake, Crescent Lake, and Mammoth Lakes, ORE.	1959
arbustus silvicola (Heller) Dunn	Silver Lake & Twin Lake, CALIF.	1955, 1959
arbustus calcaratus (Kell.) Dunn	Pequop Summit, NEV.	1955
argenteus var. *tenellus* (Dougl. *ex* G. Don) Dunn	Eureka, NEV.; McGee Creek, CALIF.	1959
caudatus Kell.	Big Cottonwood Canyon, UTAH; Austin Summit & Eastgate, NEV.; LeeVining, CALIF.	1955, 1959
caudatus Kell. × *Lupinus* sp.?	Austin Summit, NEV.	1955
chamissonis Eschs.	San Francisco, CALIF. (beach)	Williams, 1910; Hovanitz, 1937
densiflorus var. *gloreosus* (C. P. Sm.)	Frazier Park, CALIF.	Montgomery*, 1959
fulcratus Greene	Meyers & Fallen Leaf Lake, CALIF.	1955, 1959
glacialis C. P. Sm.	Hurricane Ridge, WASH.	1959
holosericeus Nutt. *ex* Torr. & Gray	Lamoille & Pequop Summit, NEV.	1959
latifolius J. G. Agardh.	Weaverville and Boggs Lake, CALIF.;	1955
	Shawnigan Lake, BRIT. COL.	1959
latifolius var. *columbianus* (Heller) C. P. Sm.	Goldstream, BRIT. COL.	Barnes & McD., 1919
leptostachyus Greene	Bondurant, WYO.	1959
meionanthus Gray	Lake Tahoe, CALIF.	Newcomer, 1911
	Sonora Pass, CALIF.	1959
micranthus Dougl.	San Francisco, CALIF.	Williams, 1908
sericeus Pursh	Avon, COLO.; Parley's Cany., UTAH; Butte, MONT.; Gallatin Cany. & South Gate, Y.N.P., WYO.	1959
sericeus egglestonianus C. P. Sm.	Gallatin Cany., MONT.	1959
sericeus Pursh × *leucophyllus* Dougl.	Half Moon Lake, WYO.	1959
sericeus Pursh × *caudatus* Kell.	Jenny Lake, WYO.	1959
variicolor Steud.	Twin Peaks, San Francisco, CALIF.	Hovanitz, 1937

*In letter from J. C. Montgomery, 1960

C. P. Sm. even though *latifolius* occurs there commonly. In this locality, the local form of *Glaucopsyche lygdamus* feeds on *latifolius* and some competition between the two species for the same host may exist. Lacking sufficient data on the factor of competition between species, we hesitate to suggest that a physiological "character displacement" has forced the competitors to their respective lupine hosts.

Populations from the same locality in Eureka, Nevada, utilized *L. argentus* var. *tenellus* (Dougl. *ex*. G. Don) Dunn when sampled in 1955 and 1959. The McGee Creek, Mono County, California, and Mt. Charleston, Nevada, populations also utilized this species. Though present in the environment of a population from Lamoille, Nevada, *tenellus* was rejected in favor of *holosericeus* Nutt. *Lupinus leptostachyus* Greene occurs both at Bondurant and Half Moon Lake, Wyoming, but it is the host plant only in the former locality. The Half Moon Lake population feeds on a hybrid, *L. sericeus* × *L. leucophyllus*.

Foodplant associations could not always be established, particularly in areas where the butterfly was rare or absent on the day collections were made. Many species of *Lupinus* listed in Table 1 were very common in other regions, and undoubtedly serve as hosts in localities other than those indicated. Other species of lupine were collected, both from areas of known-host populations and elsewhere, but were never found to be utilized by the butterfly. These include the following: *albicaulis* Dougl. *ex* Hook; *alpestris* A. Nels.; *confertus* Kell.; *excubitus* Jones; *lobbii* Gray *ex* Greene; *lyallii* Gray; *polyphyllus superbus* (Heller) Munz; *pratensis* Heller; *spathulatus* Rydb.; and *succulentus* Dougl. *ex* Kock.

The only eggs found that were not on lupine were collected at Fawn Lodge, Trinity County, California, where seven eggs were located on a single leaf of Mullein (*Verbascum thapsus* L.) and one egg on an adjacent stem of grass (*Poa* sp?). A large lupine which also contained eggs surrounded the latter two plants, and very possibly a single female laid all the eggs. There seems to be a marked preference on the part of the female for hirsute plants. When gravid females are caged with two or more types of non-host lupine, more eggs are invariably found on the hairiest species. At Austin Summit, Nevada, several broad-leaved, more densely hirsute plants were located in the midst of an extensive stand of *Lupinus caudatus* Kell., which was the host plant for the local population of butterfly. There was such a marked difference between the two types of plant that two species of plants were thought to be involved, even though we were cognizant of the effects of hybridization. Dunn identified the hirsute plant as a hybrid of *L. caudatus* × *Lupinus* sp.? The average number of eggs on the normal lupine in the vicinity was one egg per plant. Over twelve eggs per plant occurred on the hirsute hybrid. Knowledge of this oviposition response helped us on numerous occasions. For example, eggs were discovered at Rutherford, California, after collecting a few adults in the vicinity of five different species of annual and perennial lupines, by the simple expediency of initial search on the most hirsute variety. Subsequent examination of all other species of lupine in the area failed to reveal a single egg.

An attempt was made to use the number of eggs per lupine stalk as an indication of population size. So many variables were encountered however, that a satisfactory correlation could not be made. Egg density varies with the number of lupine host plants available in an area, as well as other ecological factors. By far the greatest number of eggs per plant per unit area was found in central and marginal Great Basin populations. This is probably due to the more stringent physical factors of the environment (particularly moisture) which necessitate an adaptive response on the part of the populations in the area to a shorter active life and a longer diapause. More adults and eggs were found at one lupine patch in Eureka, Nevada, for instance, than were located in a comparable expanse of lupine in the central Sierra Nevada Mountains. In areas outside of the Great Basin, rarely were over seventy-five eggs discovered in one day. However, at Pequop Summit, Nevada, over 350 eggs were collected in a little over three hours. In sixteen localities (picked at random) from which eggs were collected on annual lupine species, 2519 stalks were examined and 272 had one or more eggs, (11%). We seldom had to examine many stalks before eggs were discovered, and with this indication, if 100 stalks had no eggs we felt fairly safe in assuming the plant involved was not a host.

In laboratory experiments, both field and laboratory hatched larvae readily accept other species of lupine. In fact, to compensate for any adult variations which may have resulted from food plant differences in his studies of this species, Downey rears all larvæ on *Lupinus alba* L., a plant native to Italy and one with which none of the populations could have been associated under natural conditions. In one experiment using eggs from the population at Twin Peaks, San Francisco, California, five groups, each consisting of ten larvæ, were confined to dishes containing different species of lupine. One group was left on the natural food plant (*albifrons*) and three other groups on the following plants: *L. caudatus*, a host from Utah; *L. succulentus* Dougl. *ex* Knock, a non-host from Vacaville, California; and *L. alba* from Italy. A fifth group was transferred daily to one of the four types of lupine used in the other groups, so that every fifth day they received the same host species.

All larvæ emerged from the eggs within a twenty-four hour period, and were kept in a dark cabinet held at 80°F., 80 per cent relative humidity during development. All groups had an additional molt between hatching and larval diapause — two molts instead of one. They all molted at the same time, and began diapause at the same time in what could be judged to be the same health and vigor. This demonstrated that there was no apparent physiological effect of different host plants on the Twin Peaks population, at least to the diapause state. Unfortunately, few individuals from any of these groups terminated diapause five to six months later. This was due to factors other than host plant difficulties and applied to the control as well as the test groups. The ease with which larvae from Utah, Nevada, Oregon, Washington, California, Montana, and Wyoming accept different species of lupine in the laboratory adds weight to the premise that any species of this genus of plants can serve as a host.

COMSTOCK (1927) states that the larvæ of *P. icarioides* "have been observed feeding on lupine and clover." With trust in the author's accurate determination of the larvæ, we can only state that the utilization of clover (*Trifolium*) is the exception rather than the rule with this butterfly. There is evidence of a double-brood in Southern California populations, and if such occurs, very likely there has been a food plant adjustment.

That populations were found on only one lupine in any one locality indicates a host-specificity in nature. It is also an indication of physiological divergence between populations, but seems to be based on egg-laying habits of the adults rather than nutritional requirements of the larvæ. The physiological effects may be very subtle, but the presence of an active population on a single host plant per unit area would be an *a priori* reason for assuming physiological success. The comparative success between different populations, probably measured by abundance, requires a degree of ecological and geological knowledge which is not yet attained.

The calculations of SEWALL WRIGHT indicate that the size of subpopulations and the degree of their isolation from one another have a great deal to do with population variation and subsequent taxonomic differentiation. DOWNEY (1957) has previously pointed out that the colonial nature of the subgroups of *P. icarioides* tends to reduce the rate of interbreeding between adjacent populations, and is of signal importance in accounting for the degree of polymorphism exhibited. It is our opinion that this degree of isolation is intimately associated with the local and spotty distribution of the host plant as based on edaphic factors. We further feel that the discontinuous distribution of the host plants is of greater importance in speciation in this insect than the host specificity of individual populations.

Conclusions

1. Sixteen full species plus seven varieties or hybrids of the plant genus *Lupinus* were found to serve as host plants of different geographical populations of the butterfly *Plebejus* (*Icaricia*) *icarioides* (Bdv.). This represents a sample from thirty-four new localities scattered throughout the greater range of the species.
2. The oligophagous nature of the species was substantiated; it is restricted to members of the plant genus *Lupinus* (it is thought that the reported instance on clover is atypical). Individual populations tend to be monophagous, limiting their food plant to one species or variety.
3. Though all populations utilize only one species of lupine in a given area, some evidence indicates that a food plant change (from one lupine species to another) has occurred. This change in specificity in time is compatable with the noted differences in specificity in space.
4. Four cases were noted where populations failed to utilize a lupine species known to be a host plant in another area. Is is suggested that this difference is due to an oviposition response on the part of the adult, rather than to a nutritional preference by the larva. This oviposition response appears to be directly correlated with the hirsute qualities of the lupine.
5. The fact that larvæ have been successfully reared on lupines other than their normal host provides additional evidence that any species of *Lupinus* may be utilized by *P. icarioides* as a foodplant.
6. The localized and spotty distribution of the host plant limits the distribution of the butterfly to isolated pockets, and is presumed to have a greater effect on the variability of the insect than do the assumed differences attributed to the selection of different host plants.
7. Although variation in lupine preference of the adult may indicate a subtle difference in physiology, it is assumed that the observed difference between populations is not genetically fixed. At this stage of the evolution of *Plebejus icarioides*, foodplant specificity is not an infra-specific isolating mechanism.

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Literature Cited

Barnes, Wm., & J. H. McDunnough, 1919. A new race of *Plebeius icarioides* from Vancouver Island. *Can. ent.* 51: 92-93.

Comstock, J. A., 1927. *Butterflies of California.* 344 pp., 63 col. pls. Published by the author, Los Angeles, California.

Comstock, J. A., & C. M. Dammers, 1935. Notes on the early stages of two butterflies and one moth. *Bull. so. Calif. acad. sci.* 34: 81-87, 5 pls.

Dethier, V. G., 1953. Host plant perception in phytophagus insects. *Trans. IXth int. congress ent.*: 81-88.

............, 1954. Evolution of feeding preferences in phytophagous insects. *Evolution* 8: 33-54.

Downey, J. C., 1957. Ecology and selection in a polytypic species of butterfly. *Bull. ent. soc. Amer.* 3 (3): 22 (abstract).

Dunn, D. B., 1955. Taxonomy of *Lupinus,* group Micranthi (Leguminosæ) of the Pacific Coast. *El alizo* 3: 135-171.

Hovanitz, W., 1937. Concerning the *Plebejus icarioides* Rassenkreis. *Pan-Pacific ent.* 13: 184-189.

Jepson, W. L., 1951. *A manual of the flowering plants of California.* 1238 pp. Univ. California Press, Berkeley, California.

Newcomer, E. J., 1911. The life histories of two lycænid butterflies. *Can. ent.* 43: 83-88.

Remington, C. L., 1952. The biology of Nearctic Lepidoptera. I. Foodplants and life-histories of Colorado Papilionoidea. *Psyche* 59: 61-70.

Remington, C. L., & R. W. Pease, Jr., 1955. Studies in foodplant specificity. I. The suitability of swamp white cedar for *Mitoura gryneus* (Lycænidæ). *Lepid. news* 9: 4-6.

Williams, F. X., 1908. The life history of *Lycæna antiacis* Bdv., with notes on other species. *Ent. news* 19: 476-483.

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THE SOLUTION OF A LONG OUTSTANDING PROBLEM IN THE GENETICS OF DIMORPHISM IN *COLIAS*

by Z. LORKOVIĆ and Č. HERMAN

The interest in the dichroism of white and orange females of the butterfly genus *Colias* has been revived by the recently recognized importance of polymorphism as involved in the problems of population genetics and evolution (Ford, 1945). The problem of the genetics of this dichroism is as old as the rediscovery of the laws of heredity itself. Already in 1901 FROHAWK reported the results of breeding four wild white females of *Colias croceus* Fourc. (= *edusa*). He had obtained 110 white and 125 orange individuals, *i.e.* a ratio of 1:1. When later, in 1905, 52 white and 13 orange individuals, *i.e.* a ratio of 3:1, were obtained from one wild white female by MAIN and HARRISON, it was fairly established that a monohybrid cross of a dominant allele for white and a recessive one for orange was involved. It is likely that the report of this brood remained unnoticed since it was subscribed by "Anonymous". Anyway, it was not until 1911 that it was proved by GEROULD, who based his conclusions on numerous results of broods and crosses of the North American species *Colias philodice,* that the gene for white is wholly dominant over the gene for orange. But since white males appear neither in nature nor in experimental crosses (neither with the *AA* nor *Aa* genotype), GEROULD maintained the gene for white to be recessive in males. However, in 1923 he concluded correctly that a pair of autosomal genes were involved, their manifestation being sex-controlled. GEROULD as well as HOVANITZ and REMINGTON used for this phenomenon the term "sex-limited inheritance". The same situation is known to apply in the dimorphism of *Argynnis paphia* var. "valesina", where the allele for the dark colour is expressed only in females, as proved by GOLDSCHMIDT (1922). Evidently, this might hold for all cases of female dimorphism in butterflies.

Besides the sex-controlled or sex-limited inheritance some irregularities in the supposed *Aa* $\times$ *Aa* crosses were found by GEROULD: instead of the expected 3:1 ratio he obtained in some broods good 2:1 ratios, whereas the 3:1 ratio was found to appear only rarely. Hence he deduced that the *AA* combination was lethal. Twelve years later, however, he changed this hypothesis by supposing one separate lethal gene linked with the gene *A* or *a*. Only in this way could he explain the shortage of white females in the 3:1 ratios as well as the complete lack of homozygous orange females in one cross where a ratio 3:1 was expected.

The question of the dimorphism in the genus *Colias* was thus found unsolved twenty years ago. HOVANITZ was the first to be struck by this. The ecological significance of the dimorphism in question was amply studied by him. He observed, too, in the crosses with a very similar species *Colias eurytheme* Boisd.* that many 2:1 proportions appeared instead of 3:1. His interpretation of the anomaly is similar to that first employed by GEROULD, with the additional attempt to alleviate the lethality of the homozygous *AA* combination by sublethality and a certain modifying influence of the genic environment. Later studies of the geographic distribution of white and orange females, however, turned his attention to the possibility of the more important part being played by the environment rather than by genic modifiers, white colour was more frequent northwards and orange southwards; furthermore, the white form was more active at lower temperature and orange at higher ones. In the same sense REMINGTON, who carried out a critical review of all the broods and crosses in the genus *Colias* so far (1954), concluded that there were no convincing arguments for the hypothesis of lethality, the different viability of the genotypes in different environmental conditions being a more plausible alternative. The lethality, or disadvantage of the double dose, however was considered later by HUXLEY (1955, 1956) as a possible explanation of the maintaining of polymorphism in populations. But this is perhaps an unnecessary duplication in explaining phenomena.

The first of the authors of the present paper could not obtain convincing evidence of the existence of lethality in broods of *Colias croceus* reared by him during 1941-1951 period, since the frequency of ratios 1:0, 3:1 and 1:1 in 8 broods coincided with the percentage of white and orange females in the natural population of the surroundings of Zagreb. The proportion was in one backcross nearer to 2:1 ($X^2 = 0.666$) than 1:1 ($X^2 = 0.942$) but this could be fairly easily ascribed to the low number of individuals (16:11). In another case of a greater probability of 2:1 than 1:1 the number of individuals was still smaller (15:9) but the genotype was unknown (Lorković & Herman, 1958).

In order to solve the question definitely it was decided to carry out the necessary number of relevant types of crosses with *Colias croceus*.

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* In fact, owing to the very incomplete genetical reproductive isolation between *C. philodice* and *C. eurytheme* as established by HOVANITZ (1943), *C. eurytheme* cannot be considered as a true species but only as a semispecies.

The first experiments in 1957 were unsuccessful because of a sudden chill which destroyed all the food plants available. The experiments were started anew in August 1958 and were finished in April 1959 after 6 subsequent generations had been bred.

Materials and Methods

Three white and three orange females of *Colias croceus* Fourc., already mated with unknown males of the same species, were captured in Istria at the end of July 1958 and brought to the laboratory.

On July 28th, 1958, two white and three orange females already mated in nature were captured on Šalata in Zagreb. They were prepared for laboratory breeding.

All captured females were very young, not more than 3 to 5 days old. All were laying eggs onto young alfalfa plants (*Medicago sativa* L.) in cages sized 25 × 25 × 40 cm. During oviposition, the females were fed on beet sugar in water. The caterpillars were constantly fed on young alfalfa. Prepupæ hung themselves onto the walls of the cages resting there until the imagos got out. The butterflies after they had left the pupæ were separated into special cages owing to sex and phenotypes.

The males were fit for copulation the second day after eclosion and the females immediately after having got dried. There were obtained a lot of copulæ. The majority consisted of natural copulæ in the large cage (40 × 50 × 60) or in the large window. Some copulæ were artificial according to Lorković's method (1948) and some semi-artificial where the female was held onto by the wings with a pair of forceps and posed near the male. When there was no sunlight a 200W bulb was used.

Of wild females from Istria and Zagreb six successive laboratory generations were bred from the end of July 1958 to the beginning of May 1959.

The results were elaborated statistically using the chi-squared test (Fisher, 1948).

Results

The first laboratory generations of wild "alba" females from Istria yielded ratios of white and orange daughters that conform to the supposition 1:1 with a high probability. (See table A, broods No. 1, 2, 3.) Hence all three white mothers were of the *Aa* genotype and the unknown males they had mated with in nature had probably been of the *aa* genotype.

Table A. The obtained ratios and their statistical elaboration.

Brood	Month & year	Proportion white	: yellow	Theoretical proportion	X^2	P
1	8	17	22	1 : 1	0,64102	0,30<P<0,50
2	8	35	37	1 : 1	0,05554	0,80<P<0,90
3	8	51	58	1 : 1	0,44954	0,50<P<0,70
4	8	0	85	0 : 1		
5	8	0	100	0 : 1		
6	8	0	59	0 : 1		
7	8	21	27	1 : 1	0,75000	0,30<P<0,50
8	8	55	55	1 : 1	0,00000	100
9	8	0	149	0 : 1		
10	8	23	28	1 : 1	0,49019	0,30<P<0,50
11	8	0	101	0 : 1		
2A	9	55	14	3 : 1	0,81622	0,30<P<0,50
2B	9	0	39	0 : 1		
2C	9	47	40	1 : 1	0,56320	0,30<P<0,50
2D	9	5	2	3 : 1	0,04760	0,80<P<0,90
3A	9	27	23	1 : 1	0,32000	0,50<P<0,70
3B	9	20	10	1 : 1	3,33333	0,05<P<0,10
3C	9	29	34	1 : 1	0,39682	0,50<P<0,70
3D	9	28	34	1 : 1	0,58064	0,30<P<0,50
3E	9	35	36	1 : 1	0,01408	0,90<P<0,95
3F	9	21	19	1 : 1	0,10000	0,70<P<0,80
7A	9	29	2	3 : 1	5,08816	0,02<P<0,05
7B	9	23	4	3 : 1	0,54320	0,30<P<0,50
8A	9	54	19	3 : 1	0,04109	0,80<P<0,90
8B	9	34	11	3 : 1	0,07406	0,70<P<0,80
8C	9	0	45	0 : 1		
8D	9	23	15	1 : 1	1,68420	0,10<P<0,20
8E	9	13	4	3 : 1	0,06371	0,80<P<0,90
8F	9	29	19	1 : 1	2,08333	0,10<P<0,20
8G	9	28	27	1 : 1	0,01818	0,80<P<0,90
8H	9	0	43	0 : 1		
8K	9	0	47	0 : 1		
8L	9	12	15	1 : 1	0,33332	0,50<P<0,70
8M	9	0	15	0 : 1		
41	11	20	6	3 : 1	0,05128	0,80<P<0,90
42	11	27	0	1 : 0		
43	11	12	0	1 : 0		
44	11	30	23	1 : 1	0,92452	0,30<P<0,50
45	11	5	0	1 : 0		
46	11	3	0	1 : 0		
47	11	2	0	1 : 0		
48	11	15	11	1 : 1	0,61538	0,30<P<0,50
49	11	30	0	1 : 0		
51	11	38	11	3 : 1	0,17006	0,50<P<0,70
52	11.1958.	5	1	3 : 1	0,22221	0,50<P<0,70
A	1.1959.	12	0	1 : 0		
B	1.1959.	15	0	1 : 0		
C	1.1959.	15	0	1 : 0		
A1	3.1959.	1	0	1 : 0		
A1A	4.1959.	19	0	1 : 0		

The three orange mothers from Istria produced only orange daughters in their progeny (table A, broods 4, 5, 6). Thus they were of the *aa* type, and the males they had mated with in nature had been of the same type as well.

The two white females captured on Šalata in Zagreb yielded in their progeny white and orange daughters in a fair relationship 1:1 (table A, broods 7 and 10). They were thus of the *Aa* genotype and the males they had mated with of the *aa* genotype.

One orange female on Šalata (table A, brood 8) yielded 55 white and 55 orange daughters. This is the exact ratio of 1:1. The mother was of the *aa* genotype whereas the wild father ought to have been of the *Aa* genotype.

The remaining two orange females from Šalata yielded in their progeny only orange daughters (table A, broods 9 and 11).

Table A demonstrates clearly the ratios obtained and their statistical elaboration. Table B shows the genotypes according to their groups.

The second laboratory generation has been bred from fertilized females of broods 2, 3, 7 and 8.

From brood 2 eight females mated with brothers of the same brood. Of these there is a further progeny of two white females (broods 2 D and 2 A) and the offspring of two orange females (broods 2 C and 2 B). See scheme 1.

Five white and two orange (daughters) females have been obtained from brood 2 D. Due to the small number, the result cannot be considered as a sure evidence that their parents belong to the genotypes *Aa* × *Aa*.

Brood 2 A – mother "alba" – yielded an excellent result of 55 white: 14 orange females (daughters). X^2 is only 0.81622. The parents were *Aa* × *Aa* (table BV and table A).

Brood 2 C – mother orange – yielded a good ratio 1:1. Thus the mother was *aa* and the father *Aa*.

Brood 2 B is of the type *aa* × *aa*, since only orange daughters have been obtained.

Of the total of four copulæ two were *Aa* × *Aa*, one of them was *Aa* ×*aa* and the other *aa* ×*aa*. This fact has been confirmed on the supposition that the obtained genotypes *Aa* and *aa* in brood 2 are in the ratio of 1:1, since in five butterflies there have been found the genotype *Aa* and in three the genotype *aa*, of the total of 8 tested ones.

Brood 3 (see scheme 2) produced a total of seven matings of sisters and brothers. The progeny of three "alba" and three yellow mothers was used (Nos. 3 A, 3 B, 3 C, 3 D, 3 E and 3 F) for breeding.

Table B. The genotypes according to their groups.

I. ♂♂ aa × ♀♀ aa			
Brood	♂♂	white ♀♀ :	yellow ♀♀
4	84	0	85
5	124	0	100
6	67	0	59
9	168	0	149
11	99	0	101
2B	38	0	39
8C	44	0	45
8H	36	0	43
8K	53	0	47
8M	10	0	15

II. ♂♂ aa × ♀♀ Aa			
1	48	17	22
2	79	35	37
3	94	51	58
7	48	21	27
10	49	23	28
3A	46	27	23
3C	83	29	34
3D	55	28	34
48	22	15	11
8F	53	29	19
8L	28	12	15

III. ♂♂ aa × ♀♀ AA			
6*-1957	45	54	0

* Brood of previous experiment.

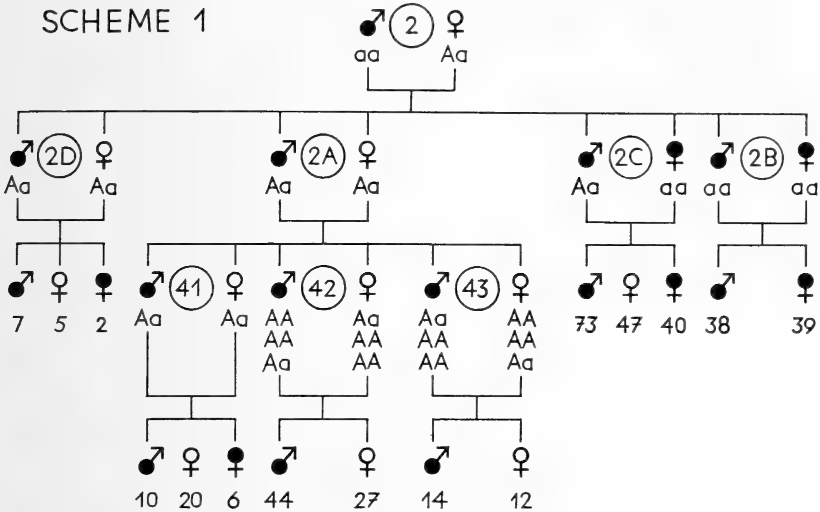
IV. ♂♂ Aa × ♀♀ aa			
Brood	♂♂	white ♀♀ :	yellow ♀♀
8	125	55	55
2C	73	47	40
3B	21	20	10
3E	42	35	36
3F	24	21	19
8D	32	23	15
8G	60	28	27
44	50	30	23

V. ♂♂ Aa × ♀♀ Aa			
8A	63	54	19
8B	55	34	11
8E	17	13	4
2D	7	5	2
2A	76	55	14
41	10	20	6
7B	30	23	4
7A	38	29	2
51	49	38	11
52	10	5	1

VI. ♂♂ AA × ♀♀ aa			
C	19	15	0

VII. White ♀♀ and one parent homozygous AA			
42	44	27	0
43	14	12	0
45	7	5	0
46	3	3	0
47	2	2	0
49	21	30	0
A	12	12	0
B	26	15	0
A1	3	1	0
A1A	20	19	0

SCHEME 1



In broods 3 A, 3 C, 3 D – mother "alba" – there are good 1:1 ratios (table B II), thus the parents were *aa* × *Aa*.

In broods 3 B, 3 E, 3 F – mother orange (table B IV) – there have been obtained good 1:1 ratios, hence their parents were *Aa* × *aa*.

Of the total of 12 butterflies tested for their genotype, six are of the *Aa* genotype and the remaining six of the *aa* genotype. That is the accurate ratio 1:1 which confirms the supposition that the butterflies of brood 3 were of the genotypes *Aa* and *aa* in the relationship 1:1. This is of course comprehensible, since they are the progeny of the crossing of the *Aa* mother and the orange *aa* male.

From brood No. 7 (scheme 3) there are five pairings. For further breeding there have been used the progeny of two "alba" females (No. 7 A and 7 B). Brood 7 B yielded a good ratio 3:1 and breed 7 A ratio 3:1 with an insignificant probability rate. The parents were thus *Aa* × *Aa*.

Brood No. 8 yielded altogether 17 copulæ. We used for breeding the progeny of 5 "alba" females (scheme 4) No. 8 A, 8 B, 8 F, 8 L and 8 E and six orange females No. 8 D, 8 G, 8 C, 8 H, 8 K and 8 M.

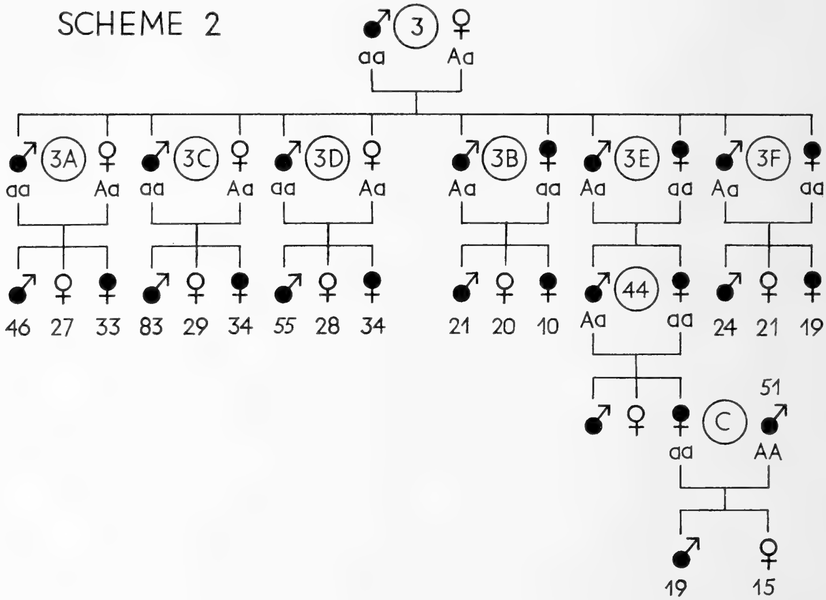
Broods 8 F and 8 L – mother white – produced good 1:1 ratios (table B II), hence the parents were *aa* × *Aa*.

Broods 8 A, 8 B, 8 E – mothers white – yielded good 3:1 ratios (B V), the parents were *Aa* × *Aa*.

Broods 8 D and 8 G – mother orange – yielded good 1:1 ratios (B IV), the parents were *Aa* × *aa* (B I).

Broods 8 C, 8 H, 8 K and 8 M – mother orange – yielded good 0:1 ratios (B I), the parents were *aa* × *aa*.

SCHEME 2



Of the total of 22 butterflies tested for their genotype in brood 8, there were 10 genotypes *Aa* and 12 genotypes *aa*, which is again a proof for the supposition that brood No. 8 was composed of genotype *Aa* and *aa* in relationship 1:1.

The third laboratory generation has been bred from the progeny of females from brood No. 2 A, 3 E, 7 B and 8 E. All females mated with males of the proper brood.

Broods 41, 42, 43 were derived (scheme 1) from "alba" females of brood No. 2 A mated with males of brood 2 A.

Brood 41 yielded a good ratio 3:1 (B V), the parents were *Aa* × *Aa*.

Broods 42 and 43 produced the ratio 1:0. There are 3 probabilities for the genotypes of the parents *AA* × *Aa*, *AA* × *AA*, *Aa* × *AA*.

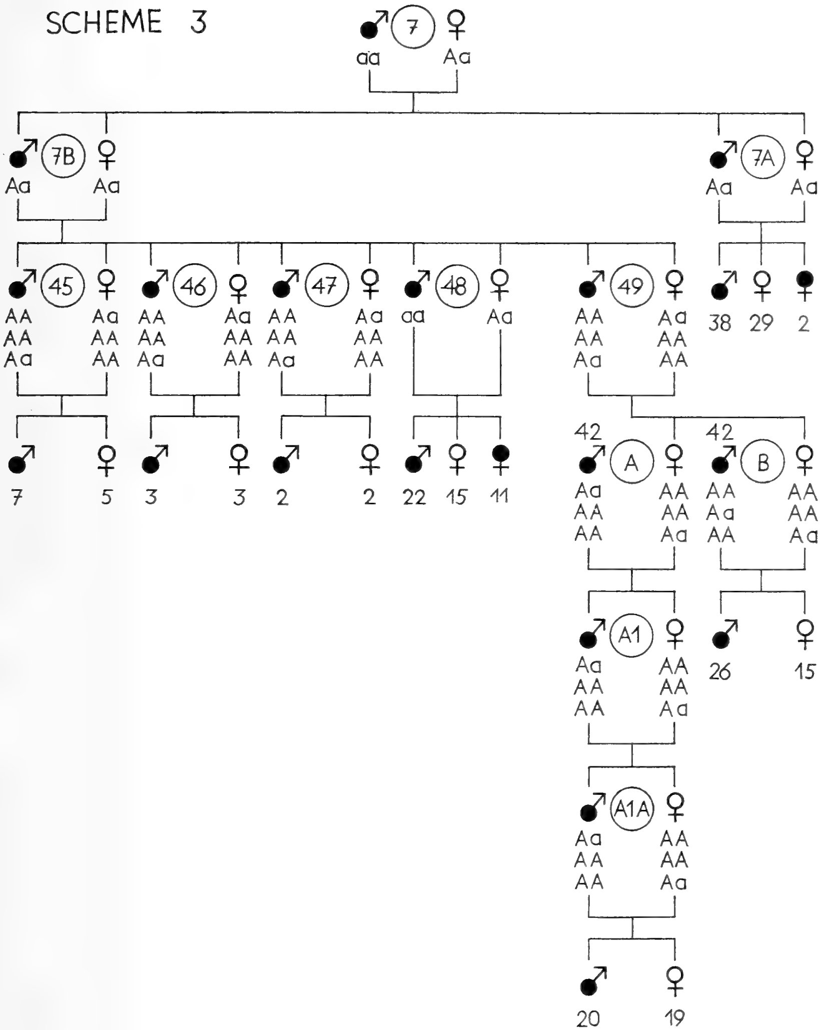
If we count with the fact that all butterflies of brood 2 A were of the genotype *AA* : 2*Aa* : *aa* (since they are the offspring of the crossing *Aa* × *Aa*) then there should be given preference to the supposition that one brood was of type *AA* × *Aa* and the other type *AA* × *AA*. Such ones belong to table B VII of white females with one homozygote parent.

Brood 44 (parents 3E × 3E) – mothers orange – (scheme 2) produced a good ratio 1:1. The parents were *Aa* × *aa* (B IV).

Broods 45, 46, 47, 48 and 49 derive from white females of breed 7 B mated with males froom breed 7 B.

Brood 48 yielded a good relationship 1:1. The parents were *aa* × *Aa*. Broods 45, 46 and 47 yielded the ratio 1:0 with a small probability rate,

SCHEME 3


7
aa
Aa
7B
Aa
Aa
7A
Aa
Aa
45
AA
AA
Aa
Aa
AA
AA
46
AA
AA
Aa
Aa
AA
AA
47
AA
AA
Aa
Aa
AA
AA
48
aa
Aa
49
AA
AA
Aa
Aa
AA
AA
38
29
2
7
5
3
3
2
2
22
15
11
42
A
Aa
AA
AA
AA
AA
Aa
42
B
AA
Aa
AA
AA
AA
Aa
A1
Aa
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AA
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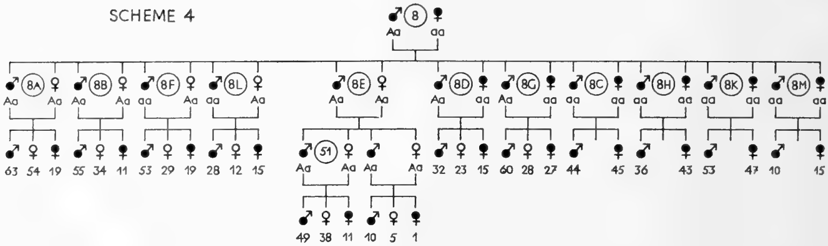
Aa
20
19

SCHEME 4



brood 49 yielded the ratio of 1:0 with a considerable probability since there emerged the total of 21 ♂♂ : 30 "alba" ♀♀ and not a single orange ♀. There are again 3 probabilities — AA × Aa, AA ×AA, Aa ×AA.

If we consider ratio *AA* : *Aa* : *aa* as the ratio 1 : 2 : 1, then we may suppose that one copula was of type *AA* × *AA*, two of type *AA* × *Aa* (resp. *Aa* × *AA*), one of type *Aa* ×*Aa* (which could be in brood 46 or 47, since it may be due to the small number) 3 males : 3 females, resp. 2 males : 2 females — orange females failed to emerge, one being certainly of type *aa* × *Aa*.

Broods 51 and 52 have been derived from "alba" females in brood 8 E mated with males from the same brood. Both broods yielded good 3 : 1 ratios, *i.e.* those crossings are *Aa* × *AA*.

The fourth laboratory generation has been bred from:

a) Two "alba" females from brood (ancestors No. 7 Šalata) mated with males from brood 42 (ancestors No. 2 from Istria, scheme 3). These are broods A and B.

b) From an orange female from brood 44 (ancestors from Istria) mated with a male from brood 51 (ancestors from Zagreb). This is brood C (scheme 2).

Broods A and B yielded good 1:0 ratios (table B VII).

Brood C also produced a good 1:0 ratio (table B VI). That is the proof that there are homozygote orange males of genotype *AA*.

The fifth laboratory generation bred from a white female from brood A mated with a male from brood A. That is brood A 1 (scheme 3). It yielded only three males and one "alba" female. This "alba" female mated with a male — her brother. Her progeny is:

The sixth laboratory generation in which there were 20 males and 19 white females (brood A 1 A).

Since in the genealogy of brood A 1 A there was no segregation in 5 successive generations, we are likely concerned with the mating *Aa* × *AA*. Both parents are homozygote dominant as to the observed characteristic. This, unfortunately, we have not been able to prove by means of further breeding.

Discussion

With our crossings of white and orange butterflies of *Colias croceus* we have attempted to obtain all those combinations of crossings indispensable for the explanation of the question concerning the viability of homozygote white *AA* genotypes. In fact, all ratios have been yielded which are possible in monohybrid autosomal crossing, *i.e.* in 11 broods the ratio of white : yellow females = 1:0 has been obtained, in 10 broods 3:1, in 19 broods 1:1, and in 10 broods 0:1. In not one single crossing have unexpected ratios been obtained, this being particularly important for the ratios 3:1 and 1:0. All ten 3:1 ratios could have been obtained only if such a ratio was expected because the parents were all from families with an equal (1:1) distribution of *Aa* and *aa* genotypes. In such a family (8) we succeeded in breeding a progeny of 11 inbred matings of which three yielded a ratio of progeny 3:1, four the ratio 1:1 and four 0:1, thus an ideal relationship of the three possible combinations from crosses of *Aa* × *Aa* and *aa* × *aa*. Moreover, in the broods with the ratio of 3:1, there were also homozygote *AA* individuals. This has been proved by 8 inbred matings (42, 47, 49, 49 A, 49 B), each with a ratio in their progeny of 1:0; hence one parent had to be homozygote. Such could have been the "alba" females being chosen for mothers, but the males as well. This latter has been proved by cross *C* (scheme 3), where a yellow (thus homozygote *aa*) mother and a father from a family with 3:1 ratio produced 19 "alba" females and not a single yellow one; thus the male must have been a homozygote *AA*.

Against the hypothesis of lethality or sublethality of the homozygote combination *AA*, postulated by Gerould and later by Hovanitz, argues the fact that the 3:1 ratios in laboratory broods are not rarer than is to be expected on the ground solely of genotypes in a series of generations. The fact that 3:1 ratios are yielded only exceptionally in progeny of wild "alba" females, while the proportion 1:1 is more frequent, is quite comprehensible due to the much lower percentage of "alba" females in nature. Therefore, instead of genetic F_2 generations, the backcross having the ratio of 1:1 occurs the most frequently, as we have already stressed in our previous study (1958).

In addition, it is very characteristic, that in our crossings among 17 with 1:1 proportions there are 14 very good ones with a mean value of P = 70, whereas only two crossings approach slightly the ratio 2:1 (though even these have a lesser probability of this ratio than of 1:1). One single crossing produced the ratio 2:1, being in fact precisely 20:10. It is just this ratio that had led to the idea of lethality of the dominant homozygote. But in this case not only is the genealogy not in support of this hypothesis, it even argues against it. The 2:1 ratio was obtained in cross 3 B, where the ratio of 3:1 is ruled out, since the mother was yellow (thus pure *aa*) whereas the father owing to his origin had to be *Aa;* hence the expected ratio could be only 1:1. Thus, in interpreting this 2:1 brood, we are not concerned with the absence of the homozygote *AA*, but with a double surplus of *Aa* genotypes.

This conforms to the fact that in 2 cases of expected 3:1 ratios the white phenotypes exceed by far the value 3 (3.74 in cross 7 A and 3.40 in 7 B). Therefore we are not at all allowed even to think of a lower viability of homozygote *AA* genotypes and even less of their lethality.

CONCLUSION

The current opinion that the dimorphism of "alba" and orange females of *Colias croceus* Fourc. is dependent on a pair of autosomal alleles with the dominant gene *A* for "alba" has been confirmed by our experiments. The phenotypic manifestation of this gene is strongly sex-controlled, for it is expressed only in the females even though males can also be *Aa* and *AA*. All this is known to apply in the North American species *Colias philodice* Latr. and *Colias* (*philodice*) *eurytheme* Boisd.* Our results can provide no support for the hypothesis of lethality of the dominant combination *AA* nor for the existence of a recessive lethal gene linked to the genes *A* or *a*. A certain excess of the white or orange form can most simply be explained by REMINGTON's hypothesis of the unequal vitality of the two genes in different environmental conditions, especially in different temperatures. Current investigations in our laboratory give support to this hypothesis and will contribute to the better understanding of the ecological side of *Colias* dimorphism with the hope that this example of morphism can be used more for population genetics.

SUMMARY

Extensive breeding and crossing with the species *Colias croceus* Fourc. have been performed in order to elucidate finally the genetics of dimorphism of white ("alba") and orange females of the genus *Colias*.

Experiments have confirmed the previous conception, that we are concerned with an autosomal pair of alleles, with the dominant gene producing white. This character is phenotypically sexually controlled, since it manifests itself only in the female.

On the other hand, no support whatsoever could be given to the hypothesis of lethality of the homozygous combination *AA*, nor of a recessive lethal gene closely linked to the genes *A* or *a*.

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* The designation of a semispecies proposed by KIRIAKOFF and LORKOVIĆ (latest 1958).

References

Burkhardt, V. R., 1948. Collecting in West Surrey, 1947. *Ent. rec.* 60: 20-21, 25-32.

Fisher, R. A., 1948. Statistical methods for research workers, Tenth Edition Revised and Enlarged. Edinburgh: Tweedale Court.

Ford, E. B., 1945. Polymorphism. *Biol. rev.* 20: 73-88.

Frohawk, F. W., 1901. On the occurrence of *Colias edusa* and *hyale* in 1901, and the results of rearing the var. *helice* from *helice* ova. *Entomologist* 34: 63-95.

Gerould, J. H., 1911. The inheritance of polymorphism and sex in *Colias philodice. Amer. nat.* 45: 257-283.

................, 1923. Inheritance of white wing color, a sex limited (sex-controlled) variation in yellow pierid butterflies. *Genetics* 8: 495-551.

................, 1943. Genetic and seasonal variations of orange wing color in *Colias* butterflies. *Proc. Amer. phil. soc.* 86: 405-438.

................, 1946. Hybridization and female albinism in *Colias philodice* and *C. eurytheme.* A New Hampshire survey in 1943 with subsequent data. *Ann. ent. soc. Amer.* 39: 383-396.

Goldschmidt, R. & E. Fischer, 1922. *Argynnis paphia-valesina,* ein Fall geschlechtskontrollierter Vererbung. *Genetica.*

Hovanitz, W., 1943. Hybridization and seasonal segregation in two races of a butterfly occuring together in two localities. *Biol. bull.* 85: 44-51.

..............., 1944a. Genetic data on the two races of *Colias chrysotheme* in North America and on a white form occuring in each. *Genetics* 29: 1-30.

..............., 1944b. The distribution of gene frequencies in wild populations of *Colias. Genetics* 29: 31-60.

..............., 1944c. The ecological significance of the color phases of *Colias chrysotheme* in North America. *Ecology* 25: 45-60.

............., 1948. Differences in the field activity of two female color phases of *Colias* butterflies at various times of the day. *Contrib. lab. vert. biol. univ. Mich.* 41: 1-37.

......., 1950. The biology of *Colias* butterflies. II. Parallel geographical variation of dimorphic color phases in North American species. *Wasmann journ. biol.* 8: 197-219.

..............., 1951. The biology of *Colias* butterflies. III. Variation of adult flight in the arctic and subarctic. *Wasmann journ. biol.* 9: 1-9.

Huxley, J., Morphism as a clue in the study of population dynamics. *Proc. roy. soc.* (*B*). 145: 319-322.

..............., 1955. Morphism in birds. *Acta XI internat. congr. orn.*: 309-328.

Lorković, Z., 1947. Umjetni postupci kopulacije leptira. *Glasnik Biol. sekcije* 2: 86-98.

..............., 1953. L'accouplement artificiel chez les lépidoptères et son application dans les recherches sur la fonction de l'appareil génital des insectes. *Physiol. comp. et œcol.* 3: 313-320.

Lorković, Z., & Herman, Č., 1958. The genetics of morphism in *Colias croceus* Fourc. from the surroundings of Zagreb. *Biol. Glasnik* 11: 55-59.

Lorković, Z., & Kiriakoff, S. G., 1958. Proposed insertion of provisions recognising the concept "semispecies". *Bull. zool. nomenclature* 15, Part 42, Section B: p.1031.

Remington, C. L., 1954. The genetics of *Colias. Advances in genetics* 6: 403-450.

Warrier, R. E., 1951. On breeding *Colias croceus* Fourc. *Ent. rec.* 63: 198-199.

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FIELD NOTES

SATYRIUM BEHRII (LYCÆNIDÆ) IN NEVADA

A small collection of Lepidoptera taken last summer in the Toiyabe Range, central Nevada, proved to include two specimens of *Satyrium behrii* (Edwards). Both were males, in good condition.

H. K. Clench, describing the range of *S. behrii* (in P. R. & A. H. Ehrlich, *How to know the butterflies*: p.192; 1961) states: " . . . strangely unrecorded from several states where it should occur: Oregon, Montana, Arizona and Nevada." It is therefore interesting to be able to record the presence of this colony of *S. behrii* resident in central Nevada.

The date of capture was 18 July 1960. The location was Kingston Forest Camp in the Toiyabe Range, Lander County, Nevada – a public campsite in the Toiyabe National Forest. The following data are for the benefit of any who may wish to visit the colony henceforth. It can be reached by taking route 8A south from its intersection with U.S. 50 a few miles east of Austin, Nevada. Just over 13½ miles from route 50 there is a gravel road heading west to, and then along, Kingston Creek. The campsite is about 5¾ miles from route 8A, at an elevation of 7100 feet. A careful examination of the rest of Kingston Canyon (the road continues up the canyon, crossing a pass at about 8650 feet, and descends the west side of the range) might prove rewarding.

One of the above specimens has been deposited in the Peabody Museum of Natural History, Yale University.

Kenelm W. Philip, 146 Garfield Ave., Hamden 18, Conn., U. S. A.

BUTTERFLY RECORDS FROM BROWNSVILLE, TEXAS

A female of *Papilio ornythion* Bdv., and a melanistic male of the same species, were collected at Brownsville, Texas, August 14, 1960. These specimens were determined by Dr. A. B. Klots and are now in the collection of the American Museum of Natural History, New York. They appear to be the only known specimens of their kind from the United States.

Also from Brownsville are the following: *Melitæa theona bolli* Edw., reared from larvæ taken on *Leucophyllum frutescens,* several adults; *Strymon pastor* Butl. & Druce; S. *simæthis* Drury (subsp. *sarita* Skinner); S. *beon* Cram.; and S. *melinus* (app. subspecies *franki* Field). Determinations are by Dr. Klots.

Jack E. Lipes, 1774 Greenbrier Ave., Brownsville, Texas, U. S. A.

PRESIDENTIAL ADDRESS TO THE TENTH ANNUAL MEETING OF THE LEPIDOPTERISTS' SOCIETY

Ladies and gentlemen:

To my great regret it is not possible for me to be present at your meeting, since I was in the United States only this past summer, at which time I was able to visit the meeting of the Pacific Coast Section of our society. I can, therefore, only send you this presidential address, together with my best wishes for the success of this meeting.

Again and again I note in conversation with lepidopterists that very unclear views exist concerning the systematic categories, especially among those who pursue the study of butterflies and moths as a hobby while earning their living at a very different occupation. Permit me, then, for this reason to say a few words on the subject, even if they hold little that is new for the specialist.

The smallest systematic unit is the *individual*. The assemblage of individuals of one species in a definite, circumscribed area of greater or lesser extent forms the *population*. The concept of the population may be used in various ways. One may speak of the population of a field or a forest, but one may speak also of the population of a mountain or of a country, if the species concerned is widely distributed and varies little or not at all. In numerous cases where the species occurs only in very restricted habitats — biotopes — and hence is found throughout its range in a more or less spotty or island-like distribution, the inhabitants of each such small territory are considered to make up a population. As a rule a population is genetically uniform and hence belongs to a single subspecies, but in some instances a population can be comprised also of individuals of two different subspecies of the same species, living together, as will be shown later.

Also within a single population we often find individuals which differ considerably in appearance from one another. This observation leads us to the problem of *variation*. In this connection, we note that among individuals closely related to one another we may encounter certain ones, *variants*, of strikingly different appearance. There exists, therefore, *variability*. This variability can have very different causes. In many instances we find a more or less considerable amount of hereditary individual variability. In extreme cases the descendents of a single parental pair can be so different among themselves that no two of them are alike as, for example, in *Euphydryas aurinia* Rott. In contrast, the widely distributed palæarctic Brimstone (*Gonepteryx rhamni* L.) may be mentioned, among specimens of which hardly any difference at all may be discerned. The spread or scatter of normal variability in a species is termed its *range of variation,* and one may apply the term to the entire external appearance (habitus, gross external facies) as well as to particular characters only, such as the form of the valva or of the uncus in the male genitalia. Individuals lying outside the normal range of variation either of a particular character or of the entire habitus are termed *extreme variants. Aberrations,* however, are pathological individuals which, because of a genetic defect or endocrine disturbances or even external influence during the time of their development, show a morbidly changed appearance. Thus dwarfs can result from insufficient food during their larval stage, but they may also arise because of irregularities in the endocrine system. Not rarely one encounters suddenly in a population a completely new form which sometimes in the course of succeeding generations becomes increasingly common. This sudden occurrence of a new form arises from an alteration in the genetic constitution — from a *mutation.* Most mutations bring with them a reduction in vigor in the affected individual and the form disappears rapidly. Many are only recessively transmitted but some, however, are dominant and have thereby a definite selective disadvantage. There are instances where a population in the course of time becomes comprised only of individuals of the newly arisen form. A form which occurs as a result or consequence of a mutation is termed a *mutant.*

Individual variability within a population can be purely genetic in nature or it can be induced by external factors, though indeed the ability of particular external influences to act in a particular way is likewise determined by heredity. The external appearance of a butterfly adult, and under certain circumstances also of the early stages, is commonly strongly influenced by external, mostly climatic, factors. In some species members of a single population in successive years of different weather conditions can be strikingly different as for example the Kite Swallowtail (*Graphium podalirius* L.) in middle Europe in hot and cool years. Even comparatively limited microclimatic differences not infrequently can leave their mark in the habitus of a butterfly. For example, within the genetically certainly quite uniform Upper Bavarian populations of the blue, *Plebejus argus* L., the lighter colored form *uliginosa* Dannehl is encountered only in the wettest parts of the bogs. By the action of external factors, often apparently by the influence of day length on the early stages, or through the alternation of wet and dry seasons, the different generations of a species encountered during the course of the year are commonly more or less different: *seasonal dimorphism*, observable in an especially pronounced degree in the middle European *Araschnia levana* L. with its summer form "prorsa". In middle Europe up to three generations, mostly more or less differing from one another, can be found in individual species, designated as *spring form* (*generatio vernalis*), *summer form* (*generatio æstivalis*), and *fall form* (*generatio autumnalis*). In warmer lands the generations of many species follow one another without showing discernible differences.

In many cases it is exceedingly difficult, indeed often almost impossible, to determine whether one has to do with genetic or nongenetic variability, since the relations between internal (genetic) factors and those operating from the outside, one sometimes reinforcing the other, sometimes working against the other, are enormously complicated. Only extensive breeding and hybridization experiments, under the most varied conditions, can bring understanding here, but such experiments, for obvious reasons, can be carried out only very infrequently.

Apart from examples of variability discussed so far the members of a single population in some instances may have a very diverse appearance. Almost always the sexes are more less different in habitus as is well marked, for example, in the blues (Lycænidæ). This is termed *sexual dichroism.* Also within a single sex two or even more genetic forms may be encountered, occurring together in the same population. In such cases we speak of *dimorphic* or *polymorphic species,* depending on whether two or more than two forms are involved. Examples of such dimorphism in one sex are *Argynnis paphia* L. with its female form "valesina" or those species of the genus *Colias* which have white females along with those "normally" colored (yellow, orange or red).

Populations differing from other populations of the same subspecies, or groups of populations standing closer to one another than to other populations of the same subspecies are termed *local forms.*

The next higher category is the *subspecies.* It is a complex of individuals of the same phylogenetic origin, genotypically and structurally fundamentally uniform though often strongly variable phenotypically, and completely fertile among themselves. It is quite possible, then, for individuals differing greatly in appearance to belong to the some subspecies. In connection with this variability we need recall only the *ecological forms* found in many subspecies, such as the *altitudinal forms* (*formæ altæ* or, at very high elevations, *formæ altissimæ*). Some species, indeed, are represented in mountainous regions by genetically fixed subspecies which have characters of the same sort as those of ecological altitudinal forms. It is usually very difficult in such cases to determine whether an endemic subspecies is involved or only an altitudinal form of a more widely distributed subspecies.

Subspecies arise through the isolation of a larger or smaller number of populations of a species in the course of geologic history. They are conceived of as potential species. The middle European subspecies owe their origin, for example, to the several changes of area caused by the Pleistocene glaciations, to the secondary intermingling of forms already genetically differentiated and to altered living conditions.

Geographical, biological and *physiological subspecies* may be distinguished. The commonest, that is the most frequently observed, kind is the *geographic subspecies.* The majority of species are composed of subspecies more or less genetically (and hence usually morphologically) differentiated, whose ranges are normally mutually exclusive (allopatric). The boundary areas often show a zone of intergradation of greater or lesser width, across which one sees a gradual change from one to the other. Gradual changes with respect to one or several characters are termed *clines.* To be sure, this term states nothing concerning the origin of this variational series. In some instances the terms *subspecies* and *cline* are identical, specifically if a subspecies shows within its range a gradual transition in one or several characters. Should such a gradual change in characters extend across the territory of two or more subspecies, then the whole complex would be termed a cline. Geographically neighboring subspecies are usually perfectly fertile *inter se;* those more widely separated need not be so. These may behave as species and, if in the course of their distributional history they should meet somewhere again they would then live side by side as two species, without intermixture.

Biological subspecies, which do not need to be differentiable on the basis of pattern or structure, are isolated by differences in their manner of living, commonly also by having different flight periods. They may occupy the same area with another subspecies of the same species (be *sympatric* with it). The same is true of *physiological subspecies,* which may be so strongly differentiated from each other by differences in secretions (such as diffrent sex odors) or by differences in chromosome structure that successful crossing of the two, even though they be sympatric, has become impossible. Biological and physiological subspecies occur not rarely in the Lepidoptera. In contrast to geographic subspecies, however, very little attention has as yet been devoted to them.

These kinds of subspecies, geographical, biological and physiological, are, naturally, susceptible to all the forms of variability already discussed in connection with the population.

The *species,* the next higher systematic category, consists usually of a series of subspecies. Only a few species are not divided into subspecies and thus, over their whole range, subject only to individual and ecological variation. Here we must make a distinction between monotypic species that are widely distributed and those occurring only in very small areas. These latter not infrequently were at one time much more widespread and probably also divided into subspecies, though today they occur only as relicts in limited areas. The division into subspecies has originated in the course of the evolutionary history of the particular species. In simple cases the species consists of a series of geographically more or less mutually excluding subspecies. As a rule, however, the subdivision of a species is not so simple. Along with geographical subspecies and their local forms and ecologically conditioned forms occur the biological and physiological subspecies, two or more of which on occasion may occur in the same area. The species, therefore, is usually an extraordinarily complicated structure. Further, subspecies can have diversified to such an extent that in many instances it is difficult or impossible to determine whether they are subspecies or already distinct species. In species with numerous subspecies and large distribution areas neighboring geographic subspecies are usually interfertile and commonly even form clines; terminal members, however, as already mentioned, often are no longer capable of interbreeding and behave as species. For species which are made up of a series of geographically mutually excluding subspecies the terms "*Formenkreis*" (circle of forms), "*Rassenkreis*" (circle of races) or "*Rassenkette*" (chain of races) were proposed, though without any implication that they represented another systematic category. Among the subspecies of a formenkreis, in some cases it is not possible to determine exactly whether we have to do with subspecies or with full species. The systematic category "species" is therefore not sharply distinguishable from the category "subspecies," for if we assume a natural, continuing evolutionary development all transitional stages must exist between subspecies and species. Where the boundary should be drawn here, and for the proper order of the system this is necessary, must in each case be left to the more or less subjective judgement of the systematist involved. Since all forms encountered in nature are in a state of continuing development our view can therefore give only a cross-section of the state of development at a single moment and it is obvious that we encounter the various forms in all stages of evolution, making their arrangement into an orderly plan—the hierarchy of systematic categories—extremely difficult. It is for these reasons that in all work in the field of systematics, and especially in the evaluation of systematic conclusions it must be remembered that this absolutely necessary taxonomic ordering can only be produced: that we are obliged more or less to force into a system what in nature had no such system. Moreover, as already mentioned, in the consideration of the animal kingdom of to-day we do not have their phylogenetic tree before us, but merely a cross-section, intersecting the present day groups and forms in the current state of their development. We should never say, therefore, that a particular recent group (or species, subspecies, etc.) is derived from another recent group; far more likely is it that both have been derived from a common stem. Commonly, however, one of the two has evolved more rapidly than the other (that is *apomorphic*) while the other, in spite of having had the same length of time available to it, has evolved less from the common ancestral group (species, etc.) and is, therefore, *plesiomorphic*. This explains why the so-called "primitive" groups are encountered in the most different places in the present system.

After this very theoretical digression let us return to the problem of the *genus*, a systematic category under which closely related species are united, species which, according to their phylogenetic history, belong together. Generic grouping as applied today is far from uniform, varying according to the state of research in the particular group. Large genera which one cannot divide into subgenera are most often a sign of deficient study of the group. In some genera the species exclude one another geographically, analogous to the geographical subspecies of a *Rassenkreis*. In such cases one has a *genus geographicum*, that is to say a higher and phylogenetically older stage of a *Formenkreis*, in which the several subspecies have attained species rank.

I hope that I have not bored you too much with these remarks. I know that for many — perhaps most — of you I will have said little that is new. In closing I wish your meeting to be both agreeable and harmonious and express once more my regret that I cannot be with you in person.

WALTER FORSTER

Menzingerstrasse 67, Munich, W. GERMANY

MINUTES OF THE TENTH ANNUAL MEETING OF THE LEPIDOPTERISTS' SOCIETY

The 10th annual meeting of the LEPIDOPTERISTS' SOCIETY was held in New York City at the Department of Entomology, of the American Museum of Natural History, on December 28, 1960.

The morning session was chaired by Dr. F. H. RINDGE. The following papers were presented:

1. "Courtship of the Queen (*Danaus gilippus*)," L. P. BROWER, Amherst College, and FLORENCE P. CRANSTON, Boston, Mass.
2. "Preliminary results of field studies of a population of *Euphydryas editha*", PAUL R. EHRLICH, Department of Biological Sciences, Stanford University.

The afternoon session was devoted to a symposium "The Family Papilionidæ," chaired by Dr. LOUIS S. MARKS. The following papers were presented:

1. "Harmonization of concepts of higher classification of the Papilionidæ," PAUL R. EHRLICH, Stanford University, and E. G. MUNROE, Entomology Research Institute, Canada Department of Agriculture.
2. "Experimental studies of the Papilionidæ", C. L. REMINGTON, Yale University.
3. "History of classification of Papilionidæ, with comments", by L. S. MARKS, Fordham University.

Papers in both sessions were followed by lively discussion.

Dr. EHRLICH, the Secretary, called the business meeting to order at 3:15. In the absence of the Treasurer, Dr. REMINGTON, Mr. HESSEL and Dr. EHRLICH explained the financial position of the Society, and the reasons for the Executive Council's recent decision for a modest increase in dues. It was pointed out that in view of the volume of publication done by the Society, the dues are still incredibly low, perhaps lower than those of any similar organization. Emphasis was given to the fact that members can be of great assistance to the Society by becoming Sustaining Members and by encouraging others to join the Society. It was moved and seconded that the concensus of the meeting be expressed supporting the action of the Executive Council in raising the dues. Passed unanimously. The meeting expressed its thanks to Dr. Rindge and the Museum for their hospitality.

The meeting was adjourned at 4:00 P.M.

Present at the meeting were: Frère Adelphe-David, W. A. Andersen, C. D. Anthony, J. W. Bakeless, L. Bayer, J. V. Z. Brower, L. P. Brower, M. E. Cady, R. T. Cardé, F. H. Chermock, J. Cooks, G. Collier, A. B. Cottrell, C. V. Covell, Jr., F. P. Cranston, C. J. Dempwolf, C. F. dos Passos, P. R. Ehrlich, R. R. Ehrlich, N. W. Gillham, G. T. Hellman, J. H. Hessel, S. A. Hessel, G. W. Kamp, W. S. McAlpine, H. Marks, L. S. Marks, L. Maurtrer, N. S. Obraztsov, K. W. Philip, D. J. Pirone, C. L. Remington, F. H. Rindge, F. Rutkowski, W. Sikora, R. S. Simmons, G. A. Trigaux, J. P. Wourms, M. Zappalorti, J. B. Ziegler.

Respectfully submitted, Paul R. Ehrlich, Secretary.

FOODPLANTS OF SPHINGIDÆ IN WISCONSIN

For the past twenty-five years I have been taking one or two specimens of *Sphinx kalmiæ* (J. E. Smith) each year at Hazelhurst, Wisconsin, but have not been able to locate it's food plant. This summer I found two freshly hatched larvæ on *Diervilla lonicera*. These were brought to maturity and are now in the pupa stage. A few years ago I found a half grown larva of *Darapsa pholus* (Cramer) on Huckleberry and a larva of *Amphion nessus* (Cram.) on Fire Weed, *Epilobium angustifolium*. I have also raised several broods of *Sphinx gordius* (Cramer) on Alder, *Alnus incana*. I am not sure that these food plants are a matter of record but present them for comment.

H. M. Bower, 601 McIndoe St., Wausau, Wis., U. S. A.

ESPECIALLY FOR FIELD COLLECTORS

(Under the supervision of Fred T. Thorne, 1360 Merritt Dr., El Cajon, Calif., U.S.A.)

AN EXPEDITION TO MEXICO FOR MEGATHYMIDÆ

by P. S. Remington

The final letter of instructions from Don Stallings, dated July 6, 1959, reads, in part: "Enclosed is a list of what to bring. While this is a *Megathymus* hunting trip, I doubt that you will see a single 'Meg' on the trip. Just might at one point. Will see you the 27th at Eagle Pass, Texas." When some of my friends learned that I was about to hunt butterflies that I would never see, they were confirmed in their opinion of me. I was a little uncertain myself, but I had great faith in the Stallings-Turner clan, who have really collected more specimens and discovered more species of Megathymidæ than any one else in the world. To see their collection in Caldwell, Kansas, is a liberal education.

The primary objects of this expedition were to collect testes of Mexican butterflies for chromosome studies and to obtain larvæ and pupæ of the puzzling complex of Megathymidæ from the northern Mexican deserts. At this season of the year no 'Meg' adults would be on the wing, but the larvæ, if they could be located in the *Yucca* and *Agave* plants, would be nearly full grown and prime for pickling. This explains the cryptic statement above — that we would never see the butterflies we were hunting. Let me say at the start that our efforts were successful and we did bring back several hundred pickled larvæ and pupæ of six or more species for morphological study.

During his year of research and study at the Genetics Laboratory and the Department of Entomology at the University Museum at Oxford, England, Dr. Charles L. Remington had found significant differences in the larvæ of butterflies which are useful in distinguishing closely related species, such as are found in the family Megathymidæ. His need for more material was the reason for our rendezvous in late July on the Mexican border at Eagle Pass. Not only did we need the preserved larvæ, but we wanted to relate the larvæ to their food plants, for this is an important point in studying the biology of an insect.

After complying with the formalities at the Mexican side of the border in Piedras Negras, we followed Highway 57 south about forty miles and then camped in a field by the roadside. This highway is a good black-top road which we followed all the way to Saltillo, almost 300 miles.

However, we took three days to make this distance because we collected intensively in the desert areas all the way.

It might be of interest to describe our equipment and the members of the expedition. Our cavalcade was always led by the STALLINGSES in their station wagon containing DON, Mrs. VIOLA STALLINGS and son JACK. Then came representatives of three generations of REMINGTONS – Dr. CHARLES, son ERIC and the writer. Then the TURNERS in their station wagon–Dr. J. E. and his mother, Mrs. R. C. TURNER, who has had a great deal of experience in 'Meg' hunting. Three pieces of equipment are necessary for this type of collecting: 1) a long-bladed sharp digging spade, 2) a strong, sharp knife, and 3) a pair of horsehide gloves. Nets were a forbidden diversion in the field when collecting 'Meg' larvæ, and the stern Kansans enforced the rule from the beginning. The spade is for digging up the underground *Yucca* caudex or severing the *Agave* plant at its base. The knife is for trimming the roots or parts of the plant containing the larvæ so that they could be more easily carried to the cars. The horsehide gloves are protection against the innumerable spines of all desert plants including the 'Meg' food plants, and also to prevent contact with the juice of the *Agave*, which is extremely irritating to the skin.

The two station wagons carried complete camping equipment for the whole party. This included two tents (with canvas floor), sleeping bags, cooking equipment, food boxes and, most important item of all, water cans. The STALLINGS and TURNER families have made this trip before and have learned to carry their own food and water entirely. In this way all possibility of dysentery is avoided. Water presents the greatest problem. Since we could not carry more than 32 gallons for the party, it had to be conserved for drinking, cooking and the absolute minimum of washing. When we reached Victoria we were able to renew our water supply by obtaining distilled water. Collecting 'Megs' in the Mexican desert is hot, hard work. The temperature was well over 100° F. in the day time and one quickly becomes dehydrated. The effort of digging and cutting, driving a few miles to a new spot, digging and cutting again, seems terrific. Yet there was great beauty too on the desert plains and especially in the passes through the mountains that ring the deserts. My kodachrome slides bring back these scenes in a memorable way.

We started collecting about 13 miles south of Allende in Coahuila. Here we collected larvæ of a member of the *Megathymus yuccæ* complex, and a few miles further we found at least two more species belonging to the *Agathymus mariæ* complex and to the *A. estellæ* complex. This particular area – in fact, all the way to Saltillo and beyond – is the home of a most confusing group of species which have not yet been finally worked out. It is hoped that the study of the larvæ, so carefully labelled and preserved, now going on in the Yale laboratory, may solve some of the puzzles. So the specific names I shall give refer to complexes, rather than to definitely determined species. The name *Agathymus* is used for the *Agave* feeders, as proposed in FREEMAN's "Revision of the Genera of the Megathymidæ" (*Lep. news* 12: 81-92; 1959). There are of course other large differences between *Megathymus* and *Agathymus* besides the food plants.

The distance from these first two collecting spots near Allende to our next spot near Gloria was over 100 miles. Most of the small towns we passed through were drab and uninviting: a few adobe buildings and huts usually plastered with Coca Cola signs. Bus stations, garages and walls of roadside buildings even far from towns were often marked with huge election slogans in Spanish – "Progress with Matteos Lopez." They were evidently effective, for he was elected President of Mexico and is extremely popular. Five miles south of Gloria we found three species of *Agathymus* – *A. mariæ* (B. & Benj.), *A. estellæ* (S. & T.), *A. hoffmanni* (Free.) – and a member of *Ægiale,* near *hesperiaris* (Wlk.). The collecting was becoming richer, also hotter, as we drove south. A heavy shower one evening cooled us off mementarily just as we were setting up camp. It was soon over and the sun came out and made a lovely double rainbow.

On July 29th we collected intensively near the pass in the Sierra de la Gavia mountains, at 3000 feet altitude. This is the spot which DON STALLINGS regards as the most prolific yet known, for variety of Megathymidæ. Three of the five genera are found here and at least six species. We began to see this as soon as we dug out some larvæ. It was obvious that we had several species. The question is often asked; how does one locate the larvæ? It is an art that has been developed to a high degree by the STALLINGS-TURNER combine. I can remember hiking through a large stand of *Yucca* plants in western Nebraska one July day in 1955 where I expected to find evidences of *Megathymus leussleri* Holland and found no trace at all, either imago, eggs, larvæ, or 'tents'. This was probably due partly to my inexperience with this very special type of collecting. In the first place, except for those in the Century Plant type of *Agave,* the 'Megs' almost invariably inhabit young plants. I had looked mostly on well-developed plants. By closely observing the experienced members of this party, I found that one can usually spot an infected plant by the 'tent' and tiny pellets of frass around the base of the leaves, if it is a *Yucca*. Then further examination of the plant usually reveals the burrow and a vigorous thrust of the spade turns up the whole underground caudex and plant. With the sharp knife we trim off the plant close to the caudex, put it in a pile with others and eventually carry them all back to the cars for later attention after supper.

If the plant is one of the smaller *Agave,* such as *A. lecheguilla,* the commonest one we saw, the procedure was much the same. If it is one of the larger Century Plants, one looks for a sort of brownish pucker, usually on the under side of the leaf, and cuts the leaf across to see if there is a larval burrow. If one finds a burrow, the spade is used again near the base and the whole plant is "popped", that is, uprooted or snapped off at a chosen point. Then the leaves are plucked off much the way they are in peeling an artichoke, until the leaf with the larva in it is uncovered. We found as many as six full-grown larvæ in one *Agave* plant. If the collector is seeking the adult butterfly, he takes the plant or root home and waits for the larva to complete its feeding, pupate, and then emerge. A letter from DON STALLINGS at Caldwell, just received, states: "Boy, have we had bugs hatching out! We are getting close to the end now, but there are still some fifty to seventy-five pupæ that can and should hatch. I'm not at all sure that they are going to help — just add to the confusion."

By locating the larvæ in the manner described above, STALLINGS has had kinds of butterflies emerge back in Caldwell which had never before been seen by any lepidopterist, simply because no one had ever been at those spots in the Mexican deserts at the time the adults emerge there. Already twelve new species have been determined and named in this way and more are waiting for final determination. At this pass in the Sierra de la Gavia mountains we found larvæ belonging to the following complexes: *Agathymus mariæ, A. estellæ, A. hoffmanni, Ægiale hesperiaris, Megathymus violæ* (S. & T.), and *M. beulahæ* (S. & T.). In one *Yucca* root a larva had pupated. STALLINGS put the pupa in a cage and the butterfly emerged a day or two later and thus I had my first look at a beautiful living *violæ.* Except for one other adult butterfly which I saw flying near the road the next day, these were the only live adult *Megathymus* that were seen on the whole trip.

Now we were approaching Saltillo and found another good collecting spot twenty-five miles northwest of the city, still on Route 57. Here on the upland desert plateaus in the shadow of the mountains were many giant *Yucca* similar to the California Joshua Tree. No larvæ were in these, but some in the small *Yucca* around them. Again we found *Agathymus mariæ, A. estellæ,* and *Megathymus beulahæ.* This was a beautiful camping spot. In the morning as we ate breakfast, the clouds were hanging low over surrounding cliffs. Then we "prospected" the area for 'Megs'. By now we had worked out a good system. Three or four of us would scatter over a small area searching for the tell-tale signs of 'Meg'-infested plants. Mrs. VIOLA STALLINGS was our best finder. As likely plants were located, a tissue-paper 'flag' would be stuck on each plant and the three men with the spades would then come along and dig up those plants. One has to keep a sharp watch for the desert rattlesnakes, whose protective coloring blends so perfectly with the gray sand and gray roots that we almost stepped on one.

Back in camp in the evening there was much work to be done after supper and we often worked far into the night under the light of a Coleman lantern. First we had to cut open the roots of the *Yucca* and cut through the fleshy leaves of the *Agave* to free the larvæ. A pile of shattered desert plants marks the site of every one of our camps. After the larvæ had been separated from the plants, they were dropped in boiling water, (in our regular cooking pans, broad-mindedly permitted by the women of the party!) then cooled, then dropped in Pampel's fixing solution for pickling. Before our horrified gaze, CHARLES munched several to assay the natural taste, as compared to the famous fried 'Meg' larvæ canned and sold as delicacies. Such devotion to science deserves a medal. He especially tried to detect taste differences in larvæ of different species of *Agathymus,* but did not notice any in this first trial. While all this table work was going on JACK and ERIC often set up a lamp out in the desert and collected Tiger beetles, moths, and other prizes that came to the light. Typical snatches of conversation as the work went on might be: "this plant has two white worms in adjacent burrows!"; "here's a blue worm!" (they were rarer); "this plant has a white and a blue worm in separate burrows!"; "oh boy, this complex gets more confusing all the time!"; "Oh, oh! this one didn't make it through, he died before he got very large"; "this fellow is coy, doesn't want to come out; guess I'll have to 'tickle' him with a straw from the other end of the burrow"; "CHARLES, do you have to pickle *all* these larvæ? Hate to think of all the rare 'Megs' we're passing up this way."

We went into Saltillo, a very attractive city, where we did a little shopping and found our Spanish to be less than adequate. Then we took Route 40 toward Monterrey, about sixty miles away. This is a heavily travelled road and traffic rumbled by our camp site most of the night. We camped about ten miles east of Saltillo. We were at a high elevation and welcomed the cool evening breeze that came down from the nearby mountains. As usual, the plum jam, home-canned beef and gravy, and ready-mix mashed potatoes were in heavy demand. The next day we collected thoroughly at two localities along Route 40, one ten miles east of Saltillo and the other twenty-five miles east of Saltillo. The plants along here were mostly *Agave,* the familiar *A. lecheguilla* and the large Century Plant, and so we again took larvæ in abundance of *Agathymus mariæ* (complex), *A. estellæ, A. hoffmanni, Ægiale* (*hesperiaris*), and *Megathymus beulahæ,* which builds a tent in the center of what is possibly an *Agave* resembling *Agave schottii* in Arizona. The plant looks more like a *Yucca* than an *Agave.* Don says that *M. beulahæ* no doubt thinks the plant is a true *Yucca.* The larval harvest was huge. Charles had brought what he assumed to be more than ample supplies of vials and fluids, but the vials ran out early and various improvisations had to be made, much to the amusement of our Kansas companions, who knew all along that no one but they or H. A. Freeman would have expected such quantities.

We followed Route 40 into Monterrey, which is a large bustling industrial city. Many modern buildings, factories, an airport, parks and a world of traffic, including automobiles of ancient vintage rolling along next to sleek modern cars and of course lots of wagons drawn by burros and crammed with wicker furniture and every imaginable native product for sale. We finally found Route 85 and followed it north forty-two miles to Mamulique Pass in the state of Nuevo Leon where the steep hillsides are covered with *Agave.* Here we took larvæ that may be in the complex of *Agathymus estellæ.* When we had finished here, we turned back to Monterrey and continued south without more collecting for 180 miles to Ciudad Victoria in Tamaulipas. A three day stay was planned here where relatives of the Turners, Dr. Ross Dickson and his wife Mrs. Julia Dickson (for whom *Agathymus juliæ* is named), own and operate Turner's Restaurant, which I can heartily recommend to any travellers along Route 85. We had pleasant rooms above the restaurant and especially enjoyed the luxury of a hot shower. We used the three days to relax, go sight-seeing in the city, and around the city do some collecting of testes for chromosome studies (see the papers in the *Journal,* vol. 13: pp. 193-203; vol. 14: 37-57, 127-147, 179-201). There is tropical jungle nearby and the collecting is very rich. So once more our evenings were spent in the familiar task of papering butterflies, most of which were semi-tropical species unfamiliar to us. This was an ideal place for lush collecting of butterflies that trickle across the border as rarities in the U. S. A. Even here the experienced members of the party soon spotted some *lecheguilla* plants and found *Agathymus* larvæ in them. Don tentatively calls them the *A. remingtoni* complex after Charles. The plants here and also further south are always found hanging over steep inclines, so that digging them out involves no little risk to life and limb.

It was with regret that we bade goodbye to our gracious host, Dr. Dickson, but not to our hostess, for Aunt Julia joined the expedition and went south with us on August 3. Our destination was a wonderful collecting spot called El Salto in the state of San Luis Potosí. As we drove south in our usual cavalcade we stopped to take pictures of a large sign erected by the Mexican government which announced that we were crossing the Tropic of Cancer. Henceforth we knew that we were really collecting "tropical" speciments.

As we approached Antiguo Morelos, about 100 miles south of Victoria, we saw some cliffs festooned with *Agave* of the *lecheguilla* type and again larvæ of the *Agathymus remingtoni* complex were found. There is confusion among botanists as to the identity of the various species of *Yucca, Agave,* and *Manfreda* plants, upon which Megathymidæ feed, so the names I used in this paper must not be considered accurate. This was not an arid desert type of location, but tropical jungle. It was decided to push on to El Salto and set up camp, then come back the next day to hit this spot hard. At Antiguo Morelos we turned west on Route 80 and drove about 30 miles to a gravel road where a sign pointed north to El Salto. We reached this spot in the late afternoon and at once set up camp on the bank of the river.

I cannot speak too glowingly of El Salto, which might be freely translated as "The Jump Off", for here a good-sized river simply pours over a high cliff and makes a spectacular water fall. All of us kept taking pictures of it. The snowy fall contrasts with the turquoise-colored water below it and the water is so pure one can drink it and cook with it. It is delightful to swim in. The mist from the falling water is carried some distance and encourages the growth of a lush tropical jungle all around. The next day we got out the nets, little used on this trip, and collected butterflies to our hearts' content. Most lepidopterists dream of some day collecting brilliant blue *Morpho* in the tropics. Well, here we all realized our dream. Young Eric was in his element and out-collected all of us. I counted more than twenty *Morpho peleides* Kollar on a short walk through the jungle, each one indescribably beautiful in the bright sunlight and seeming as big as dinner plates. However, I did not catch all of those twenty, for most of them soar regally over the trees or hop in a peculiar fashion through the dense jungle growth.

Much of our catch at El Salto has still not been identified, but it includes the following species: *Papilio idæus, P. cresphontes, Battus philenor, Heliconius charitonius,* several *Mechanitis, Dryas julia, Agraulis juno,* *Anteos clorinde, Kricogonia lyside, Phœbis agarithe, P. philea, Eurema proterpia, E. daira, E. nise, E. boisduvaliana, E. mexicana, Zerene cesonia, Anartia jatrophæ, A. fatima,* a *Diæthria, Ageronia glauconome, Eunica monima, Anæa aidea, A. perenna, Chlorippe laure, C. pavon, Metamorpha steneles, Mestra amymone, Libytheana bachmanii, Microtia elva, Eudamus alcæus, E. zilpa, Chioides catillus, Urbanus teleus* (or *tanna*), *Polythrix octomaculata, Grais stigmaticus, Onenses hyalophora, Heliopetes sublinea, Myscelus amystus, Phocides polybius,* many Riodinids and Theclines. This was a lepidopterists' paradise. It was old stuff to Don and Doc, so they went back to Antiguo Morelos for more *Agathymus remingtoni* larvæ, while we collected through the jungle around the falls, stopping frequently for a swim. The material taken for chromosome studies is probably the principal scientific booty from here and has been reported in the papers referred to above.

Our stay at El Salto was all too short, for we had to leave on August 5 and head back to the Rocky Mountain Biological Laboratory at Gothic, Colorado, where Dr. Remington was needed for important meetings. Our friends were to stay two more weeks and collect many more Megathymidæ through central Mexico. As we left them at El Salto we promised ourselves that this was one spot we would some day revisit. We arrived back in Victoria in time for another lunch at Turner's Restaurant, then set out for Monterrey and across the border at Laredo. It took some tall explaining and the appropiate Federal permit to get our plants and specimens through the Agriculture Department inspectors. We had a last fling at the 'Megs' as we drove through southern Texas. Habit was too strong for us and we stopped to examine beds of *Agave* on a desert slope near Langtry. Although it was almost dusk, we discovered the tell-tale signs of a few larvæ and we once more dug up some *lecheguilla* plants, which later produced a *mariæ* type of *Agathymus* in the Yale laboratory.

We are deeply indebted to the Stallings and Turner families (it is really one family) for giving us the opportunity to live and collect with them on this expedition. The whole family have dedicated themselves to the task of unravelling the secrets of the Megathymidæ and they go about it in a most intelligent, harmonious and tireless way. The evening sessions as we sat around the tents exchanging ideas and building theories about the 'Megs' were especially memorable. These were ten days we shall not forget.

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ANOTHER LARVAL FOODPLANT FROM TEXAS FOR *ANTIGONUS PULVERULENTA* (HESPERIIDÆ)

by Roy O. Kendall

Abutilon wrightii Gray is the second larval foodplant for *Antigonus pulverulenta* Felder found in Bexar County, Texas. Information on the other known larval foodplant, *Wissadula holosericea* (Scheele) Garcke, of this species may be found elsewhere (*Journ. lepid. soc.* 13: 221-228; 1960).

The first evidence that *A. wrightii* was a suitable larval foodplant for this skipper came to my attention 31 May 1957 when I found two pupæ on it. A third pupa was found on this same species of plant 31 August 1958. It was not until 1 April 1959 that eggs were found. By early June 1959 *A. wrightii* had been transplanted to my backyard and was growing quite well. *A. pulverulenta* was observed to deposit eggs on it at various times during the remainder of 1959. Frequent inspections revealed numerous larvæ feeding on the leaves. While most of the larvæ mature and adults emerge during the season in which the eggs are deposited, a few late ones will overwinter in the pupa stage and emerge early in February.

A. wrightii is relatively scarce and its trailing habit makes it difficult to find. One should watch for it along well drained slopes and ridges in hilly sections of its range. *W. holosericea,* the other known foodplant, usually grows in small patches and because of its height may be located easily by the collector as he drives along ranch and farm-to-market roads in the area. The distribution of both these plants is southwestern Texas; an area generally encompassing Comal, Bexar, Nueces, Webb, Maverick, Brewster, Reeves, and Jeff Davis Counties. It is throughout this same general area that *A. pulverulenta* has been found.

Acknowledgements

I should like to express my thanks to Mrs. Ellen Schultz Quillin, Director, Witte Memorial Museum, and Sister Mary Clare, C.D.P., Our Lady of the Lake College, both of San Antonio, Texas, for their botanical assistance in determining these plants.

References

Hanson, Herbert C., 1920. The malvaceous plants of Texas. *Texas agric. exper. sta., A & M. College of Texas circular* No. 22.

Metz, Sister Mary Clare, 1934. *A flora of Bexar County, Texas.* Catholic University of America. Washington, D. C.

Schulz, Ellen D., 1928. *Texas wild flowers.* Laidlaw Brothers, Chicago.

135 Vaughan Place, San Antonio 1, Texas, U. S. A.

REVIEWS

DIE TANNENSCHMETTERLINGE DER SLOWAKEI (Lepidoptera of the Fir tree in Slovakia). By Ján Patočka. 1960. 219 pp., 470 figs. Published by the Slovak Academy of Sciences, Bratislava, Czechoslovakia; price 27. — Kčs.

The book is a synthetic review of Lepidoptera occurring on the Fir tree in Slovakia and with regard to all of Central Europe. In the introduction the author gives a short report about his methods and field-work. The lepidopterous morphology is briefly discussed. The next chapter of the book has keys for the determination of all species and their early stages (pp. 23-41). The main part of the book is a systematic survey of the species (pp. 42-200). The author gives here the descriptions of all species and their known early stages, their importance in forestry, life-history, and distribution. For the pests he also describes the observed gradations and the methods of control.

In Slovakia and in the neighbouring countries there are recorded 40 regularly and 31 occasionally occuring species on the Fir tree. From the lichens growing on this tree are known nine and from mushrooms bound to pine tree four species. The book is in German, with Russian and Slovak summaries; therefore it is open to all scientific working lepidopterists.

Joseph Moucha

NAŠE MOTÝLE (Our Lepidoptera). By Jozef Ponec. 99 pp., 205 figs. 1960. Published by Osveta, Bratislava, Czechoslovakia; price 24.50 Kcs.

This publication is in reality the first Czechoslovakian book which contains photos of living Lepidoptera and their early stages. The text part written in Slovak includes 99 pages. The author gives here twenty chapters about butterflies and moths. The main part of the book has 205 photos, of which 11 are coloured. The moderate price enables this book to penetrate to a large circle of nature lovers.

Both of these books are distributed to foreign countries by "Artia", Smecky 30, Praha 1, Czechoslovakia.

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RECENT LITERATURE ON LEPIDOPTERA

(Under the supervision of PETER F. BELLINGER)

Under this heading are included abstracts of pepers and books of interest to lepidopterists. The world's literature is searched systematically, and it is intended that every work on Lepidoptera published after 1946 will be noticed here; omissions of papers more than 3 or 4 years old should be called to Dr. BELLINGER's attention. New genera and higher categories are shown in CAPITALS, new species and subspecies are noted, with type localities if given in print. Larval foodplants are usually listed. Critical comments by abstractors may be made. Papers of only local interest and papers from *The Lepidopterists' News* and the *Journal* are listed without abstract. Readers, not in North America, interested in assisting with this very large task, are invited to write Dr. BELLINGER (Dept. of Natural Sciences, San Fernando Valley State College, Northridge, Calif., U. S. A.). Abstractors' initials are as follows: [P.B.] – P. F. BELLINGER; [I.C.] I. F. B. COMMON; [W. C.] – W. C. COOK; [A.D.] – A. DIAKONOFF; [W.H.] – W. HACKMAN; [T.I.] – T. IWASE; [J.M.] – J. MOUCHA; [E.M.] – E. G. MUNROE; [N.O.] – N.S. OBRAZTSOV; [C.R.] – C. L. REMINGTON; [J.T.] – J. W. TILDEN; [P.V.] – P. E. L. VIETTE.

A. GENERAL

Brown, F. Martin, Donald Eff, & Bernard Rotger, *Colorado butterflies.* 368 pp., figs. Denver Museum of Natural History. 1957. Book assembled from parts published separately in the Museum's *Proceedings.* Descriptions & records of all spp. known from Colorado. See reviews in *Lepid. News,* vol.9: p.21; vol.11: pp.57-60.

Corbet, A. Steven, & H. M. Pendlebury, *The butterflies of the Malay Peninsula.* 2nd ed. 568 pp., 55 pls., 159 figs. London: Oliver & Boyd. 1956. See review in *Lepid. News,* vol.11: pp.60-62.

da Costa Lima, A., "Anotações ao 6° tomo de *Insetos do Brasil*" [in Portuguese]. *Mem. Inst. Oswaldo Cruz,* vol.50: pp.243-247. 1952. Corrections to the author's work on Brazilian Lepidoptera. [P.B.]

Forbes, William T. M., "Lepidoptera." *In* Kessel, E. L., ed., *A Century of Progress in the Natural Sciences*: pp.540-555. San Francisco: California Academy of Sciences. 1955. Review of developments of the past century in the study of Lepidoptera; classification is covered most thoroughly, but advances in other fields are mentioned. References to the most important papers on special groups or subjects make this article especially valuable. [P.B.]

Gaul, Albro, T., *The wonderful world of insects.* 290 pp., pls. New York: Rinehart & Co. 1953.

Hayward, Kenneth Ioannes, *Genera et species animalium argentinorum. Tomus primus. Insecta Lepidoptera (Rhopalocera), familia Hesperiidarum, subfamiliæ Pyrrhopyginarum et Pyrginarum.* 389 pp., 27 pls. Bonariæ: Guillermo Kraft Lts. 1948. See review in *Lepid. News,* vol.3: p.66.

Hayward, Kenneth Ioannes, *Genera et species animalium argentinorum. Tomus secundus. Insecta. Lepidoptera (Rhopalocera), familia Hesperiidarum, subfamilia Hesperiinarum.* 388 pp., 26 pls. Bonariæ: Kraft. 1950. Covers Hesperiinæ of Argentina. Keys to spp.; original & amplified descriptions; figures of adults & ♂ genitalia of most spp. Notes on biology are practically limited to foodplant records. A magnificently produced volume, though the plates are poorly printed in comparison with vol.1. [P.B.]

Kirkpatrick, T. W., *Insect life in the tropics.* xiv + 311 pp., 146 figs. London: Longmans Green. 1957. General account of insect structure & biology, with special reference to tropical regions. [P.B.]

Klots, Alexander B., *A field guide to the butterflies of North America, east of the Great Plains.* xvi + 349 pp., 40 pls., 14 figs. Boston: Houghton Mifflin Co. 1951. See review in *Lepid. News,* vol.5: pp.107-108.

Langer, Torben W., *Nordens dagsommerfugle.* 344 pp., 20 pls., figs. Copenhagen: Einar Munksgaard. 1958. See review in *Lepid. News,* vol.12: pp.205-206.

Portier, P., *La biologie des lépidoptères* [in French]. 643 pp., 1 pl., 392 figs. Paris: Lechevalier (*Encycl. Ent., sér. A,* vol.23). 1949. A good account of the morphology, physiology, habits, etc., of all stages; marred by highly erratic nomenclature. [P.B.]

Reiprich, Andrej, *Motyle slovenska. Oblast slovenskeho raja* [in Czech; German & Russian summaries]. 553 pp., 68 pls., 137 figs. Bratislava: Slovak Acad. Sci. 1960. See review in the *Journal,* vol.13: p.246.

Schmidlin, A., "Die Schmetterlingsfamilie Hesperiidæ (Dickkopffalter)" [in German]. *Ent. Nachrichtenbl.,* Burgdorf, vol. 2: pp.63-70, 84-86, 88-91; vol.3: pp.3-11. 1948, 1949. Describes morphology & biology of family; gives a key to the Swiss spp., and outlines, for each, distinguishing characteristics, flight period, Swiss & general distribution, foodplant, & variation. [P.B.]

Takeuchi, Kichizo, & Teiso Esaki, *Colored illustrations of the insects of Japan* [in Japanese]. 190 pp., 68 pls. Osaka. 1955. See review in *Lepid. News,* vol.12: p.56.

Villiers, A., "Les lépidoptères de l'Afrique noire française. Fasc. 1, Introduction, structure, moeurs, récolte, conservation, classification" [in French]. *Initiations africaines,* vol.14: 84 pp., 109 figs. 1957. Fascicle on the general characters of the Lepidoptera. The different parts are: morphology & anatomy (egg, larva, pupa, imago); ethology, with some photos of West African butterflies; geographical distribution of Lepidoptera in West Africa; collecting & storing, and a list of the families of Lepidoptera. The work draws extensively on the Lepidoptera part by Bourgogne of Grassé's *Traité de Zoologie.* [P.V.]

Williams, Evelyn Gilstrap, "Butterflies and moths." *School Nature League Bull.,* ser.18, no.1: 4 pp., 11 figs. 1947. Popular account.

Wright, A. Gilbert, *Common Illinois insects and why they are interesting.* 32 pp., 3 pls., figs. Springfield: Illinois State Museum. 1951.

Wynter-Blyth, M. A., "Butterfly collecting in India." *Journ. Bombay nat. Hist. Soc.,* vol.50: pp.885-893, 1 pl. 1952.

Yokoyama, Mitsuo, & Teiso Esaki, *Colored illustrations of the butterflies of Japan* [in Japanese]. 136 pp., 63 pls., figs. Osaka. 1955. See review in *Lepid. News,* vol.12: p.56.

B. SYSTEMATICS AND NOMENCLATURE

Abbott, Walter, Lawrence S. Dillon, & Robert, S. Shrode. "Geographic variation in *Pieris protodice* Boisduval and Leconte (Lepidoptera: Pieridæ)." *Wasmann Journ. Biol.,* vol. 18: pp. 103-127, 2 pls., 1 fig. 1960. From a statistical analysis of size and depth of color in 523 specimens, the authors conclude that this species varies continuously over the greater part of North America; accordingly, the names *sisymbrii, occidentalis, calyce, vernalis,* & *nelsoni* are sunk to *protodice. P. beckeri* is perhaps also a synonym. The correlation of Variation with geographic location, altitude, & climate is discussed. Taxonomic history of the group is reviewed. [P. B.]

Agenjo, R., "Dos nuevas *Pseudocopicucullia* Dumont, de Ifni (Lep. Agrot.)" [in Spanish]. *Eos,* vol. 28: pp. 367-375, 1 pl., 1 fig. 1952. Describes as new *P. bensi* (Tiliuin, 185 m.,, Ifni), *P. capazi* (Sidi Ifni). [P. B.]

Agenjo, R., "Un *Crambus* F., inedito y otro nuevo para España, descubiertos en los Picos de Europa. *C. pallidellus* Dup., 1836 (= *C. cuencalis* Hmps., 1900), *nov. syn.!*" [in Spanish]. *Eos,* vol. 28: pp. 315-322, 1 pl. 1952. Describes as new *C. hospitali* (2,000 m., Picos de Europa). Sinks *cuencalis* to *pallidellus. C. chrysonuchellus* new to Spain. [P. B.]

Agenjo, R., "Geometridæ españoles de la colección D. Hospital, de Barcelona" [in Spanish]. *Eos,* vol. 29: pp. 289-328, 2 pls., 2 figs. 1953. Records of 35 spp., with some descriptive notes & figures of genitalia. 4 spp. new to Spain. [P. B.]

Agenjo, R., "Subespecies nuevas de lepidópteros santanderinos" [in Spanish]. *Graellsia,* vol. 11: pp. 1-4. 1953. Describes as new *Anthrocera* (*Silvicola*) *scabiosæ picos* (Fuente Dé, 1001 m., Picos de Europa, Camaleño, Santander); *A.* (*Lictoria*Q *achillæ* [sic!] *pardoi* (Pesués, 14 m., Santander); *Cœnonympha dorus cantabrica* (Mt. Dobra, 605 m., Torrelavega, Santander). [P. B.]

Agenjo, R., "Un microlepidóptero murciano, género y especie nuevos de la familia Scythrididæ" [in Spanish]. *Graellsia,* vol. 11: pp. 41-47, 5 figs. 1953. Describes as new *HERINGITA* (monobasic), *H. heringi* (La Alberca, 60 m., Murcia, Spain). [P. B.]

Agenjo, R., "Especie y subespecie españolas inéditas del género *Oreopsyche* Spr. (Lep. Psych.)" [in Spanish]. *Eos,* vol. 30: pp. 379-390, 3 pls., 4 figs. 1954. Describes as new *O. ardanazi* (Posada de Valdeón), *O. angustella flamula* (San Rafael, 1,300 m., Segovia); notes on other races of *O. angustella.* [P. B.]

Agenjo, R., "Estudio de los tipos de las *Depressaria* (s. 1.) de Chiclana, descritas pos Staudinger en 1859, y de los de *Agonopteryx subpallorella* (Stgr.), con algunos datos complementarios" [in Spanish]. *Eos,* vol. 30: pp. 59-75, 2 pls. 1954. Sinks *D. sublutella* to *A. subpropinquella;* transfers *D. straminella* & *D. cachritis* to *Agonopteryx;* describes & figures type genitalia of these spp., *D. velox, D. campestrella,* & *A. subpallorella.* Notes on *A. squamosa* & *Martyrhilda lutosella.* [P. B.]

Agenjo, R., "*Ortholitha diniensis* Neub., en España y un importante error sobre *O. bipunctaria* (Schiff.) y *O. octoduresis* Favr." [in Spanish]. *Eos.* vol. 30: pp. 149-155, 2 figs. 1954. Figures genitalia of *O. diniensis* & *O. mœniata,* & gives Spanish records. Corrects error of identification of other spp. based on reversal of genitalic figures in Zerny (1927). [P. B.]

C. MORPHOLOGY

Astaurov, B. L., "The origin of triploid parthenogenesis as indicated by data on artificial polyploid parthenogenesis of the Silkworm, *Bombyx mori* L." *Proc. XV internat. Congr. Zool.,* pp.174-176. 1959.

Baranowski, Richard Matthew, "A comparative morphological study of the axillary region of some pterygote insects." *Diss. Abs.,* vol.20: pp.1486-1487. 1959. Abstract.

Barth, Rudolf, "Das Duftorgan des Maennchens von *Margaronia hyalinata* (L., 1767) (Lepidoptera, Pyraustidæ)" [in German; Portuguese summary]. *Rev. brasil. Biol.,* vol.14: pp.322-332, 14 figs. 1954. Describes scent glands & scent scales forming "brush" on end of abdomen. [P.B.]

Barth, Rudolf, "Contribuição ao conhecimento das células glandulares dos insetos" [in Portuguese; German summary]. *An. Acad. brasil. Cienc.,* vol.29: pp.465-472, 1 pl., 5 figs. 1957. Comparative study of histology of secretory cells in various insects, especially Lepidoptera. A new type of secretory cell, called "cryptocrine", is described; its secretions are in the form of droplets smaller than the limit of resolution of the microscope. Scent glands of Lepidoptera are of this type. [P.B.]

Barth, Rudolf, "Maennliche Duftorgane brasilianischer Lepidopteren. 18. Mitt.: *Phuphena fusipennis* Wlkr. (Noctuidæ, Hadeninæ)" [in German; Portuguese summary]. *An. Acad. brasil. Cienc.,* vol.29: pp.291-300, 9 figs. 1957. Describes ♂ scent organ on first abdominal segment. [P.B.]

Barth, Rudolf, "O órgão odorífero masculino de uma espécie do gênero *Episimus* (Lepidoptera, Olethreutidæ)" [in Portuguese; German summary]. *Mem. Inst. Oswaldo Cruz,* vol.55: pp.113-126, 14 figs. 1957. Describes structure & function of scent glands in tegula & on hind wing. [P.B.]

D. VARIATION

Ae, Shigeru Albert, "Genetic studies of several characters in *Colias eurytheme* (Lepidoptera, Pieridæ)." *Genetics,* vol.43: pp.564-576, 8 figs. 1958.

Ae, Shigeru Albert, "A study of hybrids in *Colias* (Lepidoptera, Pieridæ)." *Evolution,* vol.13: pp.64-88, 2 figs. 1959. Numerous interspecific crosses were attempted, of which some involving *C. philodice, C. eurytheme, C. interior,* & *C. alexandra* showed some fertility. The characters of F_1 and F_2 hybrids and the inheritance of species-specific and other characters are discussed. Suggests that all North American *Colias* may be able to exchange genes directly or indirectly, although natural hybridization is common only between *C. philodice* & *C. eurytheme.* [P.B.]

Ae, Shigeru Albert, "A study of hybrids between *Papilio xuthus* and the *P. polyxenes-machaon* group." *Journ. Lepid. Soc.,* vol.14: pp.5-16, 2 pls. 1960.

Agenjo, Casilda, "La variabilidad de la *Graellsia isabellæ* (Graells) (Lep. Syssph.)" [in Spanish]. *Graellsia,* vol.11: pp.7-10. 1953. Describes variation in reared specimens; names 4 "forms". [P.B.]

de Almeida, F. Ferrand, "Über die Konzentration von Kynurenin und Hydroxy-kynurenin während der Entwicklung bei den Genotypen *ra+* und *ra* von *Plodia interpunctella*" [in German]. *Naturwissenschaften,* vol.47: pp.27-28, 3 figs. 1961. Concentrations of these substances differ in wild type and red-eyed mutant at different times during development, but concentrations are not below normal in pupæ of mutant form. Mutant allele must interfere with conversion of substances to ommochrome. [P.B.]

Astaurov, B. L., & V. P. Ostriakova-Varshover, "Complete heterospermic androgenesis in Silkworms as a means for experimental analyis of the nucleus-cytoplasm problem." *Journ. Embryol. exper. Morph.,* vol.5: pp.449-462, 2 pls., 3 figs. 1957. In *Bombyx,* androgenetic hybrids (produced from eggs with ♀ cytoplasm but only sperm nuclei) resemble the parental stock or species, as do the offspring of backcrosses between these hybrids and the parental type; this applies to hybrids from zygotes with *B. mandarina* cytoplasm and *B. mori* nuclei, as well as to interracial hybrids of *B. mori.* No genetic or ontogenetic effect of the cytoplasm was found. [P.B.]

Balazuc, J., & J.-G. Pointel, "Observations tératologiques chez les lépidoptères" [in French]. *Bull. Soc. ent. France,* vol.61: pp.67-74, 10 figs. 1956. Describes & figures wing abnormalities of *Asopia obsoletalis, Fidonia plumistaria, Mimas tiliæ, Saturnia pyri,* & *Lycæna phlæas,* and abnormal ♂ reproductive organs of *Earias biplaga;* mentions larva of last sp. with half of epicranium undeveloped. [P.B.]

Balazuc, J., & J. Baurgogne, "Monstruosité chez un psychid" [in French]. *Bull. Soc. ent. France,* vol.64: pp.15-16. 1959. *Amicta cabrerai* ♀ with appendages like thoracic legs on third abdominal segment. [P.B.]

Baynes, E. S. A., "A remarkable aberration of *Arctia caja* L." *Ent. Rec. & Journ. Var.,* vol.65: pp.66-67. 1953. Named.

Berger, Lucien, "Remarques sur le dimorphisme saisonnier des lépidoptères du Congo Belge" [in French]. *Ann. Soc. Roy. zool. Belg.,* vol.82: pp.19-22. 1951. Note on seasonal variation, especially in Pieridæ & Papilionidæ, in the Congo; the former are particularly likely to have seasonal forms, perhaps because they live in open country & are more exposed to seasonal effects. [P.B.]

Berio, E., "Variabilità di *Hippotion rebeli* Rots.-Jord. (Lepidoptera–Sphyngidæ)" [in Italian]. *Ann. Mus. civ. Stor. nat.,* Genoa, vol.63: pp.168-172, 1 fig. 1948. Discusses variation & names 7 aberrations. [P.B.]

Bernardi, G., "Note sur la variation géogrophique de *Pinacopteryx eriphia* God., principalement au Nord de l'Equateur (Lep. Pieridæ)" [in French]. *Bull. Inst. franç. Afrique noire (A),* vol.19: pp. 1178-1196, 1 map, 1 pl. 1957. Study of the geographical variation of this African pierid, chiefly north of the equator. [P.V.]

G. PHYSIOLOGY

Ae, Shigeru Albert, "Effects of photoperiod on *Colias eurytheme.*" *Lepid. News,* vol.11: pp.207-214, 1 fig. 1958.

Anders, F., & E. Bayer, "Versuche mit dem Sexualduftstoff aus den sacculi laterales vom Seidenspinner (*Bombyx mori* L.)" [in German]. *Biol. Zentralbl.,* vol.78: pp.584-589, 1 fig. 1959. ♀ sex attractant separated by gas chromatography into 2 (possibly 3) active components. [P.B.]

Beament, J. W. L., "The waterproofing mechanism of arthropods. I. The effect of temperature on cuticle permeability in terrestrial insects and ticks."*Journ. exper. Biol.,* vol.36: pp.391-422, 17 figs. 1959. In *Pieris* pupæ & other insects, the cuticular waxes lose their impermeability abruptly & irreversibly at a specific temperature. A special molecular arrangement of the wax layer is suggested. [P.B.]

Beard, R. L., "Observations on the neuromuscular physiology of the larval foregut in *Galleria mellonella.*" *Anat. Rec.,* vol. 132: p.412. 1958. Abstract.

Beard, Raimon L., "Electrographic recording of foregut activity in larvae of *Galleria mellonella.*" *Ann. ent. Soc. Amer.,* vol. 53: pp.346-351, 1 pl., 2 figs. 1960. Nervous impulses initiating peristaltic movements can be recorded in larvæ whose body musculature has been inactivated by *Microbracon* or *Theridion* venom or by nicotine, through electrodes inserted into mouth and posterior body cavity. Location of activity center in foregut, types of peristaltic action, and the effects of several chemicals (injected through the hollow posterior electrode) are described. [P.B.]

Beck, Stanley D., "Insects and the length of the day." *Sci. Amer.,* vol.202, no.2: pp.108-118, 11 figs. 1960. Survey of effects of photoperiod in controlling life cycles. [P.B.]

Beck, Stanley D., & Edward E. Smissman, "The European Corn Borer, *Pyrausta nubilalis,* and its principal host plant. IX. Biological activity of chemical analogs of Corn Resistance Factor A (6-methoxybenzoxazolinone)." *Ann. ent. Soc. Amer.,* vol.54: pp.53-61, 1 fig. 1961. Analog tests show that growth inhibition of larvæ is associated with presence of oxazole or thiazole ring. [P.B.]

H. MIGRATION

Abbott, Charles H., "The 1958 migration of the Painted Lady Butterfly, *Vanessa cardui* (Linnæus), in California." *Pan-Pacific Ent.,* vol.35: pp.83-94. 1959. Migration involved four successive generations. Large larval populations were observed on various foodplants (listed), including some crops. Parasitization was heavy and appeared important in halting the outbreak. [P.B.]

Berard, R., & Cl. Dufay, "Sur une importante migration de lépidoptères en mai 1958" [in French]. *Bull. mens. Soc. linn. Lyon,* vol.28: pp.142-149, 1 table. 1959. Observations about an important migration of Lepidoptera in France in May 1958. The following species were observed: *Vanessa cardui, Lampides bœticus, Celerio lineata livornica, Chloridea peltigera, C. nubigera, Laphygma exigua, Plusia ni, P. gamma, Utetheisa pulchella, Mythimna loreyi, M. vitellina,* & *Nomophila noctuella;* all species well known as migrants. [P.V.]

Birchler, Alfons, "Falter auf Reisen. Eine Frühjahrs-Überraschung" [in German]. *Ent. Nachrichtembl.,* Vienna, vol.5, no.7: pp.1-3. 1958. Records of *Plusia ni, Celerio lineata,* & *Heliothis peltigera* at light in May (Switzerland). [P.B.]

Bradley, J. D., "An influx of the Humming-bird Hawk-moth in 1959." *Ent. Gazette,* vol.11: pp.4-5. 1960. British records of *Macroglossum stellatarum.* [P.B.]

Brower, Lincoln P., "Studies on the migration of the Monarch Butterfly I. Breeding populations of *Danaus plexippus* and *D. gilippus berenice* in south central Florida." *Ecology,* vol.42: pp.76-83, 1 fig. 1961. *D. plexippus* breeds in Florida, but breeding populations apparently contribute to northward movement of species in summer. Competition with the sedentary *D. g. berenice* is suggested as an explanation of the origin of migration. [P.B.]

I. TECHNIQUE

Adkisson, P. L., Erma S. Vanderzant, D. L. Bull., & W. E. Allison, "A wheat germ medium for rearing the Pink Bollworm." *Journ. econ. Ent.*, vol.53: pp.759-762. 1960. *Pectinophora gossypiella;* formulæ for 3 artificial media discussed. [W.C.]

Adkisson, Perry L., D. L. Bull., & W. E. Allison, "A comparison of certain artifical diets for laboratory cultures of the Pink Bollworm." *Journ. econ. Ent.*, vol.53: pp.791-793. 1960. *Pectinophora gossypiella;* casein and cottonseed meal compared as bases for synthetic diets. [W.C.]

Aizawa, A., & C. Vago, "Essais de cultures de tissus de lépidoptères sur matières plastiques" [in French; German summary]. *Entomophaga,* vol.4: pp.249-252, 1 fig. 1959. Polyvinyl plastic slips were used successfully for hanging-drop cultures of *Bombyx mori* ovarian tissue. [P.B.]

Appanna, M., "A cage useful for making observations on the adults of *Corcyra cephalonica* Stt." *Indian Journ. Ent.*, vol.14: p.44. 1952. Cardboard cylinder with ends closed by wire mesh. [P.B.]

Aschim, A. O., "Collecting moths and butterflies as a hobby." *Blue Jay,* vol.15: pp.84-86. 1957. Elementary technique notes. [P.B.]

Bancroft, T. A., & T. A. Brindley, "Methods for estimation of size of European Corn Borer populations." *Proc. 10th internat. Congr. Ent.*, vol.2: pp.1003-1014, 6 figs. 1958. On theory of sampling design for *Pyrausta nubilalis.* [P.B.]

Baraud, J., "Remarques sur l'emploi de l'ammoniaque dans le ramollisage des lépidoptères" [in French]. *Alexanor,* vol.1: pp.158-160. 1960. Hypothesis on the effect of ammonium hydroxide in the softening of Lepidoptera. [P.V.]

J. MISCELLANEOUS

Agenjo, R., "D. Manuel Pujol y Fiol, 1875-1953" [in Spanish]. *Graellsia,* vol.12: pp.1-19, 1 fig. 1954. Obituary of Spanish lepidopterist. [P.B.]

Agenjo, R., "R. P. Ambrosio Fernandez, O. S. A." [in Spanish]. *Graellsia,* vol.12: pp.21-28, 3 figs. 1954. Obituary of Spanish lepidopterist, with list of publications & new entities described by him. [P.B.]

Andersen, W. A., "Capture of *Nymphalis j-album* in Maryland at night." *Journ. Lepid. Soc.*, vol.14: p.62. 1960.

Anonymous, "Recent trends of lepidopterology in the world" & "Present and future of butterfly study in Japan" [in Japanese]. *Shin Konchu,* vol.5, no.4, supplement: pp.24-28, 1 fig. 1952.

Beebe, William, "The high world of the rain forest." *Nat. geogr. Mag.*, vol.113: pp.838-855, 8 pls., 2 figs. 1958. Colored paintings illustrate spp. of *Metamorpha, Ithomia,* & *Heliconius,* among other things. [P.B.]

Bernardi, G., "Le *Papilio alexanor* Esper, un des joyaux de la faune lépidoptérologique française" [in French]. *Alexanor,* vol.1: pp.4-6. 1959. Note of introduction on *P. alexanor* for this new French journal of lepidopterology. [P.V.]

Betz, J.-T., "Avertissement aux lépidoptéristes" [in French]. *Bull. mens. Soc. linn. Lyon,* vol.27: pp.197-201. 1958. Note about the destruction of good localities for collecting and preservation of nature. [P.V.]

Bielewicz, M., "Witold Niesiolowski—nestor polskiej entomologii" [in Polish]. *Bull. ent. Pologne,* vol.25: pp.5-8. 1956. Obituary note with the list of published lepidopterological papers. [J.M.]

de Biezanko, Ceslau Maria, & Oswaldo Baucke, "Nomes populares dos lepidópteros no Rio Grando do Sul" [in Portuguese]. *Agros,* vol.1: pp.164-177. 1948. Lists popular names of many Lepidoptera of southern Brazil. [P.B.]

Biezanko, J. L. M., *Referências sôbre as espécies, formas e aberrações de lepidópteros paleárticos e neotropicais descriptos por C. M. Biezanko. Gêneros e espécies dedicados ao C. M. Biezanko. En homenagen de 40 anos de atividade profissional* [in Portuguese]. 8 pp., 3 pls. Pelotas, 1960.

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The object of The Lepidopterists' Society, which was formed in May, 1947, and formally constituted in December, 1950, is "to promote the science of lepidopterology in all its branches, ... to issue a periodical and other publications on Lepidoptera; to facilitate the exchange of specimens and ideas by both the professional worker and the amateur in the field; to secure cooperation in all measures" directed toward these aims (*Constitution*, Art. II). A special goal is to encourage free interchange among the lepidopterists of all countries.

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Volume 15 1961 Number 2

THE GENUS *ITHOME* IN NORTH AMERICA NORTH OF MEXICO (WALSHIIDÆ)

by Ronald W. Hodges

Several factors have combined to create confusion concerning the generic names *Ithome* and *Eriphia*. Each was proposed with one included species, *Ithome unimaculella* and *Eriphia concolorella*. Later, Chambers (1878) described *albalineella* and *nigrilineella* and placed them with reservation in *Eriphia;* and in 1879 he stated that *unimaculella* was congeneric, not conspecific, with *Perimede erransella* Chambers. Riley (1891) incorrectly interpreted Chambers' statement concerning *unimaculella* with the result that he treated *unimaculella* as a synonym of *P. erransella*. Barnes and McDunnough (1917) indicated that *Eriphia* Chambers was preoccupied, and they placed it as a synonym of *Ithome;* however, they cited *unimaculella* as a synonym of *P. erransella*. It is difficult to understand their *lapsus* in removing the type of *Ithome* from the genus. Braun (1919) cleared up this supposed synonymy by indicating the characters of each genus, *Ithome* and *Perimede,* and by pointing out that Chambers had said that the two species were congeneric, not conspecific. Also, though not stated, she inferred that *unimaculella* and *concolorella* are congeneric. Forbes (1923) concurred with Barnes and McDunnough that *Ithome* is the valid name, even though it is a junior synonym of *Eriphia,* because *Eriphia* is a junior homonym; and he included *unimaculella* in *Ithome;* however, in 1931 he reversed his position, without giving an explanation, and used *Eriphia* as the valid name.

Braun (1923) placed *albalineella* in *Tanygona,* leaving three species, *concolorella, nigrilineella,* and *unimaculella,* in *Ithome;* and McDunnough (1939) followed this arrangement. Forbes (1931) said that *concolorella* and *unimaculella* are conspecific. I have examined Chambers' specimens of *concolorella* and *unimaculella* and confirm his statement that they are conspecific. *E. nigrilineella* has been removed (Hodges, in press) to a new genus in the Cosmopterigidæ. In this paper *I. quinquepunctata* (Forbes) is recorded from Florida, and three new species are described, bringing the number of species of *Ithome* for our fauna to five.

An additional point should be mentioned: FORBES (1931) stated that *Eritarbes* Walsingham is a synonym of *Eriphia*. The venation of *Eritarbes* is close to that of *Ithome* but not close enough to warrant the synonymy without study of the male and female genitalia.

The known larvæ of species of *Ithome* feed on the flowers of members of the Leguminosæ and Polygonaceæ. NAMBA (1956) illustrated the larva and pupa and presented the life history of *I. concolorella,* which has probably been introduced into the Hawaiian Islands.

A full definition of the Walshiidæ will appear later (Hodges, in press). The genera of Walshiidæ occurring in the United States and Canada are *Walshia, Stilbosis, Æxa, Chrysopelia, Ithome, Perimede, Periploca, Amaurogramma,* and *Sorhagenia.*

I wish to thank the following persons and institutions for allowing me to study specimens under their care (the letters in brackets are used to designate the present location of specimens): Dr. ANNETTE F. BRAUN [AFB]; Mr. M. O. GLENN [MOG]; Mr. C. P. KIMBALL [CPK]; Dr. A. B. KLOTS [ABK]; Dr. P. J. DARLINGTON, JR., Museum of Comparative Zoology [MCZ]; and Dr. J. F. G. CLARKE, United States National Museum [USNM]. Specimens in the Cornell University Collection are indicated by [CU] and those in my collection by [RWH].

Ithome Chambers

(Fig. 1)

Type: (*unimaculella* Chambers, 1875) = *concolorella* Chambers, 1875. Monotypic.

Ithome Chambers, 1875, *Can. ent.* 7: 93. Chambers, 1879, *Can. ent.* 11: 9 (as synonym of *Perimede*). Chambers, 1878, *Bull. U. S. geol. geog. surv. terr.* 4: 151 (referred to *Laverna*). Barnes & McDunnough, 1917, *Check list of the Lepidoptera of Boreal America*: 152. Braun, 1919, *Ent. news* 30: 262. Forbes, 1923, *Mem. Cornell univ. agric. exp. sta.* 68: 329. Fletcher, 1929, *Mem. dept. agric. India, ent. ser.* 11: 119 (as synonym of *Mompha*). Forbes, 1930, *Scientific survey of Porto Rico and the Virgin Islands* 12: 110. Forbes, 1931, *Jour. dept. agric. Porto Rico* 4: 358 (as synonym of *Eriphia*). McDunnough, 1939, *Mem. so. California acad. sci.* 2: 63. Namba, 1956, *Proc. Hawaiian ent. soc.* 16: 95.

Eriphia Chambers, 1875, *Can. ent.* 7: 55; not *Eriphia* Latreille, 1817; not *Eriphia* Meigen, 1826; not *Eriphia* Herrich-Schaeffer, 1856. Chambers, 1875, *Can. ent.* 7: 94. Chambers, 1877, *Bull. U. S. geol. geog. surv.* 3: 137, 141. Chambers, 1878, *Bull.*

U. S. geol. geog. surv. terr. 4: 95. Chambers, 1878, *Bull. U. S. geol. geog. surv. terr.* 4: 140. Chambers, 1880, *Jour. Cincinnati soc. nat. hist.* 2: 204, fig.41 (illustration misleading). Riley, *in* Smith, 1891, *List of Lepidoptera of Boreal America*: 108. Dyar, 1902 [1903], *Bull. U. S. natl. mus.* 52: 540 (Busck notes that *Eriphia* is probably a synonym of *Mompha*). Kearfott, *in* Smith, 1903, *Check list of the Lepidoptera of Boreal America*: 118. Barnes & McDunnough, 1917, *Check list of the Lepidoptera of North America*: 152 (as synonym of *Ithome*). Braun, 1919, *Ent. news* 30: 263 (as synonym of *Ithome*?). Forbes, 1923, *Mem. Cornell univ. agric. exp. sta.* 68: 329 (as synonym of *Ithome*). Fletcher, 1929, *Mem. dept. agric. India, ent. ser.* 11: 85 (as synonym of *Mompha*). Forbes, 1931, *Jour. dept. agric. Porto Rico* 4: 358. McDunnough, 1939, *Mem. so. California acad. sci.* 2: 63 (as synonym of *Ithome*).

Description: Head smooth-scaled; tongue moderate in length, scaled; maxillary palpus short, folded over base of tongue; labial palpus recurved, reaching beyond vertex, second segment longer than third, third segment smooth-scaled or slightly rough-scaled; antenna two-thirds length of forewing, pecten of one seta present, scape twice as long as wide, simple; ocelli visible. Metathoracic tibia with long dorsal scales. Forewing: lanceolate, apex acute; 12 veins present; lb furcate basally; 2 from before end of cell, weak basally, curved dorsally then running parallel with 3; 3 and 4 distant basally; 6, 7, and 8 stalked; 10 opposite 2; 11 from one-half of cell. Hindwing: linear, apex acute; a series of scales on costal margin at one-fourth; lb simple, weak; 3 and 4 distant; 4 and 5 connate; 6 and 7 stalked to five-sixths. Male genitalia: valvæ symmetrical or asymmetrical; processes arising from base of valvæ or absent; vinculum with narrow dorsal arms; ædeagus ankylosed; tegumen narrow, an irregular sclerotized band connecting pedunculi; subscaphium a narrow sclerotized band; uncus present; gnathos and socii absent. Female genitalia: bursa copulatrix lightly sclerotized; signa two or absent; ductus bursæ membranous; apophyses anteriores and posteriores heavily sclerotized.

Ithome is a tropical American genus which has few representatives in the United States, and of these only *concolorella* is known to occur as far north as Ohio. The other species are recorded from Texas to Florida along the Gulf of Mexico.

Key to Species of *Ithome* Based upon Maculation

1. Apex of antenna buff-white, base fuscous 2
   Shaft of antenna concolorous .... *quinquepunctata* (Forbes)

2. Scales of vertex and occiput of head concolorous 3
   Scales of vertex and occiput pale distally 4

3. A costal and a dorsal buff-white spot at three-fourths on forewing .... *concolorella* (Chambers)
   A costal buff-white spot at three-fourths on forewings; dorsal spot, if present, at two-thirds .... *ferax* Hodges

4. Most scales of vertex pale-tipped .... *lassula* Hodges
   Few scales of vertex pale-tipped; vertex sometimes buff .... *edax* Hodges

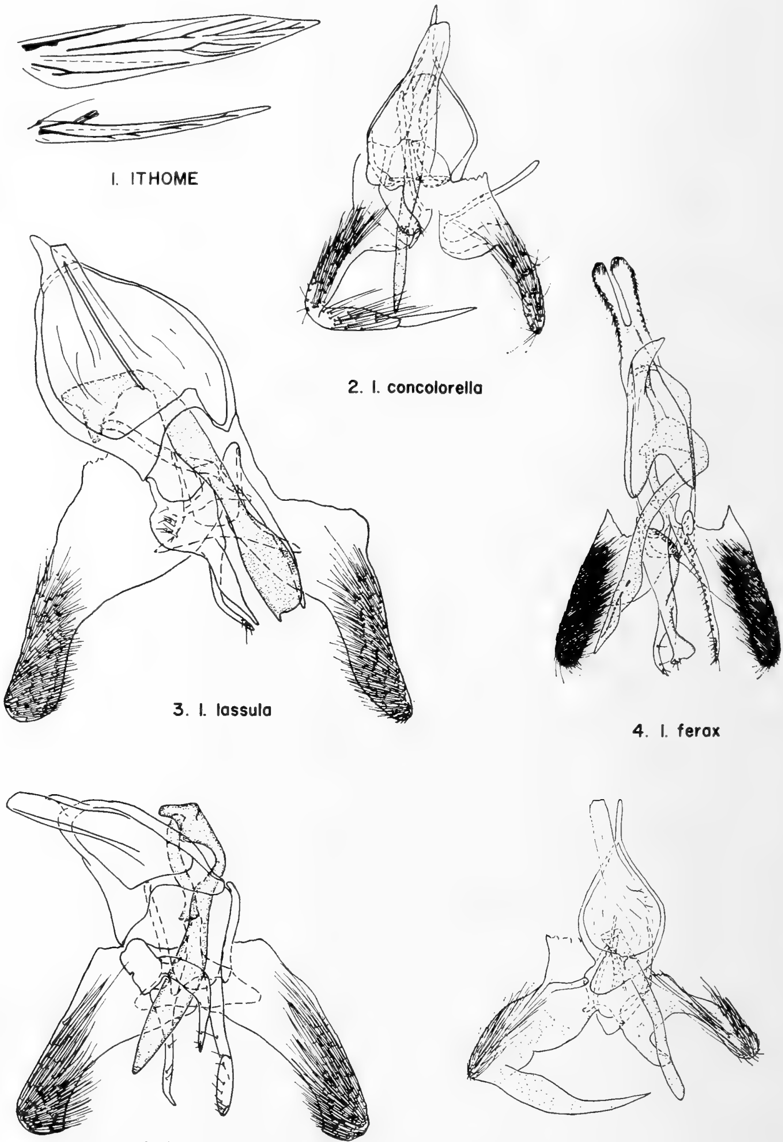


Fig. 1 – *Ithome*, venation; figs.2-6 – male genitalia of *Ithome*, ventral aspect: fig.2 – *I. concolorella* (Chambers); fig.3 – *I. lassula* Hodges; fig.4 – *I. ferax* Hodges; fig.5 – *I. edax* Hodges; fig.6 – *I. quinquepunctata* (Forbes).

Key to Species of *Ithome* Based upon Male Genitalia

1. Valvæ symmetrical 3
   Valvæ asymmetrical 2
2. Saccular region of left valva produced, forming a lobe (Fig.6) .... *quinquepunctata* (Forbes)
   Saccular region of left valva not produced (Fig.2 .... *concolorella* (Chambers)
3. Uncus simple (Fig.3) 4
   Uncus bifid (Fig.4) .... *ferax* Hodges
4. Accessory processes of right valva equal in length; apex of left accessory process simple (Fig.3) .... *lassula* Hodges
   Dorsal accessory process of right valva shorter than ventral one; apex of left accessory process expanded (Fig.5) .... *edax* Hodges

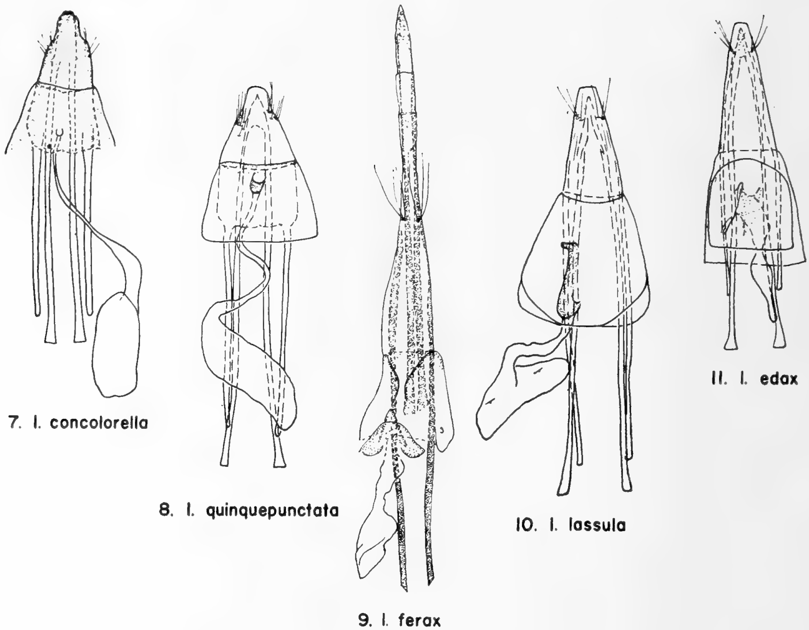
Key to Species of *Ithome* Based upon Female Genitalia

1. Lamella antevaginalis produced posteriorly (Fig.9) .... *ferax* Hodges
   Lamella antevaginalis not defined (Figs.1, 10) 2
2. Ductus bursæ slender (Fig.7) 3
   Ductus bursæ broad, becoming wider posteriorly (Fig.11) .... *edax* Hodges
3. Ostium bursæ a circular opening (Fig.8) 4
   Ostium bursæ an irregular opening (Fig.10) .... *lassula* Hodges
4. Ostium bursæ at posterior two-thirds of seventh sternum; ductus bursæ sclerotized before ostium bursæ (Fig.8) .... *quinquepunctata* (Forbes)
   Ostium bursæ at middle of seventh sternum; ductus bursæ not sclerotized (Fig.7) .... *concolorella* (Chambers)

Ithome concolorella (Chambers)

(Figs. 2, 7, 12)

Eriphia concolorella Chambers, 1875, *Can. ent.* 7: 55. Chambers, 1875, *Can. ent.* 7: 94. Chambers, 1877, *Bull. U. S. geol. geog. surv.* 3: 137, 141. Chambers, 1878, *Bull. U. S. geol. geog. surv. terr.* 4: 95. Chambers, 1878, *Bull. U. S. geol. geog. surv. terr.* 4: 140. Chambers, 1880, *Jour. Cincinnati soc. nat. hist.* 2: 204, fig. 41. Riley, *in* Smith, 1891, *List of Lepidoptera of Boreal America*: 108. Dyar, 1902 [1903], *Bull. U. S. natl. mus.* 52: 540. Kearfott, *in* Smith, 1903, *Check list of the Lepidoptera of*



Female genitalia of *Ithome* spp., ventral aspect: fig.7 – *I. concolorella* (Chambers); fig.8 – *I. quinquepunctata* (Forbes); fig.9 – *I. ferax* Hodges; fig.10 – *I. lassula* Hodges; fig.11 – *I. edax* Hodges.

Boreal America: 118. Forbes, 1923, *Mem. Cornell univ. agric. exp. sta.* 68: 319, fig. 193. Fletcher, 1929, *Mem. dept. agric. India, ent. ser.* 11: 85. Forbes, 1931, *Jour. dept. agric. Porto Rico* 4: 359.

Ithome concolorella, Barnes & McDunnough, 1917, *Check list of the Lepidoptera of North America*: 152. McDunnough, 1939, *Mem. so. California acad. sci.* 2: 64. Namba, 1956, *Proc. Hawaiian ent. soc.* 16: 95.

Ithome (?) *concolorella*, Forbes, 1923, *Mem. Cornell univ. agric. exp. sta.* 68: 329.

Ithome unimaculella Chambers, 1875, *Can. ent.* 7: 94. Braun, 1919, *Ent. news* 30: 262. Forbes, 1923, *Mem. Cornell univ. agric. exp. sta.* 68: 329. Fletcher, 1929, *Mem. dept. agric. India, ent. ser.* 11: 119. McDunnough, 1939, *Mem. so. California acad. sci.* 2: 63.

Perimede unomaculella [*sic*], Chambers, 1879, *Can. ent.* 11: 9 (misspelling). Barnes & McDunnough, 1917, *Check List of the Lepidoptera of North America*: 152 (as synonym of *erransella*) (misspelling).

"*Ithome unomaculella* [*sic*], Cham. = *Perimede unomaculella* [*sic*], Cham., and referred to *Laverna, q. v.*" Chambers, *Bull. U. S. geol. geog. surv. terr.* 4: 151 (misspelling) (the combination *Laverna unimaculella* does not occur in this work).

Perimede (*Laverna*) *unomaculella* [*sic*], Chambers, 1880, *Jour. Cincinnati soc. nat. hist.* 2: 199 (misspelling).

Laverna unomaculella [*sic*], Riley, *in* Smith, 1891, *List of Lepidoptera of Boreal America*: 106 (misspelling) (as synonym of *erransella*).

Mompha unomaculella [*sic*], Dyar, 1902 [1903], *Bull. U. S. natl. mus.* 52: 542 (misspelling) (as synonym of *erransella*).

Eriphia unimaculella, Forbes, 1931, *Jour. dept. agric. Porto Rico* 4: 359 (as synonym of *concolorella*).

Fig.12. Habitus of *Ithome concolorella* (Chambers).

Description: Tongue fuscous-buff basally, ochreous distally. Maxillary palpus fuscous-buff. Labial palpus dark fuscous, base and apex of third segment buff-white, three to five buff-white dots on anterior surface of third segment. Face fuscous on lower third, buff-white on upper two-thirds and on anterior part of vertex, a few fuscous-black scales before each eye; posterior portion of vertex and all of occiput fuscous-black. Antenna fuscous-black, apical ten to twelve segments buff-white. Thorax fuscous-black. Legs fuscous on outer surface, buff to fuscous-buff on inner surface; metathoracic tibia with a buff-white annulation at middle and apex, outer tibial spurs shining buff-white in some lights; apices of first four segments and all of fifth segment of metathoracic tarsus buff-white. Forewing fuscous-black, a buff-white spot on costal and dorsal margins at three-fourths distance from base to apex of wing, a buff-white spot on fold at one-third distance from base to apex of wing; cilia concolorous with wing apically, pale fuscous-buff dorsally. Hindwings fuscous, cilia pale fuscous. Abdomen fuscous in male, last segment ochreous; fuscous-buff in female. Male genitalia: as in figure 2 (R. W. H. slide 878). Female genitalia: as in figure 7 (J. F. G. Clarke slide 10495). Alar expanse: 5-7 mm.

Food plant: *Prosopis chilensis* (Mol.) Stuntz and *Acacia farnesiana* (L.) in the Hawaiian Islands, no hosts recorded for the continental United States.

Types: Of *concolorella*, LECTOTYPE, PRESENT DESIGNATION, male, bearing following labels: 1) Type, 1356. 2) Tex. 3) Chambers. 4) 98. 5) male Genitalia Slide 875, Ronald W. Hodges. In Museum of Comparative Zoology. Of *unimaculella*, LECTOTYPE, PRESENT DESIGNATION, male, bearing following labels: 1) Type, 1520. 2) Tex. 3) Chambers. 4) 102. 5) male Genitalia Slide 878, Ronald W. Hodges. In Museum of Comparative Zoology.

Specimens examined: ARIZONA: 9♂♂, 4♀♀, Madera Canyon, 4880 feet, Santa Rita Mountains, Santa Cruz Co., August 4-October 10, 1959 (R. W. Hodges), [CU, RWH]; 1♀, same locality except for elevation, 5600 feet, October 14, 1959 [RWH]; 1♀, Madera Canyon, 4000 feet, Santa Rita Mountains, Pima Co., August 9, 1959 (R. W. HODGES), [RWH]; 4♂♂, same locality, but elevation 4400 feet, October 6-12, 1959 [CU, RWH]; 1♂, 1♀, Peña Blanca Canyon, Santa Cruz Co., August 7 & 11, 1959 (R. W. HODGES), [RWH]. FLORIDA: 3♂♂, Siesta Key, Sarasota Co., March 15-28, 1952 & 1960 (C. P. KIMBALL), [CPK]. LOUISIANA: 1♂, Schriever, June 17, 1917 [CU]. MISSISSIPPI: 4♂♂, Biloxi, June 13, 1917 [CU]; 2♂♂, Bay St. Louis, June 17, 1917 [CU]. NORTH CAROLINA: 6♂♂, 6♀♀, Highlands, 3865 feet, Macon Co., July 18-August 25, 1958 (R. W. HODGES), [CU, RWH]. OHIO: 1♂, 1♀, Cincinnati, July 22 & September 23, 1903 (ANNETTE F. BRAUN), [AFB]. TENNESSEE: 6♂♂, 12♀♀, Monteagle, 2000 feet, June 22-August 7, 1930 and 1931 (A. G. RICHARDS, JR.), [ABK, CU]. TEXAS: 1♂, Corpus Christi, May 14, 1943 (W. M. GORDON), [CU]; 1♀, Victoria, June 24, 1917 [CU].

Ithome quinquepunctata (Forbes), NEW COMBINATION

(Figs. 6, 8)

Eriphia quinquepunctata Forbes, 1931, *Jour. dept. agric. Porto Rico* 4: 361.

Description: Maculation as for *concolorella* except as follows: upper part of face pale fuscous; apex of scape of antenna buff, shaft gray-buff. Male genitalia: as in figure 6 (R. W. H. slide 656). Female genitalia: as in figure 8 (R.W.H. slide 657). Alar expanse: 6-7 mm.

Food plant: *Coccoloba uvifera* (L.) Jacq.

Type: in Cornell University Collection.

Type locality: Puerto Real, Vieques Is., Puerto Rico.

Specimens examined: FLORIDA: 6♂♂, 4♀♀, Ramrod Key, reared *ex Coccoloba uvifera*, emerged March 3 & April 6, 1945 [USNM]; 16♂♂, 12♀♀, Siesta Key, Sarasota Co., January 3-December 20, 1951-1957 (C. P. KIMBALL), [CPK, RWH].

ITHOME EDAX Hodges, NEW SPECIES

(Figs. 5, 11)

Description: Maculation as for *concolorella* except as follows: occiput sometimes buff-white with fuscous scales above each eye, and some scales of vertex and occiput pale-tipped. Male genitalia: as in figure 5 (R.W.H. slide 10013). Female genitalia: as in figure 11 (R. W. H. slide 10015). Alar expanse: 6-7 mm.

Food plants: *Byra ebenus* (?).

HOLOTYPE: male, Brownsville, Texas, *ex* Ebony blossoms (*Byra ebenus?*), emerged June 7, 1944 (R.W.H. slide 10013), [USNM].

PARATYPES: TEXAS: 3♂♂, 11♀♀, same data as holotype [USNM, RWH]; 9♂♂, 4♀♀, Corpus Christi, May 8 & 14, 1943 (W. M. Gordon), [CU, RWH].

I. edax may be separated from *I. lassula* as follows: the dorsal accesory process of the right valva passes over the ædeagus in *edax;* in *lassula* the same process is parallel with the ventral one and does not pass over the ædeagus. The ædeagus of *edax* tapers gradually to the apex, whereas in *lassula* it is broad almost to the apex. In the female genitalia *edax* has no signa; *lassula* has two signa.

ITHOME LASSULA Hodges, NEW SPECIES

(Figs. 3, 10)

Description: Maculation as for *concolorella* except as follows: third segment of labial palpus slightly rough-scaled; head fuscous, apices of scales on vertex and occiput gray-buff; apex of scape of antenna buff; forewing with dorsal buff-white spot anterior to costal one or absent; abdomen fuscous with purple reflections. Male genitalia: as in figure 3 (R.W.H. slide 10021). Female genitalia: as in figure 10 (R.W.H. slide 10023). Alar expanse: 6-8 mm.

Food plant: *Leucæna glauca* (L.) Bentham.

HOLOTYPE: male, Key West, Florida, *ex* flowers of *Leucæna glauca,* emerged April 19, 1945 (R.W.H. slide 10021), [USNM].

PARATYPES: FLORIDA: 5♂♂, 10♀♀, same locality as holotype, emerged March 16-April 17, 1945 [USNM, RWH]; 1♂, Homestead, March 31, 1959 (D. O. Wolfenbarger), [CPK].

I. lassula may be separated from *I. edax* as indicated under *edax.*

ITHOME FERAX Hodges, NEW SPECIES

(Figs. 4, 9)

Description: Maculation as for *concolorella* except as follows: face fuscous-buff; forewing with dorsal buff-white spot, if present, anterior to costal one; abdomen fuscous, last segment ochreous. Male genitalia: as in figure 4 (R.W.H. slide 637). Female genitalia: as in figure 9 (R.W.H. slide 638). Alar expanse: 7-10 mm.

Food plant: unknown.

HOLOTYPE: male, Siesta Key, Sarasota County, Florida, February 29, 1960 (C. P. Kimball), [Cornell University Type No. 3828].

PARATYPES: FLORIDA: 5♂♂, 6♀♀, same locality as holotype, January 4-April 12, 1960 (C. P. Kimball), [CPK, RWH]; 2♂♂, St. Petersburg, March 16 & 23, 1960 (A. K. Wyatt), [MOG].

I. ferax may be distinguished from *I. concolorella* by the valvæ of the male genitalia being symmetrical; in *concolorella* the valvæ are asymmetrical. In the female genitalia the lamella antevaginalis is present in *ferax;* it is absent in *concolorella*.

The illustration of the female genitalia (Fig. 9) would lead one to believe that a difference exists between *ferax* and the other species of *Ithome* because the genitalia are fully extended. It is almost impossible to obtain a preparation of this nature because the orifice at the posterior extremity of the eighth abdominal segment is small and does not allow the other segments to pass. It seems to me, however, that the normal, extended position of all five of the species is much the same as is shown for *ferax*.

ACKNOWLEDGEMENTS

Grateful acknowledgement is made to the Grace H. Griswold Fund of the Department of Entomology of Cornell University for assuming the cost of engraving.

The specimens of *I. concolorella* from Highlands, North Carolina, were collected during the summer of 1958 when the author was assisting Dr. J. G. FRANCLEMONT. The collecting was done under the auspices of a grant from the Penrose Fund of the American Philosophical Society.

Literature Cited

Barnes, Wm. & McDunnough, J., 1917. *Check list of the Lepidoptera of Boreal America.* vii + 392 pp. Herald Press, Decatur, Illinois.

Braun, Annette F., 1919. Notes on Cosmopterygidæ, with descriptions of new genera and species (Microlepidoptera). *Ent. news* 30: 260-264.

..............., 1923. Microlepidoptera: notes and new species. *Trans. Amer. ent. soc.* 49: 115-127.

Chambers, V. T., 1878. Descriptions of new Tineina from Texas, and others from more northern localities. *Bull. U. S. geol. geog. surv. terr.* 4: 79-106.

..............., 1879. Micro-Lepidoptera. *Can. ent.* 11: 5-10.

Forbes, William T. M., 1923. The Lepidoptera of New York and neighboring states. *Mem. Cornell univ. agric. exp. sta.* 68: 1-729.

..............., 1931. Supplementary report on the Heterocera or moths of Porto Rico. *Jour. dept. agric. Porto Rico* 4: 339-394.

Hodges, Ronald W., in press. A revision of the Cosmopterigidæ of America north of Mexico, with a definition of the Momphidæ and Walshiidæ (Lepidoptera: Gelechioidea).

McDunnough, J., 1939. Check list of the Lepidoptera of Canada and the United States of America, part 2, Microlepidoptera. *Mem. so. California acad. sci.* 2: 1-171.

Namba, Ryoji, 1956. Descriptions of the immature states and notes on the biology of *Ithome concolorella* (Chambers) (Lepidoptera: Cosmopterygidæ), a pest of Kiawe in the Hawaiian Islands. *Proc. Hawaiian ent. soc.* 16: 95-100.

Riley, C. V., *in* Smith, John B., 1891. *List of the Lepidoptera of Boreal America.* v + 124 pp. Amer. Ent. Soc., Philadelphia.

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MIDGE-FLIES BITING BUTTERFLIES

by David L. Bauer

Late one hot August afternoon while collecting in Black Canyon on Mingus Mt., Yavapai Co., Arizona; I came upon a milkweed vine on whose flowers the butterflies were feeding in considerable numbers. They were so absorbed in their feeding that I had a chance to look the specimens over for imperfections before clamping the lid of the killing jar over them. While thus examining the various species I noticed a specimen of *Mitoura siva* Edwards, which appeared to be an aberration with black spots on the undersurface of the secondaries, so I eagerly captured it. But when I had it in the killing jar where I could see it better, I noticed that some of the spots had disappeared, and a quick second look proved the remaining black spots to be midge-flies biting the butterfly on the larger veins of the wing.

This discovery aroused my interest so I captured several other specimens of *Mitoura siva* which had these small flies biting them. The skipper *Cogia hippalus* Edwards was also captured, but no specimens of midges were seen on them, perhaps because of the spotted dark coloring of the undersurface of the secondaries. When the jar was emptied fourteen of these small midge flies were found, preserved, and sent to Dr. Willis W. Wirth at the U. S. Department of Agriculture, Insect Identification Office.

Dr. Wirth identified them as a species of "no-see-ums" or "punkies" belonging to the family Heleidæ. All the specimens sent were females of an unnamed species of the genus *Forcipomyia* since described as a new species by Dr. Wirth (1956: p.361). In a letter concerning midges biting butterflies, Dr. Wirth mentioned that records of such are scarce.

There are a number of records for Europe, but the above record of midges biting *Mitoura siva* is the first record for North America. However, there are records of the caterpillars of the Papaya Sphinx being bitten in Florida by *F. erucidida* Knab, and the midge *F. crudelis* Knab has been taken sucking blood from caterpillars in Mexico.

About a week after the midges were found sucking the blood of *Mitoura siva,* they were also found sucking blood from the wings of *Philotes enoptes dammersi* Comstock & Henne taken in the canyon above Jerome, Arizona. This last locality is also on Mingus Mt., but about five or six miles from the first locality in Black Canyon.

Then while butterflies were being collected in Mexico during 1954 a specimen of the butterfly *Pyrrhogyra otolais neis* which was captured at Tamazunchale, San Luis Potosi, had two midges feeding from the veins on the upper surface of the hind wings. Since these midges remained on the wings when the specimen was killed, the butterfly and the midges were sent to Dr. Wirth for identification. After studying these two specimens (also females), Dr. Wirth found them to be another unnamed *Forcipomyia* and described them as *F. mexicana* Wirth (1956: p.361).

These little midges make an interesting sideline for observation and study by lepidopterists. Anyone collecting Lepidoptera or other insects on which these midges are feeding should contact Dr. Willis W. Wirth, as he is very interested in obtaining specimens and records of hosts.

Acknowledgements

I am indebted to Dr. Wirth for information concerning the habits of midges and for identification of the specimens.

References

Wirth, Willis W., 1956. New species and records of biting midges ectoparasitic on insects (Diptera, Heleidæ). *Ann. ent. soc. America* 49: 356-364.

................, 1956. The biting midges ectoparasitic on Blister Beetles (Diptera, Heleidæ). *Proc. ent. soc. Washington* 58: 15-23.

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SOME INTERESTING BUTTERFLY RECORDS FROM ONTARIO

Erora læta (Edw.) was taken at the end of May 1960 once again in Ontario, after a long time. A fact which makes the whole matter still more interesting is that this find was in Algonquin Park, 45. 35° N, near the northern limits of the beech tree.

The other records concern *Feniseca tarquinius* (Fabr.) and *Melitæa harrisii* (Scud.), both taken at the end of May resp. June 1960 on the shore of a lake near Sudbury. They were taken there a long time ago when Canadian lepidopterology was at its beginning, in the days of C. J. S. Bethune and J. Fletcher (near 1880). Their old specimens are still well preserved in the Canadian National Collection in Ottawa; the recent ones are in the American Museum of Natural History in New York.

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LEPIDOPTERA AS PREY OF OTHER INSECTS

by Homer F. Price

During the past 21 years the writer has collected 120 species of Odonata and 20 species of robberflies (Asilidæ) in northwestern Ohio and northeastern Indiana. Of the Odonata, 4800 specimens were taken in Ohio and 480 specimens in Indiana. Considerable attention has been given to the larger prey of these insects with rather poor results. In all cases the Odonata and prey were papered together while the robberflies and prey were pinned together. Dr. E. S. Thomas and his assistant Mr. Robert Goslin of the Ohio State Museum have determined nearly all of my collection of robberflies. Dr. B. Eldwood Montgomery of Purdue University and Dr. D. J. Borror of the Ohio State University have determined or checked one or more specimens of nearly every species of Odonata in my collection. The following list was prepared for the instances in which butterflies were taken as prey.

Odonata Taken with Prey

1. *Gomphus externus* Hagen, ♂, 3 Aug. 1947, Maumee River, Paulding Co., Ohio, prey – *Pieris rapæ* Linné.
2. *Gomphus fraternus* Say, ♀, 11 June 1953, pond in Williams Co., Ohio, prey–*Phyciodes tharos* Drury.
3. *Dromogomphus spoliatus* Hagen: ♂, 5 Aug. 1946, Eagle Creek, Defiance Co., Ohio, prey–*Pieris rapæ;* ♂, 25 Aug. 1950, Brown Township, Paulding Co., Ohio, prey–*Colias philodice* Latreille; ♂, 19 Aug. 1949, Flatrock Creek, Paulding Co., Ohio, prey–*Phyciodes tharos.*
4. *Erythemis simplicicollis* Say: ♀, 7 July 1955, Cedar Lake bog, Lagrange Co. Ind., prey–*Lycæna phlæas americana* Harris; ♀, 22 July 1949, pond in Paulding Co., Ohio; prey–*Phyciodes tharos.*

Robberflies Taken with Prey

1. *Promachus vertebratus* Say, ♂, 20 Aug. 1950, Mud Lake, Williams Co., Ohio, prey–*Pieris rapæ.*
2. *Asilus sericeus* Say: ♀, 7 July 1942, Auglaize River, Paulding Co., Ohio, prey–*Cercyonis pegala nephele* Kirby; ♀, 14 June 1958, Oak Openings, Lucas Co., Ohio; prey–*Euptychia cymela* Cramer.

The following observations are also given: *Anax junius* Drury was seen in October while capturing either *Colias philodice* or *C. eurytheme* Boisduval. The common Tenspot (*Libellula pulchella* Drury) was once observed while capturing an unidentified butterfly. The large bold *Hagenius brevistylus* Selys was once seen on wet sand vibrating and showing great interest in a concentration of *Colias philodice* only inches away at the water's edge of the Maumee River; it probably would soon have captured a butterfly if I had not quickly netted it. The very large *Epiæschna heros* Fabricius was once noted securing a moth about the size of an *Autographa;* it flew around in circles afterward for several minutes as if greatly pleased and finally alighted high up in a tree where it could not be taken. At the Monument City bog in Huntington County, Indiana, a large *Tachopteryx thoreyi* Hagen once alighted on my shoulder with a small moth; it flew away when I tried to take it but was captured soon afterward although the moth was lost. At Mud Lake in Williams County, Ohio, a large Green Frog (*Rana clamitans* Latreille) was once seen to jump a few inches and capture a large swallowtail butterfly which it quickly swallowed entire; several other frogs of the same species were observed in the same area, crouched in deep depressions formed in the wet soil by the feet of livestock; they probably secured many butterflies as well as other insects.

I was puzzled for a long time by the sight of numbers of wings of *Colias philodice* and *C. eurytheme* lying on the wet earth in the bottom of ditches where the species congregated. For some time it was believed that Odonata were responsible for this although none were ever observed making captures. I lacked the time and patience to solve the problem, but believe now that shrews and mice were probably responsible; shrews were often glimpsed running along the ditch bottom.

It is the opinion of the writer that butterflies and moths constitute a small part of the food of Odonata and robberflies.

Reference

Price, Homer F., 1958. Additional notes on the dragonflies of northwestern Ohio. *Ohio journ. sci.* 1958: 50-62.

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EARLY RECORDS OF *EREBIA DISCOIDALIS* (SATYRIDÆ) IN WISCONSIN

by WILLIAM H. ELDER

A recent inquiry concerning my records of *Erebia discoidalis* in Wisconsin has prompted me to publish them and to make a search of the literature and some of the larger collections in order to determine the status of this species in the United States.

No specimen of *Erebia discoidalis* (Kirby) taken within the confines of continental United States south of the Canadian border was found in the extensive collections of the United States National Museum, Washington, the American Museum of Natural History, New York, the Carnegie Museum, Pittsburgh, Snow Entomological Museum, Lawrence, Kansas, or the Milwaukee Public Museum. Letters to collectors of long standing in Wisconsin produced no records nor did inquiries to those long interested in the genus *Erebia*, such as P. R. EHRLICH, C. F. DOS PASSOS, ALEXANDER B. KLOTS and P. S. REMINGTON.

It therefore seems of value to set on record data from three specimens which I took within a mile or two of Argonne, Forest County, Wisconsin when I resided there as a boy some thirty years ago.

Data from the original labels follows.

Sex	*Date Captured*	*Width in mm.*
Male	May 29, 1929	40
Female	May 10, 1930	43
Male	May 23, 1931	41

The first specimen is now in the Milwaukee Public Museum (catalogue number 102,197), the other two in my private collection. All are small for the averages given by WARREN (1936) in his monograph of the genus. Dos PASSOS (1940) has pointed out that some specimens from southern Manitoba are smaller and paler than those from farther north considered typical of the species. Mine apparently were the first three specimens taken in the United States, the only other being that of DAGGY (1936) in northern Minnesota, May 31, 1935.

Of his capture DAGGY says, "Taken in a small, swampy clearing surrounded by willows in a dense forest of mixed hardwoods and conifers. The fresh condition of the specimen and the early date of its capture would seem to indicate that the butterfly is a native to Minnesota and not a chance migrant from farther north."

The first specimen I captured was dull and worn and I assumed it had been blown in by the high winds of the previous day which accompanied a storm movement typically passing from west to east. But the second specimen, the female, was in fresh condition and much finer than either male. It was also the earliest on the wing, nearly a month earlier than the usual date for the species as given by WARREN (1936) and EHRLICH (1956).

The habitat in which all three specimens were found was open, grassy meadows with conifers, willows and mixed hardwoods nearby, just as EHRLICH found them in Alaska and elsewhere (1956, 1958). He states that all doubtless feed on grasses or sedges, so that food plants can hardly be a limiting factor in their distribution.

The range of the species was given by HOLLAND (1931 new ed.) as "widely distributed from the region of Hudson Bay to the Pacific in Alaska". This undoubtedly was based on KIRBY's original description of specimens supposedly taken near Hudson Bay, but DOS PASSOS (1940) has shown that KIRBY's specimens really came from Saskatchewan. MCDUNNOUGH (1937) showed that the species ranged as far east as Sudbury, Ontario, and FREEMAN (1958) gives records of its occurrence in all the southern Canadian provinces from Alberta to Quebec. He states, "The distributional pattern of *E. discoidalis* Kby. (Fig. 26) suggests a post glacial entry from the north-west, apparently not yet having reached eastern Quebec and the Maritime provinces." It seems very likely that search in proper habitats in North Dakota (Turtle Mountains) and the upper penninsula of Michigan will reveal that it is present in these states as well as in Minnesota and Wisconsin.

References

Daggy, R. H., 1936. New butterfly record for United States. *Ent. news* 47: 52.

dos Passos, C. F., 1940. A new subspecies of *Erebia discoidalis* Kirby (Rhopalocera: Satyridæ). *Amer. mus. novitates* 1053: 1-2.

Ehrlich, P. R., 1956. Ecological observations on *Erebia* (Lepidoptera: Satyridæ) in northwestern America. *Ent. news* 67: 29-36.

……………, 1958. Problems of arctic-alpine insect distribution as illustrated by the butterfly genus *Erebia* (Satyridæ). *Proc. X. int. congress ent.* 1: 683-686.

Freeman, T. N., 1958. The distribution of arctic and subarctic butterflies. *Proc. X. int. congress ent.* 1: 659-672.

Holland, W. J., 1931. *The butterfly book*, new ed. 424 pp. + 77 pls. Doubleday, Doran & Co. Inc., Garden City, N.Y.

McDunnough, J., 1937. Critical notes on the Canadian species of the genus *Erebia* (Lepid.). *Canadian ent.* 69: 14-18.

Warren, B. C. S., 1936. *Monograph of the genus* Erebia. 407 pp., 104 pls. British Museum (Nat. Hist.), London.

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NOTES ON NINE IOWA BUTTERFLY SPECIES, INCLUDING FOUR NEW TO THE STATE

by Lee D. Miller

Very little has been published on the butterflies of Iowa, indeed, very little collecting has been done, since the days of Lindsey in the first two decades of this century. At first glance Iowa is not too inviting a place for the lepidopterist; due to the preponderance of cultivated land there are relatively few good collecting spots in the state. At present the best places are generally within the confines of the woodland state parks, although a few patches of virgin prairie still exist, as do some fairly extensive wooded areas, especially along the major rivers.

The records which follow are from the various state parks and from some wooded patches near Des Moines.

Lethe eurydice fumosus Leussler. This subspecies (or form), originally described from eastern Nebraska, has been "lost" almost since its description, although a few specimens have been taken in Colorado and southwestern Pennsylvania that approach it. In the company of Messrs. B. C. Johnson, Ronald Royer, and Norris Young, the writer took a fine series of this butterfly in the only acid bog in Iowa at Pilot Knob State Park, Hancock Co., Iowa on July 22, 1960. These specimens agree with typical *fumosus,* being very large and dark above, the ground color almost as dark as *L. portlandia. L. fumosus* has never before been recorded from Iowa. I hesitate to decide as to the merits of the subspeciation of this form. It appears *fumosus* is a dweller of the bogs of the southwestern part of the range of the species, and perhaps as such, a valid subspecies. If this is the case, the butterfly must have once had a continuous distribution.

Strymon m-album Boisduval & Le Conte. The writer took a very fresh female of this species near an oak thicket at Waubonsie State Park, Fremont Co., in the southwest corner of Iowa on May 22, 1960. The condition of this specimen leaves the possibility that a small colony of the species may be established in the park.

S. caryævorus McDunnough. This species has been reported from Iowa on one previous occasion. A pair of specimens from the northeastern part of the state at Decorah were taken in 1909. An extremely fresh female from Waubonsie Park taken by the writer on June 27, 1960 was referred to this species by Mr. Harry K. Clench. Subsequent reexamination of the writer's series of *S. falacer* Godart revealed two more specimens from the Des Moines area, a male taken in Des Moines, Iowa on July 1, 1960 and a female taken two miles north of Earlham, Dallas Co., Iowa on June 29, 1958. All these specimens were taken in hickory woods. It appears this species occurs locally throughout the state, since the records are now from northeastern, central, and southwestern parts of the state.

Achalarus lyciades Geyer. KLOTS reports this species from eastern Iowa, and the writer has specimens from Des Moines. It was surprising, however, when the writer, B. C. JOHNSON, and RONALD ROYER took the species at Waubonsie Park on both May 15 and 22, 1960. This species was in the woodland clearings, each specimen guarding its own territory reminiscent of *Epargyreus clarus* Cramer. This represents a range extension for the species in Iowa of about 150 miles.

Pholisora hayhurstii Edwards, *Hylephila phyleus* Drury, and *Poanes zabulon* Edwards are all fairly well-established in the Des Moines area. It is probable that *phyleus* is reintroduced year after year, since it is a well-known migratory species. It seems to appear each year about the end of June and raise one brood. The other two species are uncommon, but apparently well-established in some of the river-bottom woodlands around Des Moines, *hayhurstii* appearing in June and August, and *zabulon* appearing in late May and August.

Poanes viator Edwards and *Atrytone dion* Edwards. Apparently neither of these species has been previously credited to the Iowa fauna. The writer in company of Messrs. JOHNSON, ROYER, and YOUNG took these species in the bog at Pilot Knob State Park on July 22, 1960, along with the beforementioned *Lethe eurydice fumosus*. *A. dion* was taken in small numbers throughout the bog, showing some preference to the cattails. A few more specimens of this species were taken in a swamp near Klemme, Hancock Co., Iowa on the same day. *P. viator* was taken by the score in the sedges along the margins of the bog. Unfortunately, no identification was made on the species of sedge, for the writer feels this may well be the foodplant of *viator*. The Iowa *viator* are somewhat atypical, but not enough to warrant naming; none were seen at Klemme.

The species recorded as probably new to the Iowa fauna are *Lethe eurydice fumosus* Leussler, and *Poanes viator* Edwards, recorded at Pilot Knob State Park, Hancock Co., Iowa on July 22, 1960, *Atrytone dion* Edwards, recorded at Pilot Knob State Park and near Klemme, Hancock Co., Iowa on July 22, 1960, and *Strymon m-album* Boisduval & Le Conte, taken at Waubonsie State Park, Fremont Co., Iowa on May 22, 1960.

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NOTES ON FIVE NEW BUTTERFLY RECORDS FOR THE STATE OF MARYLAND

by Robert S. Simmons and William A. Andersen

Several field trips by the authors during the past few years have resulted in taking four new species of butterflies for the State of Maryland. The junior author captured another new species for the State practically in his back yard.

While investigating Charles County in southern Maryland on July 28, 1960 for new material, the senior author discovered a large colony of *Euptychia hermes sosybia* Fabricius two miles southwest of White Plains. The immediate area was a semi-open climax forest occupying the flood plain of a slowly moving creek, a tributary of the Port Tobacco River. *E. h. sosybia* was common and flying with numerous *Euptychia cymela* Cramer and an occasional *Lethe eurydice* Johannson. Since there were no flowers present, most of the specimens were captured as they rested on the uppermost blades of high grass that abounded in the area.

Dr. Andersen and Mr. Paul Chermock attempted a trip to the area a week later. Following the senior author's directions, they promptly became lost but remembering the description of the type area found another colony of *E. h. sosybia* along a creek, assuming this to be the first locality discovered. After conferring with Dr. Simmons, they learned their discovery was a new colony seven miles south of the original but along another smaller tributary of the Port Tobacco River. These records consitute new finds for the State.

On June 20, 1957, the authors headed for the mountains of western Maryland. Near Friendsville, in Garrett County, we each netted a *Polygonia progne* Cramer and observed several others. The following year was also good for *P. progne* as we each captured a few specimens at a locality along the Castleman River near Grantsville, Garrett County on July 10 and 17, 1958. Both areas were dense deciduous forest with some scattered Hemlock. All of the specimens were taken along dirt roads through forests where they would play back and fourth in the dappled light much the same as *Polygonia comma* Harris flies.

The mountains of western Maryland were again visited by the authors on June 30, 1960. Near Green Ridge Mountain, Allegany County, we found collecting exceptionally good, especially along a drying creek bed. Along with a series of *Limenitis astyanax* Fabricus, the senior author captured a fresh *Limenitis arthemis* form "albofasciata". Although the *L. astyanax* were fresh, many of them had considerable portions of their wings broken, perhaps due to attacks by birds. Fortunately, the "albofasciata" was undamaged.

During the month of August, 1960, the investigation of Charles County in southern Maryland for new species led to the discovery of some outstanding areas for good general butterfly collecting. This prompted a program to systematically work the County. A choice area was thus discovered on September 8, 1960 near Liverpool Point, where in a field full of large patches of yellow composite flowers (*Coreopsis* sp.), *Colias cesonia* Stoll were flying in good numbers. Over a two week period we took a series of fifty-nine, representing only a small percentage of specimens that were actually on wing. When not feeding on the *Coreopsis* flowers, these strong flying butterflies were extremely wary and consequently almost impossible to capture. A few of the specimens taken near the end of the season represented the form "rosa". An odd fact concerning this new butterfly find for Maryland was the predominance of males. Only four females were captured, and curiously three of those were "rosa".

An interesting feature about this region is that it lies just across the Potomac River from the Quantico-Triangle area in Virginia where SIDNEY A. HESSEL captured this species twenty-three years ago as reported by AUSTIN H. CLARK and LEILA F. CLARK "The butterflies of Virginia", *Smiths. Misc. Coll.* 116, No. 7: p.112; 1951).

The junior author captured an *Urbanus proteus* Linnæus on the afternoon of August 21, 1948, as it was feeding on the lavender blossoms of a butterfly bush located on a lot adjacent to his home in northern suburbs of Baltimore City. Another specimen was seen later in the day on the same blossoms but unfortunately could not be captured.

On September 1, 1953, Mr. ROBERT ROZMAN of Takoma Park, Maryland, while vacationing at Chesapeake Beach in Calvert County, netted a fresh but tailess *U. proteus* just outside of the door to his rented cottage on Chesapeake Bay proper. Apparently a predator had just broken the tails from the specimen prior to capture. Mr. ROZMAN very kindly gave the senior author the specimen which is in perfect condition except for the loss of the tails.

Briefly summarized, the Maryland records are as follows:

Species	*Date*	*Location*
Euptychia h. sosybia	VII-28-60	Two miles southwest of White Plains, Charles Co.
	VIII-4-60	Two miles south of Port Tobacco, Charles Co.

Polygonia progne	VI-20-57	Near Friendsville, Garrett Co.
	VII-10-58 VII-17-58	Along Castleman River, near Grantsville, Garrett Co.
Limenitis a. "albofasciata"	VI-30-60	Near Green Ridge Mountain, Allegany Co.
Colias cesonia	IX-8-60	Near Liverpool Point, Charles Co.
Urbanus proteus	IX-1-53	Chesapeake Beach, Calvert Co.
	VIII-21-48	Baltimore City.

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NYMPHALIS J-ALBUM CAPTURED AT FLUORESCENT LIGHT IN CHICAGO

After reading the note by W. A. Andersen vol.14: page 62 of the *Journal,* I remembered that I too had caught a *Nymphalis j-album* Boisduval & Le Conte at a light. Thus, looking back among my field notes I came upon the following notation: "On the morning (about 9:00) of Aug. 20, 1952 one of the girls that worked in the laboratory where I work came to me in the Animal Room all excited and exclaimed, "Come quickly there is a large moth flying about the lights in the lab." I had visions of perhaps a Cecropia or something which had possibly emerged late in the season so went right away to see what it was. The "moth" turned out to be a large nice perfect specimen of *N. j-album* and with some difficulty I managed to capture it by climbing up a stepladder. The butterfly was very active, flying at the fluorescent light in the ceiling of the laboratory. This is the first time I have ever observed *N. j-album* in Chicago."

I might further add that I have not seen any since that time anywhere in the Chicago Area. The specimen now resides in my private collection. I would also like to mention here (this is from memory only) that back in about July 1946 I saw 6 or 7 *Pieris rapæ* L. flying about a street light at night in Le Claire, Iowa.

Leonard S. Phillips, Armour Res. Foundation, Ill. Inst. Tech., Chicago, Ill., U. S. A.

A CAGE TO SIMPLIFY THE REARING OF THE GREATER WAX MOTH, *GALLERIA MELLONELLA* (PYRALIDÆ)

by Joan F. Bronskill

Mason jars (Haydak 1936) have been used for some time at this Institute as cages for the rearing of the Greater Wax Moth, *Galleria mellonella* (L.); however, they have proved to be somewhat incovenient. Larvæ, in the later instars, produce an excessive amount of frass which tends to mould as it accumulates on the bottom of the jars. This necessitates transferring the larvæ to fresh jars of food at regular intervals. Because the larvæ spin their cocoons and pupate either in the mess of food and frass or on the upper walls of the Mason jars, it is often difficult to remove the pupæ, required for host material, from the jars without injuring them. These problems are overcome with the lantern-globe cage in which 200-250 healthy larvæ, that produce pupæ of 207.8 ± 13.5 mgm. in approximately 42 days after oviposition, can be reared.

Essentially, the lantern-globe cage (Fig. 1) consists of an ordinary 4¾-inch high, squat type, glass lantern globe (g) with a 3¾-inch diameter upper opening and a 3-inch diameter lower opening (inside dimensions), equipped with a lid (1) and a base (b) of copper screening (50 mesh per inch) soldered to ⅜-inch high metal rims that fit snugly over the lantern globe. The base (Fig. 1, b) of the cage has three metal legs (⅛ inch in diameter) soldered to its rim equidistant from each other which raise the cage ½ inch above the tray (t); this allows for better circulation of air through the cage. A 4-inch diameter rack (Fig. 1, r) of copper screening (14 mesh per inch) rests on the lower shoulder of the globe and supports the food. A piece of copper screening (13 inches long by 3½ inches wide), pleated crosswise and shaped to form an 8-pointed column (Fig. 1, s), is placed on the rack of copper screening (r). It (Fig. 1, s) serves as a support on which the mature larvæ spin their cocoons and pupate. The cocoons, containing pupæ, are easily removed from this support without injury.

A variety of foods (Haydak 1936 and 1941; Good, Morrison & Mankiewicz 1953; Smith 1937; and Waterhouse 1959) have been used to nourish *G. mellonella*. At this Institute, stock cultures have been very successfully reared on a diet prepared as follows: to Pablum[1] (420

[1]Mead Johnson of Canada Ltd., Belleville, Ontario.

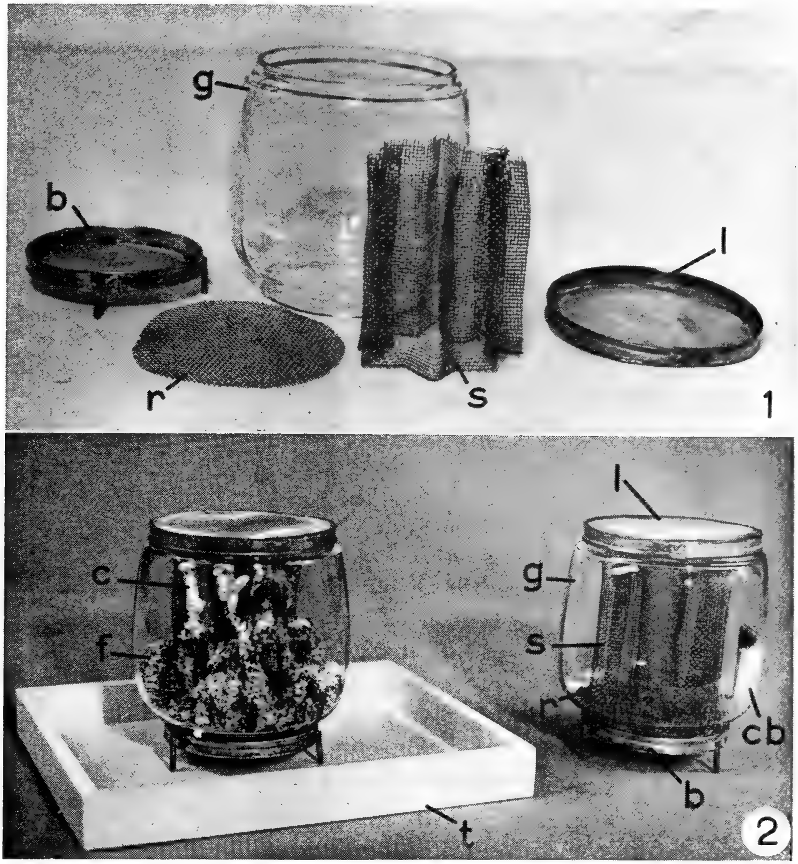

Fig. 1, An unassembled lantern-globe cage for the rearing of *G. mellonella,* showing its component parts. Fig. 2, An assembled lantern-globe cage (right) before the addition of food, and a similar cage (left) containing food (f) and pupated wax moths (c) on the support of copper screening. Abbreviations: b, base; c, wax moth cocoons; cb, corrugated cardboard; f, food; g, lantern globe; l, lid; r, rack; s, support; t, tray.

gm.) and ground brood comb (20 gm.) are added white honey (150 ml.), glycerine (150 ml.), and tap water (30 ml.) which have previously been thoroughly mixed together in a Waring Blendor. The resultant food has a consistancy of damp sawdust.

One newly emerged female and two male wax moths are put in each lantern-globe cage. Usually, within 24 hours eggs are laid between the wall of the cage and a piece of corrugated cardboard (approximately

1 by 3 inches) (Fig. 2, cb), previously attached to the inner wall of the cage by cellulose tape to facilitate oviposition. After the female has finished depositing her eggs, the adult moths are removed from the cage, the rack (Fig. 2, r) and support (s) of copper screening are placed in the cage, and food (f) is put on the rack between the pleats of the support.

When reared at a temperature of 82 ± 1° F. and a relative humidity of 37 ± 3 per cent, the eggs hatch in 8 to 10 days and the larvæ immediately crawl to the food. The first instar larvæ do not escape from the cage, as long as the food touches the corrugated cardboard (Fig. 2, cb) on which the eggs are laid. When all the eggs have hatched, the cardboard strip (cb) is removed from the cage. More food is added through the upper opening of the cage as required.

The mesh in the copper screening rack (Fig. 1, r) is small enough to adequately support the food and larvæ, yet large enough to allow the frass to fall through it onto the base (b) of the cage, from which it can be readily removed without disturbing the larvæ. Because some of the fine particles of the frass continuously fall through the mesh of the base (b), the cages are placed on trays (Fig. 2, t).

ACKNOWLEDGEMENTS

The author is indebted to Miss ETHEL BAWDEN for technical assistance and to Mr. T. H. STOVELL for taking the photographs.

References

Good, M. E., F. O. Morrison, & N. E. Mankiewicz, 1953. Lipidolytic enzymes extracted from *Galleria mellonella* L. (Lepidoptera: Pyralidæ) reared on natural and artificial media. *Canadian ent.* 85: 252-253.

Haydak, M. H., 1936. Is wax a necessary constituent of the diet of wax moth larvæ? *Ann. ent. soc. America* 29: 581-588.

................, 1941. Nutrition of the wax moth larvæ: vitamin requirement. I, Requirement for vitamin B. *Proc. Minnesota acad. sci.* 9: 27-29.

Smith, T. L., 1937. Breeding methods for *Galleria mellonella, in Culture methods for invertebrate animals,* ed. by P. S. Galtsoff, F. E. Lutz, P. S. Welch, & J. G. Needham: pp. 349-355. Comstock Pub. Co. Inc., Ithaca, N. Y.

Waterhouse, D. F., 1959. Axenic culture of wax moth for digestion studies. *Ann. N. Y. acad. sci.* 77: 283-289.

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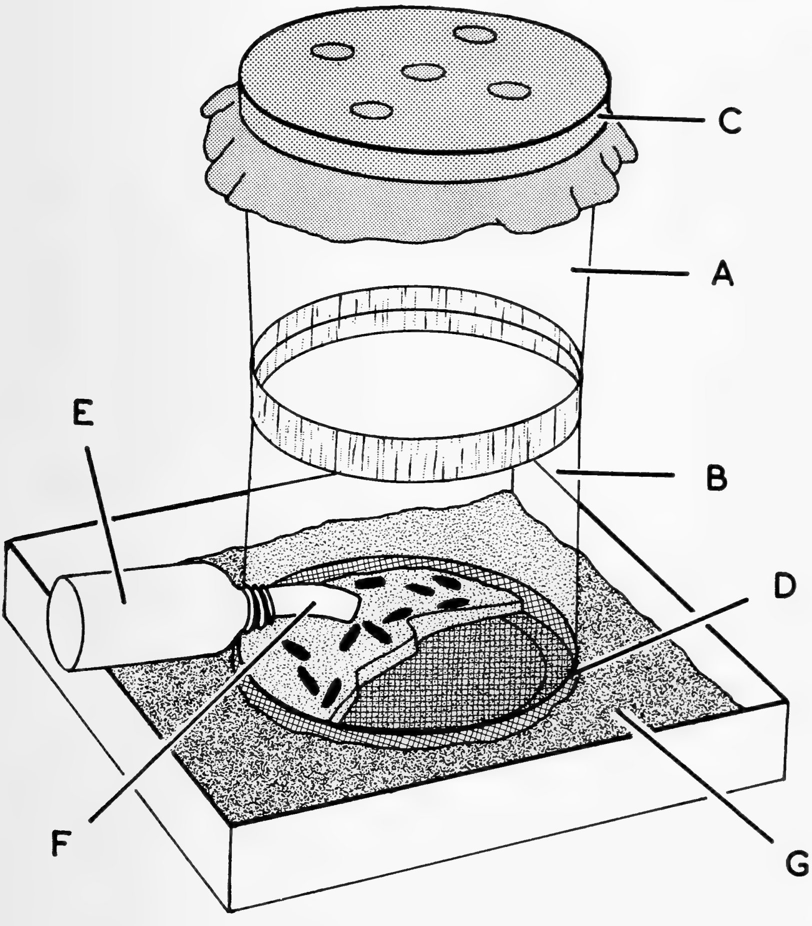
AN IMPROVED CAGE FOR REARING CUTWORM MOTHS (NOCTUIDÆ)

by D. Farnsworth

The former method of rearing cutworm moths and the collection of their eggs (Berubé, 1958), has been facilitated by the use of a new plastic cage that reduces difficulties in handling and feeding moths and in collecting their eggs.



A, B, transparent plastic containers; C, lid serving as top; D, lid serving as bottom; E, plastic food reservoir; F, dental cotton; G, sterilized fine sand.

The cage (figure) is constructed of two transparent plastic containers (A and B), the bottoms of which have been removed. The resulting edges are held together with masking tape to give a cylinder approximately five inches in diameter and ten inches high. The original plastic lids are modified to serve as ends for the cylinder. The top of the cage (C) has five ventilating holes three-quarters of an inch in diameter. A sheet of 80 mesh nylon screen is placed over the end of the cylinder and the lid forced into place so that the screen is sandwiched between the end of the cylinder and the container lid. The bottom (D) has a 4½ inch diameter disc removed and a sheet of eight mesh metal screen closes the bottom in a manner similar to the top. The food reservoir (E) is a three ounce polyethylene bottle threaded into a hole in the side of the cage 2¼ inches above the bottom. A piece of dental cotton (F), which touches the bottom of the bottle, conveys honey solution to the interior of the cage. The cage is placed in a tray 9 x 9 x 1½ in. that is partially filled with fine sand (G). In operation the cage is forced down until sand rises through the metal screen to a depth of half an inch.

Equal numbers of male and female pupæ are placed on the dry, sterile sand within the cage; a total of 30 pupæ is the most satisfactory number for a cage of this size. No further handling of the pupæ or moths is required as observations can be readily made through the clear plastic wall of the cage. When emergence begins, a ten per cent honey solution is placed in the feeding bottle which is replaced with another food reservoir as required. This method of feeding is fast and prevents the escape of moths; the transparency of the bottle ensures that food is available. The visibility of the eggs on the sand reduces unproductive sifting during egg collection and the light quality of the plastic permits greater ease of handling. Nearly all the eggs are laid on the sand and the few that are laid on the plastic wall may be easily washed off. This cage may be easily disassembled for cleaning and is unharmed by chemical sterilizing solutions.

ACKNOWLEDGEMENTS

I wish to thank Mr. T. STOVELL and Mr. C. NICHOLLS for their advice and assistance in the construction of the cage.

References

Berubé, J. A. C., 1958. Note on rearing the Red-backed Cutworm *Euxoa ochrogaster* (Guen.), in mass. *Ann. rept. ent. soc. Ontario* 88: 57.

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A NOTE ABOUT *LYCÆNA NIVALIS BROWNI* (LYCÆNIDÆ)

by F. Martin Brown

In the fall of 1959 Mr. E. J. Newcomer of Yakima, Washington, sent to me some Lycænidæ for determination. Among them was a short series of *Lycæna nivalis* (Bdv.) of particular interest. I asked him to collect for me more material in the season of 1960. This he did. Upon comparing the material he sent from Yakima and parts of Klickitat Counties with that in my collections from California, Idaho, Montana and Wyoming it seemed that the Washington material was distinctive enough to warrent a subspecific name. In October 1960 I had the opportunity to study the large series of *nivalis* from the northwestern states in the collections of the American Museum of Natural History in New York. This included the type series of *nivalis browni* dos Passos. At the close of this study I decided that the material Mr. Newcomer had sent to me, although distinguishable from most of the specimens considered to be *browni* by the author of the subspecies, is nothing more than an extreme form of that Copper.

In the course of this brief study of *browni* certain things about it became apparent. The characteristic smoky suffussion of the females that makes the subspecies recognizable seems to be a response to moisture. Such a response seems to be absent in *nivalis nivalis* which I have seen from a variety of habitats in California and Oregon and a few places in Washington along the lower reaches of the Columbia River. Apparently the gene or genetic complex that is responsible for *browni's* reaction to moisture is absent from *nivalis nivalis*.

In the most humid parts of the range of *browni* the females are universally dark. In the semi-arid parts of its range few if any of the females are "smoked". The tendency is for the smokiness to be highly developed in the western parts of the range of the subspecies and to diminish eastward until in most areas where it is found in Wyoming smokey females are exceptional. These eastern *browni* approach typical *nivalis* in color but are more brassy and less coppery-red; also they tend to be somewhat larger.

The Newcomer material that I include as an extreme form of *browni* differs from all of the *nivalis* that I have seen, except from less than one percent of the Idaho catch, in that the orange submarginal markings on the upper side of the hind wings of both sexes is absent or at best obsolete. Over eighty percent of the specimens I have had from Mr. Newcomer that were collected in Yakima County and in Klickitat County north of

Saltus Pass (3,150 feet above sea level) bear no trace of these orange marks. The others bear them in much reduced form.

Some will insist that this slight but rather constant difference warrants subspecific recognition. I disagree and believe that the material being discussed represents the ultimate expression of melanism in the melanistic subspecies *browni.*

References

Boisduval, J. B. A., 1869. Lépidoptères de la Californie. *Ann. soc. ent. Belgigue* 12: 44 (original description of *nivalis*).

dos Passos, C. F., 1938. Some new subspecies of North American Lycænidæ (Lepid.). *Canadian ent.* 70: 45-46, pl.2, figs.1-4 (original description of *browni*).

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OBSERVATIONS ON *STRYMON LIPAROPS* (LYCÆNIDÆ)

On re-reading H. K. Clench's article (*Lepid. news* 9: 105-117; 1955) on the habits of *Strymon falacer* (Godt.), I was struck by the similarity between the situation he described with respect to the distribution of this species in a field surrounded by woods in Michigan and the circumstances under which I collected *S. liparops* (Bdv. & Lec.) in a similar field at Point Pelee, Essex Co., Ontario, on July 8th and 9th, 1956. At Mr. Clench's urging, I am recording my observations as I recall them on those days, in the hope that these may stimulate more critical observations of these species.

The field in question was roughly 10 acres or more, broken by small stands of sumach and other trees. The predominant plant species visited by butterflies were *Apocynum* sp., *Melilotus alba* Desr. and *Asclepias syriaca* L. *M. officionalis* (L.) Lam. was present but I do not recall collecting anything on it. There were a few *S. liparops* on the *Apocynum.* This plant seemed to be favoured by *Epargyreus clarus* Cram.; a dozen or more individuals were seen or collected on this species. The *S. liparops* were commonest by far on the *M. alba* and then on the *A. syriaca,* which was considerably less abundant.

I have no data as to sex ratio, but I do recall observing that the hairstreaks frequented flowers (both *M. alba* and *A. syriaca*) that were approximately 15 to 20 feet from the woods' edge. The frequency of *M. alba* dropped off rapidly from this point towards the woods but remained high, or increased, towards the center of the field. The frequency of *S. liparops,* however, decidedly decreased towards the center of the field.

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ESPECIALLY FOR FIELD COLLECTORS

(Under the supervision of FRED T. THORNE, 1360 Merritt Dr., El Cajon, Calif., U.S.A.)

A MALTESE LEPIDOPTERIST IN THE U. S. A.

by ANTHONY VALLETTA

Dreams, sometimes, do come true! When I joined the Lepidopterists' Society some ten years ago, I never thought that one day I would be fortunate enough to meet some of its members and to see their wonderful collections; neither did I think that I would see on the wing the butterflies I read about from time to time in the Society's *Journal* nor that I would have the chance to net a few myself; however as all "brothers of the net" can vouch, occasionally, collectors have queer dreams, such as running after butterflies or other insects in far off lands. I am no exception, and after reading some interesting collecting adventure in the journal, I dreamt that I was in the States, chasing butterflies, and enjoyed the fantastic nightmare hunt, only to be disappointed when I woke up.

But such dreams came true on September 3rd, 1959, when as a participant in the International Teacher Development Program which is part of the Educational Exchange Program sponsored by the U. S. Department of State, I arrived in Washington, D. C., to spend a happy and busy period of six months together with 272 other educators from 72 different countries. It was the eve of Independence Day when Mr. RUSSELL L. RILEY, the American consul general in Malta, rang me up to break the good news and to congratulate me on my selection to go to the States and to invite me to participate in the local American celebrations the next day. The following days were hectic ones for me, as I had to prepare a lot for this long trip, and at the same time to carry on with my office work.

Naturally, my mission in America was in the field of education; however time is found for a little bit of everything. As a naturalist, I made it a point to study also the flora and fauna in my spare time, if any, giving special attention to the Lepidoptera, and therefore I did not forget to put in one of the baggages the net, a killing bottle, a few nesting boxes and above all, the list of the members of the Lepidopterists' Society.

Unluckily, I could not do much in this field as I had to spend the fall term on the chilly shores of Lake Michigan, in Evanston and Chicago, and again, the winter months in California were hopeless, but still I made the best of it and got all the possible fun from my normal work.

My plane left Malta exactly at mid-day on September 2nd. The first stop was at Ajaccio in Corsica; it was pouring as we got there, and the hour stop was spent under cover sipping a glass of Corsican wine. When it was time to board the plane again, the pilot announced a delay of two hours as something went wrong with the defrosting apparatus; luckily, the rain stopped and I could, then watch the swift manouvering of swallows skimming along the wet, shiny surface of the runway and hear the continuous calling of so many quails and the mellow chirping of noisy crickets.

We arrived in London rather late but still in time to pass through the customs, to travel to the other side of the airport and take my connection to New York. It was raining in Shannon too, and no moths were at the lights. The Atlantic crossed, Boston was reached the next morning; nothing was seen as the early mist was still very low; a lonely grasshopper rested on the waiting room wall, the first American insect I saw.

New York was reached half an hour later, and the high humidity could be noticed as soon as we left the plane and walked to the customs. A change of plane made me travel some distance, and while doing this I noticed the first butterfly sailing swiftly; it was the Alfalfa Butterfly, *Colias eurytheme* Boisduval. The third stop in the States was at Philadelphia. As it was a very short one I stayed in the plane watching from the porthole the numerous Pieridæ *Pieris rapæ* Linné sipping the yellow flowers of cruciferous plants which grew abundantly by the sides of the runway. Washington was the last stop and my destination, and being welcomed by the Program Officer and directed to a hotel, tired but happy, I felt that I was in reality, bodily and soul in the States.

The Orientation Period at Washington covered a heavy program; we were kept busy all the time from 9 a.m. till, sometimes, even up to 7:30 p.m. with a short break for lunch, as we had so many lectures to attend,, take part in discussion groups, visit historical places and schools, set up an international exhibition and also stage a Talent Show. Luckily, close to the Department Of Health, Education and Welfare in Constitution Avenue, just opposite the Botanic Gardens, there is a small rock garden with a lovely fountain in the centre; while visiting this nice spot before the start of the lectures, I managed to take two species of skippers viz. The Whirlabout, *Polites vibex* Geyer and the Sachem, *Atalopedes campestris* Boisduval, which were in large numbers on the zinnias and on the gomphrena. Every morning as I walked from the hotel to the bus stop, I disturbed the common *Plathypena scabra* Fabr.

Mr. H. W. Capps of the National Museum was first member I met, and through his kindness and help I was able to admire the private collections which are stored in this magnificent Museum.

Visiting the Zoo, on a Sunday morning, I saw the Black Swallowtail, *Papilio polyxenes asterius* Stoll, hawking here and there beyond the railings. On that same day, while I was transferring a Spring Azure, *Lycænopsis argiolus* Linné from the net to the killing bottle, I noticed close to my feet some small pupæ of a micro wrapped in fine web along the stem of an ailanthus plant; later, small spotted moths emerged.

When I visited Mount Vernon and the Arlington National Cemetery, together with the other members of the group, I noticed again the Alfalfa Butterfly and some Sulphurs.

The Orientation Period came to an end on the 19th September and travelling all the night of the 20th and almost the next day I reached Chicago when a thunderstorm was well ahead. Northwestern University in Evanston was to be my home for the fall term and through the help of Mr. Blair Turner, another member of our Society, I found accommodation not far from his house; unfortunately, as he was still studying at Massachusetts, I could not meet him as he left Evanston the day before I reached there; however his parents were most helpful and visiting them so often I found in them a second home.

I must not forget my meeting with Mr. Arthur C. Allyn Jr., who although meeting me for the first time was so benevolent that he presented me with a copy of the wonderful book "Butterflies and Moths" published by Randon House, New York, which I highly appreciated; I still cherish his kind gesture and warm hospitality.

The University campus was wonderful at that time of the year, with all the majestic oak and maple trees just changing the colour of their leaves before shedding them for their winter rest. The weather was generally cold with no sunshine at all. I dare say, that in almost three months, I only saw one Mourning Cloak (*Nymphalis antiopa* Linné) and a couple of Sulphurs; however, returning home every evening from the University, I managed to bottle quite a good number of noctuids and geometers which were resting on the glass-panes of lit shopwindows. The following were the most common; *Protoparce quinquemaculatus* Haw., *Prodenia ornithogalli* Guenée, *Autographa precationis* Guenée, *Alabama argillacea* Hbn., *Drasteria erechtea* (?), and *Amyna octo* Guenée.

Every Saturday morning the Natural History Museum of Chicago was my rendez-vous; however as the curator of insects was away on Saturdays, I met him only once on a free Wednesday morning. While in Evanston, I got in touch with Mr. Thomas Brady, a fellow member who lives at La Grange and who invited me twice to dinner and to see his collection; together with his wife, he drove me in his car out in the country to do some collecting and to show me Morton Arboretum and the Chysanthemum Show at Garfield Park. One afternoon, we collected the Silvery Checkerspot, *Melitæa nycteis* Doubleday, the Clouded Sulphur, *Colias philodice* Latreille and the "pallida" form of the Alfalfa. He also gave me a lot of his spare butterflies which he had collected from Florida, Arizona, and Colorado.

On the 18th December I left Chicago in bright sunshine for California, stopping at Kansas City, Santa Fe, Albuquerque, and at the Grand Canyon of Arizona. I spent the Christmas week at Los Angeles visiting San Diego, Whittier, Hollywood, Disneyland, and Santa Monica and was in San Francisco for the New Year. On January 6th, 1960, I reached Sacramento. I must not forget to record that travelling from San Francisco to Sacramento, I noticed four *Danaus plexippus* Linné. When in Sacramento, I paid a short visit to my friend, Mr. Noel La Due with whom I had already exchanged some butterflies and so we knew each other through correspondence. He was surprised when he heard my voice on the telephone, as he never knew that I was in the States. He took me to his house to meet his family and to see his collection.

From the capital I travelled to Butte County where I had to spend the community phase of my program. I soon got familiar with the towns of this rural county, such as Chico, Oroville, Gridley, Durham, Paradise, and Biggs, as I spent a week in each as the guest of the County Superintendent of Schools and of his consultants, visiting Schools and lecturing to the various clubs and organizations.

When in Oroville, I visited a friend who was rearing tropical fish and under a verandah, I noticed a large number of pupæ all parasitized. I discovered from my friend that the caterpillars had eaten up the whole vine, a *Passiflora,* during the summer. With a little good luck, I managed to discover a live pupa which was still attached to a twig and wriggling its abdomen; it was carefully placed in a glass-bottomed box and put it close to the heater; in four days' time a lovely Fritillary emerged, *Agraulis vanillæ* Linné.

And again when in Durham, I was hearing mass one Sunday morning when the sun peeped out through an overcast sky and I heard the flapping of wings against the glass-panes of a nearby window, and through the venetian blind I could see a butterfly trying to escape. As the sunlight soon faded away, the hibernating butterfly went back to sleep. I waited patiently till the last member of the congregation had left the church, and then on tiptoe I went to the window and there I saw a big sized Tortoise Shell, may be the *Nymphalis californica.*

At Chico I dug a couple of pupæ of the Tomato Hawk Moth, commonly known as Tomato hornworm, but unfortunately they never emerged.

On February 12th, I left Butte County and proceeded to Denver, in Colorado, but snow covered the whole place, and again at St. Louis in

Missouri, it was raining all the time. My last week in Washington for the Evaluation Period was a contrast to my first week in September; cold wind, rain and snow, all the time. In New York from the 27th Feb. to the 2nd March, the temperature was always below the freezing point.

Thus ended my trip to the States, which after all, now, after a year away, I do consider as a real dream; but the contacts I made, the experience I gained, and the warm hospitality I received wherever I have been, made my stay with my fellow members and with the Americans in general an unforgettable event in the best part of my life. Everytime the postman calls he brings with him sweet recollections. As a lepidopterist, I consider this small but sincere contribution incomplete without giving the names of all the moths I collected; perhaps, one day, I shall find someone who would be kind enough to determine them for me and a complete list will be published.

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THE OCCURRENCE OF TWO *EUCHLOE* SPECIES IN ONTARIO (PIERIDÆ)

Species of the genus *Euchloe* Hbn. had not been recorded from Ontario until 1959. Klots (1951) omits Ontario from the range of *Euchloe olympia* Edw., and makes no mention of *Euchloe ausonides* Bdv. at all. Riotte (1959) records *E. ausonides mayi* Cherm. for the first time. The following is a detailed account of the known *Euchloe* specimens from the province to date.

On June 1, 1958, Mr. D. M. Wood and the author collected a series of *E. ausonides mayi* along the roadside, 3 to 15 miles east of Beardmore, Thunder Bay Dist., Ont. These butterflies were very fresh; the only female collected had not flown. A specimen was sent to Dr. T. N. Freeman, Ottawa, who kindly determined it. At the same time, he informed me of four specimens of *E. olympia rosa* Edw. in the Canadian National Collection. These were taken on Strawberry Island, in the north channel of Georgian Bay, Ont., on May 10, 1942.

Another Ontario specimen of *E. ausonides mayi* was found in the Royal Ontario Museum, Toronto. It was taken at Malachi, Kenora Dist., Ont. (near the Manitoba border), July 5, 1947. A third record was submitted by Mr. U. Paim, Toronto, who collected a series of the insect on June 1, 1956, at Basswood Lake, Rainy River Dist., Ont., near the Minnesota border.

Rev. J. C. E. RIOTTE, who has done extensive collecting in the Beardmore area, reports he has never seen the insect on the wing. It was a conspicuous butterfly when we collected our series from three places east of Beardmore.

References

Klots, A. B., 1951. *A field guide to the butterflies.* Houghton Mifflin Co., Boston.

Riotte, J. C. E., 1959. Revision of C. J. S. Bethune's list of the butterflies of the eastern provinces of Canada as far as northern Ontario is concerned. *Ontario field biologist* 13: 1-18.

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MORE BUTTERFLY RECORDS FROM BROWNSVILLE, TEXAS, INCLUDING A FOODPLANT OF *PHOCIDES POLYBIUS* (HESP.)

A small pierid was collected while in flight on November 24, 1960. Dr. A. B. KLOTS confirmed that it was *Eurema daira lydia* Felder, and said that this is certainly one of the few authentic records of this subspecies from Texas. This specimen was contributed to the American Museum of Natural History, New York.

I have this to report on *Phocides polybius lilea* Reakirt (syn. *sanguinea* Scud.): A ragged *P. lilea* adult female was collected by me in Brownsville on August 28, 1958. In the spring of 1959, several more specimens were captured in flight. Since that time *P. lilea* could be found during the summer and fall months frequenting the blossoms of male Papaya trees.

A gravid female was taken on August 15, 1960, and an attempt was made to get her to oviposit on the following series of plants: Papaya, Bougainvilla, Hibiscus, and Banana leaves. All to no avail, and all of these plants are native to Brownsville.

On February 2, 1961, six late instar hesperiid larvæ were discovered feeding on *Psidium guayava* (native to this part of Texas). These larvæ were observed feeding only at night on the leaves. Five of the larvæ pupated within seven to ten days. The sixth larva was preserved in 70% alcohol after boiling in water and sent to the U. S. National Museum.

On February 28th, the first adult, a female *Phocides polybius lilea,* emerged. The remaining four, 2 males and 2 females, emerged in rapid succession, the last one on March 8th. As far as I can ascertain, this is the first published record for the food plant of *P. polybius lilea* in Texas. Dr. KLOTS remarked that this information was interesting and should be published.

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BOLORIA SELENE (NYMPHALIDÆ) IN WASHINGTON

The recent note on the occurrence of *Boloria selene tollandensis* (Barnes & Benjamin) in Oregon, by Ray Albright in vol.14: p.158 of the *Journal*, prompts the penning of this one as a correlate.

So far as is known, only two records exist for the capture of *B. selene* in Washington. In or before 1916, the late John C. Hopfinger of Brewster, Washington, collected one or more specimens near Gamble's Mill northwest of Brewster in Okanogan County. The specimens were later lost in Texas. Also, Leighton's check list of the Butterflies of Washington notes one "well-defined specimen" as having been taken by Ruby Curtiss at Malott on April 14, 1938. Aside from these two records, the species is not known to have been collected in this state. However, it does occur in the Vaseaux Lake area of British Columbia's Okanogan Valley, only twenty five miles north of the Washington border.

This past spring, a field trip was planned especially for the purpose of ferreting out the species in the Okanogan area of northern Washington, contiguous with the Canadian border. May 28 and 29, a beautiful pair of spring days, provided choice opportunity for the trip. "Field headquarters" were established in the little town of Oroville, and the warm daylight hours spent in browsing through the foothills of the Cascades to the west of the town.

The first day out proved to be the eventful one. Our road wound its way westward through the canyon of the Similkameen River, intersected by myriad gullies and dry rocky stream beds (among which a beautiful series of *Phyciodes barnesi* was taken). Our appetites so nicely whetted, we arrived in the vicinity of Palmer Lake. Along its south-east shore, the prize was found. Here there are inviting marsh-edged meadows, bedecked with Indian Paint Brush and a tall, purplish-white aster. Apparently conditions were just right, for in one of these meadows, among the asters, we stumbled upon a well-established colony of *B. selene*. Two days' collecting yielded a fine series of sixteen newly emerged specimens, nine males and seven females. All were taken on or near the tall aster which grows in the moist inner third of the meadow, closest to its marshy bank.

Future collecting in the Palmer Lake region will undoubtedly clear up the matter as to whether or not there are later broods of *selene* this far north.

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PRESIDENTIAL ADDRESS TO THE SEVENTH PACIFIC SLOPE MEETING OF THE LEPIDOPTERISTS' SOCIETY

Ladies and gentlemen:

It is a very special pleasure for me to take part in your meeting here to-day and to be able to deliver the Presidential Address in person. This is not the first time that I have had the pleasure of visiting the New World: my happiest entomological recollections are bound up with the American continents. In North America – in Canada and the United States – it is true that I have not yet had many opportunities of working as a collector and field entomologist, but in South America I have been able to spend over two years altogether, collecting and conducting entomological studies, chiefly in the mountains and lowlands of Bolivia and in the Amazonian jungles of northern Brasil. The identification and study of the rich insect collections made there is still far from completed, but certain fundamental results are already apparent, and I should like to tell about them now.

One of the most stirring experiences for the naturalist is a trip from the Bolivian highlands down over the eastern slope of the cordillera and into the hot jungles of the tropical lowlands. Nowhere on earth, save for certain parts of the south slopes of the Himalayas and in the mountains of western China, do the most extreme zones of climate lie so close together as on the eastern slopes of the Andes. Two or three hours by automobile suffice to go from the icy heights of the Altiplano, the high plateau of Bolivia with its thin, cold, snowy air, up over passes of almost 5000 meters elevation, down into the hot, humid valleys of the Yungas, in the tropical rainforest region on the eastern slopes of the mountains. For the lepidopterist this means the chance of studying two completely different Lepidoptera faunæ in immediate proximity: the high mountain fauna above tree line, with its thoroughly "holarctic" aspect, and the "neotropical" fauna of the valleys: two sharply differing and non-intergrading complexes.

I should like to say something about this most interesting butterfly world of the Cordillera Real of Bolivia, but before doing so a few words are necessary concerning the zoogeographical relationships of the other parts of Bolivia and of all South America generally. In the tropical lowlands of Bolivia we find that fauna of Lepidoptera which in the strict sense is called *neotropical*. It represents a component of the primeval forest fauna distributed over the whole tropical virgin forest region of northern South America, which has remained substantially unchanged since Tertiary times. It is rich in ancient species with only limited subdivision into chiefly wide-ranging subspecies. Numerous families found only in South America give evidence of a very long independent development of this fauna. The Morphidæ, Brassolidæ, Ithomiidæ, Heliconiidæ, Dalceridæ, Mimallonidæ and Megalopygidæ are some examples of such families occuring in the tropical forest fauna of the New World, having no or only very few near relatives in the Old World. It may be concluded that most of these groups developed during upper Cretaceous or early Tertiary times in the northeastern land mass, the Archiguayana of von Ihering, which was then still isolated from the rest of South America by the Amazon Sea; and only later did they spread out, by dividing into additional forms so far as climatic relationships permitted, into the present day distribution pattern of continental South America. The present fauna, and the flora well, of the tropical primary forest of South America should consist, in substantial part, of elements of former guayanan origin. In the territory of the South American tropical lowland forest there has been probably no significant change in climate since the Tertiary, and there is thus no reason for any substantial movement of animals and plants, so that in general the Tertiary fauna is still to be found there even to-day.

In contrast to this nearly static lowland fauna stands the fauna of the Yungas, the rainforests on the eastern slopes of the Cordillera. This Yungas fauna extends between roughly 500 and 3500 meters from Colombia to the knee of the Andes near Santa Cruz de la Sierra in Bolivia, its southern limit, and includes a large number of endemic species. It is striking, however, that although the number of species definitely decreases from north to south, the differences in the relative composition of species are significantly greater going from lower to higher elevations than from north to south. Typical butterfly species of the Yungas are for example: *Papilio isidorus* Doubl. in the lower forest levels; *Papilio warscewiczii* Hopffer in the upper; species of the large entirely neotropical pierid genera *Catasticta* and *Dismorphia;* the satyrid genus *Pedaliodes;* and many others. This fauna which, even though impoverished, extends upward to tree line, is exceptionally interesting and is certainly by far the richest in species in South America. In its development it is, geologically speaking, comparatively young. The raising of the Cordillera in the early Tertiary – a process which apparently continues to this day – first laid the groundwork for the development of this tropical mountain fauna. As already remarked, living conditions in the tropical lowlands can hardly have changed significantly since the middle Tertiary, and therefore for a long time there has been no effective external compulsion for the forms present there to change; in the Yungas area, however, because of the unfolding and mountain-building, forms occuring there were forced either to adapt to the changing living conditions by appropriate movements or else to be exterminated. Add to this the isolation of smaller or larger populations and their consequent subspecific or even specific breaking up occasioned by geologic events and certainly also by climatic fluctuations of the Pleistocene, and we have the explanation for the origin of the widespread richness of the modern Yungas fauna. The evolution of this animal world of the tropical mountain forests from the tropical lowland fauna of the Tertiary is clearly evident from the close relationship of the members of the two faunæ, while on the other hand there is no trace of relationship to the high cordillera and highland fauna. In summary, then, the statement may be made that the rain forest fauna of the Andean east slopes consists substantially of elements of Archiguayanan origin. Elements of the present day fauna of central and southern Brasil, whose origin may be derived from the old Brasilian land mass, the Archibrasil of von Ihering, and which consequently occasionally show near relationships to corresponding African and southern Asiatic form (*e.g.* the Acræidæ), nonetheless play a substantial role in the lowlands of southeastern Bolivia, but participate in only a very subordinate way in the composition of the Yungas fauna.

As soon as we ascend beyond tree line, which on the east side of the Cordillera Real lies between 3000 and 3500 meters, we encounter a fauna completely different from that of the above-mentioned forest areas. Not one species of the true neotropic fauna is to be seen, while forms fly here which, at first glance, make a pronounced holarctic impression. By its very nature this fauna of the high Andes and of the Bolivian highlands – the Altiplano – is not very rich. Only species adjusted to the most extreme conditions are in a position to endure the raw climate of altitudes exceeding 3500 meters. A whole series of species, especially those that live in the high valleys of the Cordillera, during the cold dry period fly in the sunshine low over the ground in protected places. During the summer rainy season insect life at these heights is presumably nearly impossible because of the heavy snowfall. Among the butterflies the following belong to this winter-flying group: the pierid *Phulia illimani* Weymer, the nymphalid *Argynnis inca* Stgr., the lycænid *Itylos speciosa*

Stgr., and the hesperiid *Hesperia limbata nigella* Weeks. Various moths may also be taken at light during this cold dry season. The upper limit of lepidopterous life on the Cordillera Real lies somewhat over 5000 meters where, at the glacier's edge on the last upper fringes of vegetation, fly the pierids *Phulia paranympha* Stgr. and *Piercolias huanaco* Stgr.; and also *Colias euxanthe* Felder and *Argynnis inca* Stgr. again, as well as a few species of noctuids, are still to be found at these heights.

As already mentioned, the butterfly fauna of the high altitudes of Bolivia is composed, for the greater part, of species belonging to genera of chiefly holarctic distribution such as, for example, *Colias, Argynnis* or *Hesperia,* or at least to genera having their nearest relatives in the holarctic, such as the pierid genera *Phulia* and *Piercolias*, probably most nearly allied to the central Asiatic genus *Baltia*. The fauna originally native to the high Andes region was presumably of Patagonian — Chilean origin. Apparently in consequence of the raising of the land since the early Tertiary it was exterminated in the areas above tree line. In connection with this it should be recalled that near Potosi, at an elevation of over 4000 meters, a tertiary fossil flora was found which certainly once prospered at lower, warmer levels. The remnants of the original fauna, derived probably from the old patagonian — Chilean land mass (Archiplata of VON IHERING) has maintained itself only in the comparatively warm inner Andean dry valleys. The pierids, *Teriocolias atinas* Hew. and *Mathania carrizoi* Giacomelli, are such forms of Patagonian origin. The fauna of the Bolivian Cordillera and of the Bolivian highlands is comprised, therefore, in general of a comparatively few elements from the old Archiplata and of a much larger proportion of holarctic elements which first arrived from the North during and after the raising of the land. Which route this immigration might have taken is, to be sure, still very uncertain, since numerous forms show a closer relation to the fauna of eastern and central Asia than to that of North America. It seems certain, however, that this immigration took place at different times and in several waves, of which the latest arrived after the last glaciation, geologically speaking in the most recent times. Also the effect of the Pleistocene glaciations may be recognised in the present representation of forms in the highland fauna, since it must be accepted that during each glacial maximum the forms, in a manner similar to that known in the northern hemisphere, were forced down into restricted refuge areas in which they were then able to develop new forms. The faunal shifts due to the glaciations seem certainly to have been far less extensive in South America than in the Old World. Established generic differentiations, such as the two pierid genera *Phulia* and *Piercolias*, whose nearest allies were noted above to live in central Asia, are apparently the results of an isolation induced by an earlier glaciation. The division of both these genera into numerous closely allied species with frequently very limited ranges, however, is likely to have been a consequence of the last glaciation. The highly polytypic genus *Colias*, however, widespread in Eurasia and in North America, appears to have invaded South America in geologically very recent times, since the last glaciation, because the high Andean species of this genus are only slightly differentiated into subspecies and still show great similarity in every respect to their relatives in Holarctica.

Many interesting peculiarities might be mentioned about the butterflies of the Bolivian highlands and the Cordillera Real, such as the interesting, apparently temperature-controlled, variation in wing color in *Colias euxanthe* Felder, which is orange yellow at high elevations, dull yellow green down near tree line, with intermediates of every degree in the intervening levels. The slower operation of metabolism at the lower temperatures of high altitudes and the consequently reduced excretion, apparently result in only incomplete elimination of the uric acid metabolism products which are deposited in the wings as pigments. A similar instance has been shown already in the Heteroptera.

I hope I have not bored you too much with these short and everywhere incomplete observations on the butterfly fauna of the Cordillera Real. My intent was to draw your attention to the butterfly world of these magnificent and magnificently contrasting mountains, a world still largely unknown in its details, and to the many still unanswered questions of distribution, origins and ecology of the various species as well as the influences which the extreme conditions of life impose upon them.

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THE WALTER C. STINSON COLLECTION OF LEPIDOPTERA

The extensive collection of Michigan Lepidoptera amassed by the late WALTER C. STINSON has recently been donated to the entomology museum at Michigan State University. WALTER C. STINSON, 60, was secretary of the State Bridge Commission of Michigan and manager of the international Blue Water bridge at Port Huron, Michigan, since its opening in the fall of 1938.

STINSON was born February 6, 1898, in Elkhart, Indiana, where he received his grade and high school education. He graduated from the University of Michigan in 1921 with a B. S. degree in civil engineering. After associations with several construction firms, STINSON joined the highway department as Municipal Survey Chief in 1933. In 1937 STINSON assumed his duties as Secretary of the State Bridge Commission. In that capacity STINSON played a prominent part in the construction of the Port Huron - Sarnia bridge and had been its manager since its completion. He died suddenly of a heart attack on May 11, 1958, at his home on the Lake Huron shore north of Port Huron.

The Stinson collection numbers over 7000 specimens representing nearly 1100 species of Michigan Lepidoptera. The collection is remarkable in respect to the extent of his collecting interests, for unlike many amateurs he collected all groups of Lepidoptera. Thus, using the 1955 Moore check list of Michigan moths (*Misc. publ. mus. zool. Univ. Michigan,* no. 88) as a guide, we find that 75 per cent of the Michigan Rhopalocera and 60 per cent of the Michigan Macrolepidoptera are represented in the collection. There is no accurate estimate of the number of Michigan species of Microlepidoptera, but the Stinson collection has over four hundred species represented.

The collection contains a number of species which are represented from the state by only a single specimen or only very few specimens. These include among the Noctuidæ the following species: *Graptolitha tepida* (Grote), *Graptolitha fagina* (Morrison), *Litholomia napæa* (Morrison), *Anathix ralla* (Grote & Robinson), *Chrysanympha formosa* (Grote), *Autographa oxygramma* Geyer, *Heliothis virescens* (Fabricius), and *Erebus odora* (Linnæus); in the Sphingidæ: *Sphecodina abbotii* (Swainson) and *Sphinx luscitiosa* Clemens; and in the Saturniidæ, *Hemileuca maia* Drury.

The collection is in remarkable state of preservation and is indicative of the care and exactness of the man himself. A large number of the labels are hand printed in a very neat and careful hand, probably reflecting the early training of Mr. STINSON in civil engineering. The

Photo Askar-Shain

WALTER C. STINSON (1898 - 1958)

specimens themselves must have been carefully selected, for the great majority of specimens are in the best of shape, both in mounting and brightness. In most instances a species is represented by a series of six or so specimens, unless variation or sexual dimorphism warrants more.

Again, the collection is remarkable for the quantity and quality of the material collected over a period of only a few years. Collecting dates indicate that STINSON was an active collector during the years 1930-1937. During this period he was associated with the old Detroit Naturalists Club whose members comprised a core of other notable Michigan lepidopterists including BRYANT WALKER, SHERMAN MOORE, and Dr. GEORGE W. RAWSON. This group spent many a week end together collecting Lepidoptera in southeastern Michigan. Presumably through their common interest in the Detroit Naturalists Club or because of their mutual vocation, civil engineering, WALT STINSON and SHERMAN MOORE became very closely associated. A constant exchange of specimens took place between MOORE and STINSON for comparison and verification of identifications made by STINSON. Numerous notes made by MOORE are attached to many of the specimens indicating his approval or disapproval of STINSON'S identifications. One can envision that many a winter evening was spent by these two men pouring over descriptions and arguing over the identification of a particular specimen. Undoubtedly the close association of STINSON and MOORE was mutually beneficial.

WALT was an exceptionally intelligent man as may be attested by the fact that he built such an exceptional collection in such a short period of time. Again, his determinations were extremely accurate. In addition to the identification of the Lepidoptera he was remarkably well informed on the native Michigan Lepidoptera, of which he reared many.

Because of his inactivity in the entomological field in his later years, the passing on of many of his collecting associates, and the dulling of memories through the passage of time, information concerning STINSON and his collecting activities has been difficult to secure. However, I wish to extend my appreciation for the odd-ments of information which have been gathered together from the following: Dr. GEORGE W. RAWSON, New Smyrna Beach, Florida; WILBUR S. MCALPINE, Birmingham, Michigan; and JOHN H. NEWMAN, South Lyon, Michigan. Lastly, special gratitude is expressed to his widow, ALICE STINSON, for her most generous gift to Michigan State University. Mrs. STINSON is to be further commended for her public spirited action in making such a collection generally available to the collecting fraternity and to science.

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FRANCIS RICHARD ARNHOLD (1904-1959)

On 19 April 1959, Francis Richard (Dick) Arnhold was fatally stricken by a heart attack while working in the yard of his home at Chippewa Falls, Wisconsin.

Mr. Arnhold was born 5 September 1904 in St. Louis, Missouri, the son of the late Karl Richard and Anna Senik Arnhold. His father was a noted collector of Lepidoptera in Missouri for many years, specializing in collecting and breeding *Catocala*.

Mr. Arnhold attended the University of Missouri, and after graduating he became a diesel engineer. At the time of his death he was superintendent of the generating plants of the Dairyland Power Co-operative at Chippewa Falls and at Twin Lakes, Minnesota. He had previously been a Chief Engineer for the Hawaiian Steamship Company for a number of years and had also been with the Busch-Sultzer Company of St. Louis until March 1940. His early years were spent operating diesel electrical plants on barges in the Mississippi River basin. Much of the time he was in the bayou country of Louisiana. It was here that he was fortunate in capturing and breeding the exceedingly rare sphingid moth, *Isoparce cupressi*. A large percentage of the specimens of this species contained in private collections and in museums today has come from him. His engineering posts had also allowed him to collect many Lepidoptera around Memphis, Tenn., Lynxville, Wisc., Texas, California, and abroad.

Besides having a general interest in Lepidoptera, especially Rhopalocera, Mr. Arnhold was an expert on *Catocala*. His collection contained most of the species of this genus found in North America, and a good number from Europe and some from Asia. He bred large numbers of specimens from the larva, particularly the *Amorpha* freeders such as *C. amestris* and *C. nuptialis*.

Much of his collecting in recent years was confined to the region of Wisconsin where he lived, but he made several summer field trips, including one in 1956 as far west as the Hopfinger home at Brewster, Washington. He discovered isolated colonies of *Œneis jutta* and *Lycæna epixanthe* in a bog near Chippewa Falls, and he collected and bred *Euchloe olympia* close to his home.

In addition to being an ardent lepidopterist, he also was much interested in bee-keeping and maintained a large number of hives.

He is survived by his wife, Edith (Bonnet) of Kansas City, whom he married in 1940, and daughter, Robin Ruth, both of whom helped him greatly in collecting. They traveled with him extensively on his recent field trips ranging from eastern Canada to Washington and B. C.

Mrs. ARNHOLD has generously presented the Arnhold Collection to the Peabody Museum of Natural History at Yale University. It contains about 5,550 specimens, of which 1,450 are *Catocala*. These are all receiving an appropriate collection label as they are integrated into the general study series.

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and
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R E V I E W S

INTERNATIONAL CODE OF ZOOLOGICAL NOMENCLATURE ADOPTED BY THE XV INTERNATIONAL CONGRESS OF ZOOLOGY [in English and French]. Prepared by Editorial Committee, N. R. Stoll, Chairman. xviii + 176 pp. 1961 [actually received for review 31 October]. Published for The International Commission on Zoological Nomenclature. [Available from the International Trust for Zoological Nomenclature, 14 Belgrave Square, London S. W. 1, England; price, bound, is £1. 0s. 0d. (about $3.00).]

The entirely revised Code was written mainly on the basis of the discussions and conclusions of the 1958 Colloquium. This gathering of 209 interested taxonomists from 31 countries met in London 9-15 July, just prior to the XV International Congress of Zoology. The old code (*Règles internationales de la nomenclature zoologique*) had been adopted in 1901 and issued in 1905. In the interim, various (sometimes contradictory) modifications were voted at International Congresses of Zoology and in Opinions and Declarations by the International Commission on Zoological Nomenclature. Thorough-going revision, including codification of the modifications, was begun at the urging of FRANCIS HEMMING, then Secretary of the Commission, at the Congresses in Paris (1948) and Copenhagen (1953). It culminated in a tentative draft by J. CHESTER BRADLEY, President of the Commission. This draft and numerous commentaries and counter-proposals by animal taxonomists were published in preparation for and well in advance of the London Colloquium.

Since the Colloquium, an Editorial Committee of seven members has produced the formal wording of the new Code, in both English and French. The results are a monument to the enormous labor, skill, and doubtless goodwill that must have gone into making the finished product.

The Preamble notes: "The object of the Code is to promote stability and universality in the scientific names of animals. . . . All its provisions are subservient to these ends, and none restricts the freedom of taxonomic thought and action. Priority is the basic principle of zoological nomenclature. Its application, however, under conditions specified in the Code, may be moderated to preserve a long-accepted name in its accustomed meaning." The specific limitation on the Law of Priority (Art. 23) is of great importance but sometimes will be impossible to apply without a ruling from the commission:

> "A name that has remained unused as a senior synonym in the primary zoological literature for more than fifty years is to be considered a forgotten name (nomen oblitum)."

Many provisions of the 1961 Code are either new or were formulated in 1948 and 1953 but held in abeyance by practicing taxonomists until the new Code had been settled. Provisions of special concern to lepidopterists include the 50-year rule just quoted, the method of designating neotypes and type localities, and the explicit removal of infrasubspecific forms (seasonal, aberrational, sexual, etc.) from the protection and regulation of the Code.

The Code proper is followed by appendices setting forth a code of ethics, mode of transliteration and latinization of Greek, geographical, and proper names, general recommendations, and a lengthy section on how to form names. Latin authorities will disagree with some of the procedures specified, and editors will reject others. But these Recommendations in both the Code and the appendices are considered violable, unlike the "mandatory rules."

A valuable Glossary and detailed Index conclude the book. The first queried term ("primary zoological literature") this reviewer took to the Glossary and Index proved to be missing, but such omissions are doubtless very few.

Many taxonomists will wish that still more problems had been codified which must now be referred to the Commission for action, and nearly every worker will regret one or more of the present rules, but he will realize that his view, usually "correct" of course, represents a minority opinion among animal taxonomists, and in the interests of stability he will be obliged to conform to the Code. Even the most unsatisfied taxonomist can conclude that this Code is a magnificent piece of work and that no better job could have been done today with the English-French version. Hopefully, the Commission will press as rapidly as possible for the publication of translations of the Code in informally correct (if not "legally" binding) form in Russian, German, Italian, Spanish, Portuguese, Japanese, Chinese, Hindi, and every other scholarly language possible. The present limitation to English and French is a sorry fact in a field as remote from nationalism as taxonomy must be.

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THE GENITALIA OF THE GROUP TORTRICIDÆ OF THE LEPIDOPTERA OF THE BRITISH ISLANDS. By F. N. Pierce & J. W. Metcalfe. 1960. xxii + 101 pp., 34 pls. ("Facsimile reprint.") Publisher: E. W. Classey, Feltham, Middlesex, England [available from the publisher; price £3.0.0.].

The books of the late F. N. PIERCE on the genitalia of the Lepidoptera, although restricted to the species of the British fauna, have earned a great and estimable popularity not only among the British lepidopterists, but also among those of the entire European continent and beyond its limits. Without exaggeration it must be said that these books stimulated examination of the genitalia of the Lepidoptera, and contributed much to their application in the taxonomy of this order. Published in a limited number of copies, the books of PIERCE have now become rather rare and hardly available to the people interested in them. Especially scarce are the volumes on the Tortricidæ and the females of the Noctuidæ, which for a long time have not been obtainable, even second hand. Fortunately, the natural history publisher and bookseller E. W. CLASSEY not only hit upon the idea to re-publish these two rare volumes, but has also realized it. The present review concerns the volume dealing with the Torticidæ.

It would perhaps be belated to review in detail a book published in 1922, the litho-offset copy of which has appeared last year, reproducing the complete text and illustrations of the original edition. The only addition consists of one page of foreword of the re-publisher, in which he expresses his hopes that this "reprint will prove of value to many people who have been searching in vain for copies of the original edition." For those who have forgotten the edition of 1922, or are not well acquainted with it, some basic information would probably be useful.

In a short introduction, PIERCE, the only author of the entire text, gives a general description of the genitalic features of the Tortricidæ, and on the following 97 pages describes the male and female genitalia of 335 British species belonging to 99 genera. The concept of the family Tortricidæ includes the present subfamilies Tortricinæ, Sparganothidinæ, and Olethreutinæ, and the family Phaloniidæ. PIERCE divided the family into nine groups (Archipsidii, Cnephasidii, Peroneidii, Phaloniadii, Olethreutidii, Ancylisidii, Epiblemidii, Ephippiphoridii, and Lipoptychidii), and describes the general genitalic characters of each group. Each species is illustrated by drawings of Rev. J. W. METCALFE, which represent the genitalia of both sexes.

This short review does not permit a discussion of all the changes and corrections done during the 38 years from the day of publication of the original edition of the book. It would nevertheless be useful to mention that some of the genera, not named in the book and indicated by numbers, have since then received new names. These are: Archipsidii, genus 4 – *Siclobola* Diakonoff (1947), genus 8 – *Paraclepsis* Obraztsov (1954), genus 12 – *Cacœcimorpha* Obraztsov (1954); Cnephasidii, genus 8 – *Pseudargyrotoza* Obraztsov (1954); Phaloniadii, genus 3 – *Hysterophora* Obraztsov (1943), genus 5 – *Phalonidia* Le Marchand (1933), genus 6 – *Cochylichroa* Obraztsov & Swatschek (1958), genus 7 – *Acornutia* Obraztsov (1943) and *Brevisociaria* Obraztsov (1943), genus 15 – *Falseuncaria* Obraztsov & Swatschek (1958), genus 16 – *Cochylidia* Obraztsov (1956), genus 18 – *Piercea* Filipjev (1940); Epiblemidii, genus 3 – *Epinotia* Hübner subgenus *Hamuligera* Obraztsov (1946), genus 16 – *Petrova* Heinrich (1923) and *Blastesthia* Obraztsov (1960); Ephippiphoridii, genus 2 – *Gibberifera* Obraztsov (1946), genus 3 – *Eucosmomorpha* Obraztsov (1951), genus 8 – *Clavigesta* Obraztsov (1946), genus 15 – *Pseudotomoides* Obraztsov (1959), and genus 22 – *Lathronympha* Meyrick (1926).

The appearance of the re-published book is pleasing, the cover is solid. The re-publisher calls the book a "Facsimile reprint," but from the bibliographical point of view this is not quite correct, for the following reasons. The book is re-published in a slightly reduced format (5½ by 8⅝ inches, instead of 5¾ by 9½ inches); the cover is different. Moreover, the title page does not reproduce any data about the first publisher, the place, and the year of the original edition; even in the re-publisher's foreword these data are not mentioned. They were: Oundle, Northants., England: F. N. Pierce, The Old Rectory, Warmington; 1922. The motto page of the original edition is omitted in the copy. The plates with illustrations are printed on both sides; in the original edition the opposite side was plain. The paper is good, but of a different kind from that used in the original. The reduced format of the litho-offset copy did not influence the clearness of the text, but some of the details of the illustrations became lost.

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ERGEBNISSE DER DEUTSCHEN AFGHANISTAN-EXPEDITION 1956 DER LANDESSAMMLUNGEN FÜR NATURKUNDE IN KARLSRUHE. [Results of the German Afghanistan Expedition 1956 of the Country Collections of Natural History in Karlsruhe.] *Beiträge zur naturkundlichen Forschung in Südwestdeutschland,* Vol.19, No.3, Afghanistan-

Heft, pp.191-435, 11 pls. 1961. Kommissions-Verlag G. Braun, Karlsruhe, W. Germany [available from the publisher; price DM 30.00].

At first glance it might look somewhat strange and incomprehensible, that the results of an Afghanistan expedition are published in a serial, the title of which refers rather to regional studies in southwestern Germany. But to those who are better acquainted with the *Country Collections of Natural History in Karlsruhe,* it is well known that these "Collections" had for a long time overstepped the tasks of a strictly regional institution, and became a museum dealing with scientific problems of general interest. The museum itself, its Department of Entomology, and especially the collections of the Lepidoptera under the guidance of Dr. H. G. Amsel, possess valuable scientific materials from countries lying in many cases far beyond the limits of Germany. In 1956, the museum organized a three-man expedition to Afghanistan, headed by Dr. Amsel. For the present it is difficult to summarize the entire results of this expedition, but already the published part shows their great importance for science. A continuation of the report on the expedition is in preparation and will appear in one of the next issues of the serial.

The present issue includes thirty papers by many authors, and reports on the following insect groups, collected by the expedition: Heteroptera, Coleoptera, Dermaptera, Acridoidea, Mantodea, Blattariæ, Diptera, Trichoptera, and Odonata, and two papers dealing with the Lepidoptera. In addition to the materials collected by the expedition, those of the expeditions of J. Klapperich, G. Ebert, and K. Lindberg are also taken into consideration. For the most part the papers are completed by families, worked up by specialists. These papers represent an important contribution to the entomological study of a very interesting part of the Eremic subregion, which has hitherto been almost a *"terra incognita."*

In a paper on the Lepidoptera, E. P. Wiltshire ("Middle East Lepidoptera, XV, A second contribution to the Lepidoptera of Afghanistan," pp.337-371) gives an annotated list of the collected Heterocera, and describes several species and subspecies. The genitalia are represented by 54 drawings, some of them with additional details. Plates II-IV show black and white photographs of moths. A paper on Noctuidæ-Trifinæ by Ch. Boursin (pp.373-398) lists about 100 species of this group of the Lepidoptera from Afghanistan, establishes the synonymy of some of them, and describes as new a few subspecies and one species. Plates V-X give black and white photographs of moths and their genitalia.

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TINEIDÆ, SECT. 3, *TINEINÆ.* (*Fauna of the U. S. S. R., Lepidoptera,* vol.4, part 3.) By A. K. Zagulajev. 1960. 266 pp., 231 text figs., 3 color pls. Published by the Zoological Institute of the Academy of Sciences, Moscow & Leningrad, U. S. S. R. (new series no.78). [Available from E. W. Classey, 4 Church Street, Isleworth, Middx., England; price £1.10.0.]

This new volume of the *Fauna of the U. S. S. R.* represents a part of the monograph on the family Tineidæ and deals with the sub-family Tineinæ occurring in the U. S. S. R. and the adjoining countries.

The division of the monograph into three parts (parts 1 and 2 are not yet published), along with the subdivision of the family into sub-families, and the treatment of every part (*i.e.*, subfamily) separately, seems to me a very fortunate principle. In this way the author is able to concentrate on each section and to elaborate it. In this respect the present part of the "Fauna" forms a favourable contrast with a previous Lepidoptera part of the series, the family Psychidæ, by I. V. Kozhanchikov, where the already large family was widely extended by adding all possible case-baring forms, many hardly related to the Psychidæ. The result war partly a rather superficial compilation of literature data.

In the present part on the subfamily Tineinæ, the True Clothes Moths, all ceratophagous and many synanthropous species, are dealt with extensively. The material used originates from several collections in Leningrad and Moscow, personal collecting by the author, the collections of Wocke (preserved in Leningrad), Ershoff, Eversmann, etc.

A chapter on general morphology precedes the special part. A chapter on the biology of the species comprises over 20 pages, including noteworthy details on the occurrence of little-known Central Asiatic species and an interesting compilation of the author's views of the descent and probable development of the remarkable wool-eating habits. Then follow remarks on the author's classification and phylogeny of the species. Chapters on the economic importance, the control, the parasites of the Tineinæ, and a list of literature complete the general part.

It is of interest that the genera concerned may also be subdivided biologically. So *Nemapogon* contains phyto-detritophagous species, most of them mycetophagous; *Haplotinea* species feed on flour, seeds, cereals, etc.;*Tinea* and *Tineola* are ceratophagous; *Myrmecozela* lives in old ants' nests; etc.

In the special part the Tineidæ are subdivided into several sub-families, of which only three, the Scardiinæ, the Nemapogoninæ, and the Tineinæ are closely interrelated. Of these only the last subfamily is treated in the present part.

The old complex genera of the Tineinæ, such as *Tinea, Tineola, Myrmecozela*, etc., appear to be quite unnatural, and considerable regrouping was necessary. So, *e.g.*, the old genus *Tinea* has been revised with the use of the characters of male genitalia, venation, location of median spur of posterior tibia, and the amount of apical spines of the tarsal segments, etc., with the following result: 19 species were referred to nine other old genera, chiefly to *Blabophanes* and *Myrmecozela;* 38 species were placed in *Nemapogon;* 25 species in *Lichenovora, Cephimallota,* and *Hoplotinea,* while only 25 species remained in *Tinea.*

For the subdivision into higher taxa the morphology of the adults and the genital characters of the two sexes were chiefly used, but the morphology of the immature stages (larval chætotaxy, etc.) and also biology, were fully considered. A new classification has resulted, in which certain genera and subgenera are differently placed than was done by PIERCE (1935) and PETERSEN (1957). This is evident from the following subdivision of the book, where six genera and seven subgenera are classifies thus: (1) *Monopis,* subdivided into the subgenera *Monopis, Blabophanes,* and *Monopina;* (2) *Tinea,* divided into *Tinea, Acedes, Tineida,* and *Tineopsis* (the two last are indicated as "new subgenera", but as far as I understand, both are only lowered to a "new status", having been described as genera earlier); (3) *Tineola;* (4) *Fermocelina;* (5) *Cilicorneola;* and (6) *Trichophaga.* In total 57 species are described and recorded, of which 12 are new. *Niditinea* Pet. 1957 is sunk as a synonym of *Tineidia* Zag. 1954.

The well-illustrated special part deals with the following numbers of species: *Monopis* (13), *Tinea* (25), *Tineola* (2), *Fermocelina* (5), *Cilicorneola* (1), and *Trichophaga* (6). Morphology and biology (when known) of each species are given, ♂ and ♀ genitalia, and often the adult, are figured. Descriptions are based on the adults, but for economically inportant species full descriptions and figures of the larvæ and their chætotaxy are added.

ZAGULAJEV's monograph makes an excellent impression of accuracy, completeness, and competence. And I sincerely hope that the future parts 1 and 2 of the Tineidæ will be of the same high standard and will follow soon. In the way of well-meant criticism it may be remarked that for the sake of completeness it would be advisable to add citations of type species under each genus and subgenus and of type localities under each species; this has been omitted. A great advantage for the readers of the monograph would be bibliography of the genera; although bibliography of each species is cited extensively, that of the genera is omitted altogether. This is the more deplorable because an important paper of ZAGULAJEV, "Survey of Palæarctic Tineina", 1954, a precursor of the present monograph, apparently containing important descriptions, is either rare or not at all accessible in libraries outside the U. S. S. R.

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KLUCZE DO OZNACZANIA OWADÓW POLSKI [Keys for the Identification of Polish insects]. Published by the Polish Entomological Society (in Polish), distributed by "Ars Polona", Krakowskie Przedmieście 7, Warszawa, Poland.

The results of faunistic research are summarized in the studies of the fauna of different countries. These are usually published in two forms: in book form with the monographic studies; or as booklets with the keys for identification. In Poland the second form has been established.

The XXVIIth part of the "Keys" is reserved for the Lepidoptera. It is planned to issue 66 numbers of the unbounded booklets, to cover all the families, and inclusive of one number "The Introduction" for all Lepidoptera. In each number there are a short introduction, the list of all Central European species of the published family, and data on morphology and life-history. The main part contains the keys for the identification of the species. The text is supplemented by a number of figures.

So far, at our disposal are the following numbers:

2-4: Toll, S., 1959: Micropterygidæ (pp.3-15, 27 figs.), Eriocraniidæ (pp.16-31, 40 figs.), and Hepialidæ (pp.32-49, 44 figs.).

6 : Toll, S., 1959: Tischeriidæ (21 pp., 46 figs.).

37: Schneider, J., Schneider, J., & Schneider, Z., 1961: Ægeriidæ (42 pp., 52 figs., 6 col. plates).

39-40: Toll, S., 1956: Glyphipterygidæ (pp.3-36, 88 figs.), Douglasiidæ (pp.37-50, 32 figs.).

45b: Bleszyński S., 1956: Pyralidæ-Crambinæ (87 pp., 286 figs.).

46a: Bleszyński S., 1960: Geometridæ: Brephinæ, Orthostixinæ, Geometrinæ, Sterrhinæ (149 pp., 446 figs.).

53a: Kostrowicki A.S., 1956: Noctuidæ-Cuculiinæ (124 pp., 441 figs.).

53b: Kostrowicki A.S., 1959: Noctuidæ-Agrotinæ, Melicleptriinæ (145 pp., 429 figs.).

61-62: Krzywicki M., 1959: Lycænidæ (pp.3-59, 72 figs.) and Erycinidæ (pp.60-64, 3 figs.).

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RECENT LITERATURE ON LEPIDOPTERA

(Under the supervision of Peter F. Bellinger)

B. SYSTEMATICS AND NOMENCLATURE

Agenjo, R., "Otro nuevo *Crambus* F., español (Lep. Cramb.)" [in Spanish]. *Eos,* vol. 30: pp. 345-352, 1 pl., 3 figs. 1954. Describes as new *C. vilarrubiæ* (Montgrony, 1600-1665 m., Gombreny, Gerona). Names a "form" of *C. pinellus.* Additional localities for *C. bolivari* & *C. digitellus.* [P. B.]

Agenjo, R., "Diferenciación anatómica y dispersion en España de las *Apatele psi* (L.), *tridens* (Schiff.) y *cuspis* (Hb.) (Lep. Phalæn.)" [in Spanish]. *Eos,* vol 31: pp. 39-51, 3 pls. 1955. Figures genitalia, gives records, & discusses distribution [P. B.]

Agenjo, R., "Nuevo *Evergestis* Hb., hispano-marroquí (Lep. Pyraust.)" [in Spanish]. *Eos,* vol. 31: pp. 241-245, 1 pl. 1955. Describes as new *E. dusmeti* (Orihuela, Alicante Prov., Spain). [P. B.]

Agenjo, R., "Tres noctuidos de la comarca de Albarracín, en Teruel, que pasan a sinonimia (Lep. Phalæn.)" [in Spanish]. *Eos,* vol. 31: pp. 217-240, 2 pls. 1955. Sinks *Atethmia schleppniki* to *A. algirica; Acronicta schwingenschussi* to *Apatele auricoma; Apamea amaliæ to Luperina testacea.* Extensive systematic notes & locality records. [P. B.]

Agenjo, R., "Tribus y subtribus de la Subfamilia Phycitinæ Cotes, 1899 (Lep. Phycitidæ" [in Spanish]. *Eos,* vol. 34: pp. 205-208. 1958. Proposes names for the "Groups" and "Venational Divisions" of Heinrich, 1956: PHYCITIDI, including CRYPTOBLABINI, ACROBASIINI, ECTOMYELOISINI, & PHYCITINI; EPHESTIIDI, including EUPHOCERINI, EURYTHMASIINI, HOMŒOSOMINI, DIVIANINI, EPHESTIINI, & VARNERIINI; & CABNIIDI. [P. B.]

Agenjo, R., "Existe la *Gegenes pumilio* (Hoffm., 1804) en España (Lep. Hesp.)?" [in Spanish]. *Eos,* vol. 35: pp. 197-208, 6 figs. 1959. Distinguishes *G. pumilio* from *G. nostradamus,* & gives locality records of latter; no certain Spanish records of former. Transfers *G. zelleri* to *Borbo.* [P. B.]

Agenjo, R., "Las *Catocala* Schrk., españoles, con mâs amplias consideraciones respecto a las de mayor interés forestal (Lep. Noct.)" [in Spanish]. *Eos,* vol. 35: pp. 301-384, 6 pls., 30 figs. 1959. Redescribes the 15 Spanish spp.; figures genitalia; gives Spanish records; lists foodplants. Keys to subfamilies & tribes of Noctuidæ, & to subgenera & spp. of *Catocala* occurring in Spain. [P. B.]

Alberti, Burchard, "Die Zygænidæ (Insecta, Lepidoptera) als Modelfall Stammesgeschichtlicher Studienmöglichkeit an rezenten Tiergruppen" [in German]. *Proc. XV internat. Congr. Zool.,* pp. 166-168. 1959. Discusses study of character and species evolution in living forms; examples from Zygænidæ. [P. B.]

d'Almeida, R. Ferreira, "Breves notas sòbre o gênero *Rothschildia* Grote, 1897 (Lepidoptera, Saturniidæ)" [in Portuguese]. *Bol. Mus. nac.,* Rio de Janeiro, n. s., *Zool.,* no. 171: 47 pp., 5 figs. 1957. Catalogue of genus with notes on synonymy. Describes early stages of *R. erycina belus, R. arethusa, R. betis,* & *R. aurota speculifer.* [P. B.]

d'Almeida, R. Ferreira, "Espécies e subespécies novas de Ithomiidæ (Lepidoptera-Rhopalocera)" [in Portuguese]. *Bol. Mus. nac.,* Rio de Janeiro, n. s., *Zool.,* no. 173: 17 pp., 12 figs. 1958. Describes as new *Napeogenes paruensis* (Maracanaí, Rio Paru de Leste, Pará, Brazil), *N. sylphis acreana* (near Vila Taumaturgo, Rio Juruá, Acre, Brazil); *Hypothyris honesta acreana* (near Vila Taumaturgo), *H. meterus arpi* (Itaituba, Tapajoz, Pará, Brazil); *Callithomia travassosi* (Dumba, Rio Araguaia, Mato Grosso, Brazil), *C. juruaensis* (near Vila Taumaturgo, Rio Juruá, Acre, Brazil); *Hypoleria plisthenes* (Carmo do Rio Claro, Minas Gerais, Brazil), *H. novaesi* (near Vila Taumaturgo, Rio Juruá, Acre, Brazil), *H. mulveriana*

(Fordlândia, Rio Tapajos, Pará, Brazil); *Heterosais edessa covella* (Cojimies, Manabi, Ecuador). Transfers *exornata* Haensch to *Hypoleria.* [P. B.]

d'Almeida, R. Ferreira, "Ligeiras notas sôbre algumas *Actinote* do sudeste do Brasil (Lepidoptera-Rhopalocera)" [in Portuguese; English summary]. *Bol. Mus. nac.,* Rio de Janeiro, n. s., *Zool.,* no. 178: 7 pp., 1 fig. 1958. Describes allotypes of *A. discrepans* & *A. melanisans.* Gives synonymy of latter & of *A. pyrrha;* sinks *A. brasiliensis* to *A. pyrrha.* Notes on difficulty of determinations in this group of spp. [P. B.]

Amadon, Dean, "Proposals concerning homonymous family-group names based on the generic names *Drepana* Schrank, 1802 (Class Insecta, Order Lepidoptera), and *Drepanis* Temminck, 1820 (Class Aves); request for the use of the Plenary Powers to suppress the generic name *Drepanis* Brisson, 1760." *Bull. zool. Nomencl.,* vol. 17: pp. 220-223. 1960. Drepanidæ is the correct family name in Lepidoptera, Drepanididæ in Aves. Request for placement on Official List of *Drepana,* type *falcataria.* [P. B.]

Amsel, H. G., "*Catabrachmia rozsikella* Rebel 1909 = *Xystophora palustrella* Douglas 1850 (Lepidoptera: Gelechiidæ)" [in German]. *Zeitschr. wiener ent. Ges.,* vol. 43: pp. 286-287. 1958. *Catabrachmia* is a valid genus. *C. palustrella* has a remarkable distribution, being found in N. Europe and isolated in Hungary (*roszikella*). [P. B.]

Amsel, H. G., "Cyprische Kleinschmetterlinge" [in German]. *Zeitschr. wiener ent. Ges.,* vol. 43: pp. 51-58, 69-75, 135, 1 pl., 14 figs. 1958. Describes as new: (Pyralidæ) *Ommatopteryx* (*Eromene*) *cypriusella* (Kyrenia); *Pempelia albicostella* (Kyrenia); *CYPRUSIA* (monobasic), *C. wiltshirei* (Kyrenia Mts.); *Scoparia unicolorella* (emended to *unicornutella* on p. 135) (Kyrenia); *Metasia cypriusalis* (Kyrenia); (Tortricidæ) *Cnephasia tolli palæstinensis* (Abu Goasch, near Jerusalem); *Laspeyresia prædorsana* (Kyrenia); (tineoids) *Agonopteryx scopariella calycotumella* (Kyrenia Mts.); *Crossotocera wagnerella tripunctella* (Prodromos, 4000 ft.); *Œgoconia apatemella* (Triboukkia, Prodromos, 4000 ft.). Records numerous other spp. from Cyprus, 23 being new to the island; gives descriptive & systematic notes on some. [P. B.]

Amsel, H. G., "Eine neue *Stagmatophora*-Art aus Persien (Lepidoptera: Momphidæ)" [in German]. *Ent. Tidskr.,* vol. 79: pp. 102-103, 1 pl. 1959. Describes as new *S. schultzendorffi* (Sine Sefid, prov. Fars, Iran, 2200 m.). [P. B.]

Aubert, Jacques-F., "Les géométrides paléarctiques du genre *Entephria* Hb. Description d'un genre nouveau pour *argentiplumbea* Hmps." [in French; German summary]. *Zeitschr. wiener ent. Ges.,* vol. 44: pp. 177-209, 6 pls., 18 figs., 1 map. 1959. Describes as new *E. luteolata* (Nepal, Mustangbhot, Gargompa, Penga, 4000 m.), *E. politaria tibetaria* (or new sp?; Bhutan; Tibet), *E. multicava orientata* (or new sp?; Ta Tsien Lou; Tibet), *E. albipunctata* (Yatung, 4500 m., central Tibet); *CŒNOLARENTIA* (type *argentiplumbea* Hampson); also some new "forms". Revision of 22 Palearctic spp. and their races; transfers 5 spp. to other genera. [P. B.]

Banks, Leslie, "*Schinia brevis* Grote — a synonym." *Bull. Brooklyn ent. Soc.,* vol. 47: p. 28. 1952. Sunk to *septentrionalis* Walker. [P. B.]

Bauer, David L., "A new subspecies of *Microtia dymas* (Nymphalidæ) from southern California." *Lepid. News,* vol. 12: pp. 97-100. 1959. Describes as new *M. d. imperialis* (Palm Springs).

Bernardi, G., "La variation géographique du polymorphisme chez les *Hypolimnas* du continent africain (Lep. Nymphalidæ)" [in French]. *Bull. Inst. franç. Afrique noire* (*A*), vol. 21: pp. 1021-1032, 9 figs. 1959. Study of the geographical variation of the polymorphism in the species of *Hypolimnas* (*H. misippus, H. dinarcha, H. mechovi*) in continental Africa. Description of *H. dinarcha liberiensis* n. ssp. (hinterland of Liberia), and two morphs, one in *misippus,* the other in *mechovi.* [P. V.]

Bernardi, G., "Note sur la variation geographique de deux dualspecies: *Leptosia alcesta* Stoll et *Leptosia nupta* Butler (Lep. Pieridæ)" [in French]. *Bull. Soc. ent.*

France, vol. 64: pp. 30-36, 10 figs. 1959. Note on the geographical variation of the two dualspecies of pierids, *L. alcesta* & *L. nupta.* Describes as new *L. n. viettei* (Madagascar), *L. a. pseudonuptilla* (Ethiopia), *L. a. inalcesta* (Tanganyika, Kilimandjaro), *L. a. pseudonupta* (Belgian Congo, Stanleyville). [P. V.]

Bernardi, G., "Note sur la variation géographique de *Nepheronia* (*Leuceronia*) *buqueti* Boisd. particulièrement à Madagascar (Lep. Pieridæ)" [in French]. *Naturaliste malgache,* vol. 10: pp. 81-86, 1 pl., 3 figs. "1958" [1959]. Note on the geographical variation of *N.* (*L.*) *buqueti* and description of *N.* (*L.*) *buqueti pauliani* n. ssp. (Madagascar: Tuléar). [P. V.]

Bernardi, G., & P. Viette, "Deux nouvelles sous-espèces françaises du genre *Zygæna* Fabricius (Lep. Zygænidæ)" [in French]. *Entomologiste,* vol. 15: pp. 3-6. 1959. Description of two new French subspecies: *Z. sarpedon pictonorum* (Vendée: Longeville) & *Z. lavandulæ lecharlesi* (Aude: Villespassans). [P. V.]

Bernardi, G., & P. Viette, "Note sur la nomenclature de trois espèces du genre *Zygæna* Fabricius (Lep. Zygænidæ)" [in French]. *Bull. mens. Soc. linn. Lyon,* vol. 29: pp. 238-248. 1960. The species of *Zygæna* usually named *achilleæ* Esper, *meliloti* Esper, and *scabiosæ* Scheven should be named: *achilleæ* Esper, *viciæ* Paula Schrank, and *dalmatina* Boisduval. The names *meliloti* and *scabiosæ* are incorrect. Except one, all the names of *Zygæna* of Denis and Schiffermüller are *nomina nuda.* [P. V.]

Bernardi, G., "Une nouvelle sous-espèce de *Colotis evippe* L. (Lep. Pieridæ)" [in French]. *Bull. Soc. ent. France,* vol. 65: pp. 123-124. 1960. *C. e. mirei,* a new ssp. of pierid from Tibesti Mts. [P. V.]

Bernardi, G., & P. Viette, "A propos du récent travail de M. H. Reiss: '*Zygæna ephialtes parisica* n. subsp.' (Lep. Zygænidæ)" [in French]. *Bull. Soc. ent. Mulhouse, 1960*: pp. 31-33, 1 table. Note to show that the name *Z. e. parisica* Reiss, 1959, is a synonym of *Z. e. rubens* Verity, 1946, and indicate the geographical distribution of the subspecies. [P. V.]

Biezanko, C. M., "Nota sôbre a invalidade do gênero *Hepialopsis* Warren, 1907 (Lep. Het. Thyrididæ) e sua substituição por *FORBESOPSIS* gênero novo" [in Portuguese]. *Agros,* Pelotas, vol. 10, no. 1: 2 pp., 1 pl. 1957. *Hepialopsis* preoccupied by *Hepialopsis* Dyar (Eucleidæ). Figures *Forbesopsis sphingipennis,* the type sp. [P. B.]

Biezanko, C. M., "Papilionidæ da zona sueste do Rio Grande do Sul" [in Portuguese]. *Arq. Ent. Inst. agron. do Sul,* Petotas, *ser. A,* no. 1A: 16 pp., 3 figs. 1959. List of 13 spp., with systematic notes by W. T. M. Forbes; records of foodplants. [P. B.]

Biezanko, C. M., "Sobre dos nuevas especies de la familia Noctuidæ: *Hoplotarache rufinelli,* sp. n. (Acontiinæ) y *Herminodes carbonelli,* sp. n. (Erebinæ) de la Republica Oriental del Uruguay y de Rio Grande do Sul, Brazil" [in Spanish]. *Rev. Soc. uruguaya Ent.,* vol. 3: pp. 35-39, a figs. 1959. Type localities not identified; genitalia not described. [P. B.]

Biezanko, C. M., *Álbum iconográfico dos lepidópteros coletados por C. M. Biezanko. Papilionidæ. Pars prima.* 20 pls. Pelotas. 1960. Photos of 19 spp. of South American papilionids (*Graphium, Papilio, Atrophaneura, Battus, Euryades*). [P. B.]

Bigot, L., "Les *Agdistis* de la faune française (Lep. Pterophoridæ)" [in French]. *Alexanor,* vol. 1: pp. 149-157, 1 fig. 1960. Study of the eight spp. of *Agdistis* of the French fauna, with figures of the ♂ & ♀ genitalia. [P. V.]

Bigot, L., "Un *Agdistis* nouveau de Tripolitaine: *A. fiorii* n. sp. (Lep. Pterophoridæ)" [in French]. *Alexanor,* vol. 1: pp. 201-203, 3 figs. 1960. Describes as new the pterophorid *A. fiorii* (Tripoli, Suk el Giuma). [P. V.]

Birket-Smith, J., "Results from the Danish Expedition to the French Cameroons (1949-50). XXVII. – Lepidoptera (part I). *Bull. Inst. franç. Afrique noire* (*A*), vol. 22: pp. 521-554, 17 figs. 1960. In this part are studied Papilionidæ, Pieridæ, Danaidæ and Satyridæ. Describes as new *Mycalesis nanodes nyongensis* and a number of "forms" and aberrations. [P. V.]

Birket-Smith, J., "Results from the Danish Expedition to the French Cameroons (1949-50). XXVII – Lepidoptera (part II)." *Bull. Inst. franç. Afrique noire* (*A*), vol. 22: pp. 924-982, 2 col. pls., figs. 18-32, 1 table. 1960. List of the Rhopalocera collected. Describes as new *Cymothoë electrinos; Euphædra erasmus; Neptis infusa* (Nymphalidæ); *LECTILES*, & type *L. collitorum; Powellana virginea; Lachnocnema makakensis; Hypokopelates kallipygos* (Lycænidæ); all from R. Nyong, S. of Makak Station. Figures in color last instar larvæ of *Papilio bromius, P. demodocus, Pyrrhochalcia iphis, Charaxes pleione, Cymothoë cænis, Neptis nemetes, Acræa zetes, A. orestia,* & *A. alciope*. It seems that many of the new taxa will be synonyms. [P. V.]

Bleszyński, Stanislaw, "Studies on the Crambidæ. Part XVIII. Revision of the genus *Chrysocrambus* Blesz." [in English; Polish & Russian summaries]. *Acta zool. cracov.*, vol. 2: pp. 843-886, 41 figs. 1958. As new are described: *C. danutæ* (Hispania: Sierra la Sagra, Granada), *C. cassentiniellus pseudocraterellus* (Lebanon); *C.* (*Chrysocramboides*) *craterellus alpinus* (Alps), *C.* (*C.*) *craterellus abruzzellus* (Italy), *C.* (*C.*) *craterellus libani* (Lebanon). The synonymy of *C.* (*Chrysocrambus*) *cassentiniellus* Zell. and *C.* (*Chrysocramboides*) *craterellus* Scop. is recorded in detail. [J. M.]

Blesyński, Stanislaw, "Studies on the Crambidæ. Part XXII. On the systematical position of several North-American species of the generic group *Crambus* F. s. 1." [in English; Polish summary]. *Bull. ent. Pologne,* vol. 29: pp. 447-482, 63 figs. 1959. Discussed are 25 Nearctic spp. of Crambidæ, without new taxa. [J. M.]

Bleszyński, Stanislaw, "A new genus *CLASSEYA* for some species of the genera *Argyria* Hbn. and *Platytes* Gn. and a new species of this genus from Senegal (Crambidæ)" [in English]. *Acta Soc. ent. Cechoslov.*, vol. 57: pp. 267-274, 1 pl., 17 figs. 1960. As new are described: *CLASSEYA* n. gen. (type: *Argyria bicuspidalis* Hampson 1919), *C. placydioni* (Sedhiou, Senegal). Many new combinations. Genitalia are figured. [J. M.]

Bleszyński, Stanislaw, "Studies on the Crambidæ. Part XXIII. New species of the generic group *Crambus* F." [in English; Polish summary]. *Bull. ent. Pologne,* vol. 30: pp. 11-22, 10 figs. 1960. As new are described: *Crambus whalleyi* (Brazil: São Paulo); *Xanthocrambus watsoni* (Maroc: Timhadit); *Mesocrambus tamsi* (Maroc: Tangier); *Calamotropha bradleyi* (S. Africa: Cape Colony); *C. azumai* (Japan: Nishinomiya). [J. M.]

Bleszyňski, Stanislaw, "Studies on the Crambidæ, Part XXIV. On the synonymy of the generic group *Crambus* F." [in English; Polish summary]. *Bull. ent. Pologne,* vol. 30: pp. 23-32, 3 figs. 1960. *Agriphila cyrenaicella* Rag. (=*Crambus alexandriensis* B.-Baker, *n. syn.*). *A. tristella* Schiff. & Den. (=*Crambus discistrigatus* Hampson, *n. syn.*). *A. argentistrigella* (Rag.) *n. comb.* (=*Crambus nebrodellus* Zerny, *n. syn.*). *Catoptria dimorphella* (Stdgr.) *n. comb.* (=*Crambus haywardi* Rebel, *n. syn.*). *Pediasia ribbeella* (Car.) *n. comb.* (=*Crambus escalerellus Schmidt, n. syn.*). *P. aridella* (Thnbg.) *n. comb.* (=*P. squalidalis* Hbn., *n. syn.*). *P. aridella caradjaella* (Reb.) (=*Crambus salinellus nepos* Rothschild, *n. syn.*). *P. luteella* (Schiff. & Den.) (=*Crambus uhryki* Rothschild, *n. syn.*). *P. siculella* (Dup.) (=*Crambus subdesertellus* Chrétien = *C. mariæ-ludovicæ* Lucas, *n. syn.*). *Calamotropha orontella* Rag. (=*Crambus leucaniellus* Zerny = *C. fuscilineatellus* Lucas, *n. syn.*). *Chrysocrambus similimellus* (M. R.) (=*Chrysocrambus lambesselus* Blesz.). [J. M.]

Bourgogne, J., "Deux psychides nouvelles de l'Afrique occidentale (Lep. Psychidæ)" [in French]. *Bull. Inst. franç. Afrique noire* (*A*), vol. 20: pp. 1234-1242, 14 figs. 1958. Description of two new spp. of psychids: *Manatha microcera* (Bamako, French Sudan), *M. grandis* (Nimba, French Guinea). [P. V.]

Bourgogne, J., "La femelle d'*Amicta cabrerai*, espèce endémique des îles Canaries (Lep. Psychidæ)" [in French]. *Bull. Soc. ent. France,* vol. 64: pp. 119-120, 4 figs. 1959. First description of ♀. [P. B.]

Bourgogne, J., "La véritable identité de deux Psychidæ de la faune éthiopienne" [in French]. *Bull. Soc. ent. France,* vol. 63: pp. 218-220. "1958" [1959]. On the identity of the spp. *Psyche vuilleti* & *P. joannisi* Ch. Oberthür; these are synonyms of *Kotochalia junodi.* [P. V.]

Bradley, J. D., "A new species of *Ochsenheimeria* Huebner from central Himalaya (Lepidoptera: Tineidæ)." *Ann. & Mag. nat. Hist.,* ser. 12, vol. 6: pp. 832-833, 1 pl. 1953. Describes as new *O. hugginsi* (Tehri-Garhwal, Rudugira Gael, 15,400 ft.). [P. B.]

Bradley, J. D., & Brian O. C. Gardner, "*Pammene aurantiana* (Staudinger), a tortricid recently discovered in the British Isles (Lep: Tortricidæ)." *Ent. Gazette,* vol. 9: pp. 60-62, 1 pl. 1958. Redescription & record of first discovery. [P. B.]

Bradley, J. D., "Pyrales and Microlepidoptera collected by Mr. E. W. Classey in Madeira, 1957." *Entomologist,* vol. 91: pp. 192-197, 3 figs. 1958. Describes as new *Blastobasis acuta* (Funchal). Sinks *Ephippiphora maderæ* to *Enarmonia leplastriana; Blastobasis flavescentella* to *B. lignea.* Records of 23 spp. of micros. [P. B.]

Bradley, J. D., "Taxonomic notes on *Leucoptera meyricki* Ghesquière and *Leucoptera coffeella* (Guérin-Méneville) (Lepidoptera, Lyonetiidæ)." *Bull. ent. Res.,* vol. 49: pp. 417-419. 1958. *L. coffeella* is neatropical; east African records of "*coffeella*" are of *L. meyricki* & other old world records are dubious. Identity & generic assignment of *coffeella* need reconsideration. [P. B.]

Bradley, J. D., "A xylorictid moth attacking the bark of the rubber tree in Malaya." *Bull. ent. Res.,* vol. 50: pp. 9-10, 2 figs. 1959. Redescribes *Deloryctis corticivora.* [P. B.]

Bradley, J. D., "An illustrated list of the British Tortricidæ. Part II: Olethreutinæ." *Ent. Gazette,* vol. 10: pp. 60-80, 19 pls., 12 figs. 1959. Representative adults of all spp. are figured. Notes on the 7 spp. found in the British Isles since Meyrick's *Handbook.* Figures of genitalia of the 12 spp. not figured by Pierce & Metcalfe. [P. B.]

Bradley, J. D., & D. S. Fletcher, "Lepidoptera records from the Isle of Portland and Chesil Beach, including a description of *Coleophora versurella* Zeller, a species new to the British list." *Entomologist,* vol. 92: pp. 27-33, 2 figs. 1959. Redescribes *C. versurella* & figures genitalia. List of moths from these localities. [P. B.]

Bradley, J. D., "Additional records of Microlepidoptera collected in the Burren, Co. Clare, Ireland, in 1951 and 1952." *Ent. Gazette,* vol. 11: pp. 31-36, 12 figs. 1960. Distinguishes *Coleophora ramosella* & *C. derivatella* from *C. troglodytella,* & *C. therinella* from *C. peribenanderi.* Figures genitalia of first 4 spp. Records of 2 other *Coleophora.* [P. B.]

Braun, Annette F., "Taxonomy of the North American species of *Bucculatrix*: correlation of genitalic structure with food plant groups." *Proc. 10th internat. Congr. Ent.,* vol. 1: p. 297. 1958. Abstract.

Brower, Lincoln P., "Peale's *Lepidoptera Americana* and the correct name for *Papilio multicaudatus.*" *Lepid. News,* vol. 12: pp. 101-102. 1959.

Brower, Lincoln P., "Speciation in butterflies of the *Papilio glaucus* group. I. Morphological relationships and hybridization." *Evolution,* vol. 13: pp. 40-63, 8 figs. 1959. *P. pilumnus* is removed to *troilus* group. Study of larval markings, ♂ genitalia, etc. shows that *P. eurymedon, P. multicaudatus* & *P. rutulus* are more closely related among themselves than to the eastern *P. glaucus.* Natural hybrids, especially in overlap zones of *P. glaucus* & *P. rutulus,* and the possible origin of the spp., are discussed. [P. B.]

Brown, F. Martin, "A new subspecies of *Cœnonympha nipisiquit* McDunnough from New York State." *Journ. New York ent. Soc.,* vol. 66: pp. 63-73, 1 pl. 1958. Describes as new *C. n. heinemani* from Thousand Islands. [W. C.]

Brown, F. M., & Bernard Heineman, "The generic name *Anetia* Huebner (Danaidæ, Rhopalocera)." *Journ. New York ent. Soc.,* vol. 66: pp. 99-102. 1958. *Anetia* takes priority over *Anelia* Hbn., as the proper name for butterflies now called *Clothilda.*

Designates *numidia* ♀ on Huebner's plate as type specimen of *Anelia*, and *numidia* ♂ on same plate as type of *Anetia*. [W. C.]

Burdick, William N., "A new race of *Euphydryas* from the Cascade Range of Oregon." *Lepid. News*, vol. 12: pp. 165-.70, 1 fig. 1959. *E. editha remingtoni* (Mt. Thielsen, Douglas Co., Oregon). [P. B.]

Burmann, Karl, "*Eriocrania alpinella* nov. spec. (Lepidoptera, Eriocraniidæ)" [in German]. *Zeitschr. wiener ent. Ges.*, vol. 43: pp. 269-271, 1 pl., 2 figs. 1958. Type locality Vennatal, Zillertaler Alps, 1900 m.; foodplant probably *Alnus viridis.* [P. B.]

Burns, John M., "A new species of oak-eating *Erynnis* (Lepidoptera: Hesperiidæ) restricted to the southern Cordillera of the United States." *Wasmann Journ. Biol.*, vol. 18: pp. 147-160, 7 figs. 1960. Describes as new *E. telemachus* (Hualapai Mts., 6,500 ft., 10 mi. SE of Kingman, Mohave Co., Arizona). Foodplant *Quercus gambeli.* [P. B.]

Capuse, J., "*ANCATA* n. g. (*Tæniocampa* Gn. partim)" [in French]. *Bull. ent. Pologne*, vol. 28: pp. 167-171, 3 figs. 1958. The new genus is established for *Tæniocampa gothica.* The author gives the description of genitalia of some *Tæniocampa* spp. also. [J. M.]

Clarke, J. F. Gates, "A new heliodinid from Illinois (Lepidoptera, Heliodinidæ)." *Proc. ent. Soc. Washington*, vol. 54: pp. 138-139, 1 pl. 1952. Describes as new *Heliodines ionis* (Champaign, Ill.; foodplant *Mirabilis nyctaginea*). [P. B.]

Clarke, J. F. Gates, "An unrecorded homonym in Gelechiidæ (Lepidoptera)." *Proc. ent. Soc. Washington*, vol. 54: p. 99. 1952. Proposes *PARELECTROIDES* to replace *Parelectra* Meyrick, *nec Parelectra* Dognin (Noctuidæ). [P. B.]

Clarke, J. F. G., "The correct name for a pest of beans." *Proc. ent. Soc. Washington*, vol. 60: p. 187. 1958. *Laspeyresia fabivora* Meyrick is the correct name for *L. leguminis* Heinrich, a pest of beans in central America. [P. B.]

Clench, Harry K., "A new cossid moth from western China (Lep. Cossidæ)." *Mitt. münchner ent. Ges.*, vol. 48: pp. 82-85, 1 pl. 1958. Describes as new *SINICOSSUS* (monobasic), *S. danieli* (Omei-Shan, 7000 ft., Szechwan). [P. B.]

Clench, Harry K., "Three interesting Lepidoptera from the Philippines." *Ann. Carnegie Mus.*, vol. 35: pp. 69-76. 1958. Describes as new *Danaus apoxanthus* (Seliban R., Mt. Apo, 7000 ft., Mindanao); *PHILIPPODAMIAS* (Agaristidæ), & type *P. jocelyna* (Matuguinao, Samar Is.). Discusses related agaristid genera & transfers *claggi* to *Philippodamias.* Gives descriptive notes on *Delias levicki* & separates *apoensis* from *levicki* as good sp. [P. B.]

Clench, H. K., "On the unusual structure and affinities of the Madagascan genus *Pseudocossus* (Lep. Cossidæ)." *Rev. franç. Ent.*, vol. 26: pp. 44-49, 2 figs. 1959. The genus *Pseudocossus* has affinities with two genera isolated in Chile of the *Chilecomadia* group. These genera have a "prototympanum". [P. V.]

Collenette, C. L., "Notes on African Lymantriidæ with descriptions of new species." *Ann. & Mag. nat. Hist.*, ser. 12, vol. 6: pp. 561-578, 1 pl. 1953. Describes as new: *Olapa phæospila* (Bitje, Ja R., Cameroons); *SYCHNACEDES* (monobasic), *S. idiopsis* (Antsianaka, Madagascar); *Crorema moco* (Mt. Moco, Luimbale, Angola, 1800-1900 m.); *Marbla paradoxa heteropa* (Ogruga, Niger); *Pirgula delosema* (Solwezi, NW Rhodesia); *Euproctis aplegia* (Mafuga Rain Forest, Kigezi, Uganda), *E. silacea* (Station Perinet, E. Madagascar)), *E. apoblepta* (Tananarive, Madagascar), *E. taylori* (Kampala, Uganda), *E. euryochra* (Kissenyies, Ruanda, Kivu, 5000 ft.); *Porthesaroa aclyta* (Massadou, near Macenta, Fr. Guinea, 1600 ft.); *Aroa eugonia* (Bingerville, Ivory Coast); *HEMEROPHANES* (n. n. for *Dasycampa*, preoccupied) *eucrita* (Usambara, E. Tanganyika); *Dasychira esthlopis* (Mountain Inn, Melsetter, S. Rhodesia), *D. allotria scæa* (Kawanda, Uganda); *Aclonophlebia macarthuri* (Mtito Andei, Kenya), *A. pinheyi* Mt. Elgon, Kenya), *A. baliocosma* (Yanongwe, Belgian Congo); *Palasea melia jacksoni* (Maroto, Karamoja, Uganda); *Lymantria kettlewelli* (Wilderness, Knysna, Cape Prov.);

THAMBETA (monobasic), *T. haigi* (Obudu, S. Nigeria). Sinks *Pirgulina* to *Pirgula*. Gives key to spp. of *Crorema*. Notes on other spp., with some new synonymy. [P. B.]

Collenette, C. L., "Some new Lymantriidæ from Madagascar." *Mém. Inst. scient. Madagascar, ser. E,* vol. 5: pp. 125-131, 1 pl. 1954. Description of *Euproctis perixesta* (Ankaratra Mt.); *Dasychira ambahona* (Ankaratra Mt.), *D. lygropis* (Tananarive), *D. batoides spirucha* (Tananarive), *D. viettei* (Ankaratra Mt.), *D. cydista* (Ankaratra Mt.). [P. V.]

Collenette, C. L., "Further new species of Lymantriidæ from Madagascar." *Ann. Soc. ent. France,* vol. 128: pp. 103-120, 2 pls. 1959. Descriptions of *Leucoma lechrisemata* (Ambatondrazaka); *Homœomeria iraceræa* (Perinet);*Olapa notia* (Sakaraha), *O. terina* (Ampijoroa); *Marblepsis semna* (Maroantsetra); *Crorema viettei* (Anosibe); *Pirgula polylopha* (Perinet); *Euproctis stenobia* (Perinet), *E. eurybia* (Ambohitantely; *Dasychoproctis lasioma* (Ampolomita); *Porthesaroa xanthoselas* (Anosibe); *Homaroa tamsi* (La Mandraka), *H. frieda* (Anosibe); *Dasychira cyclota* (Ankaratra Mts.), *D. sphenosema* (Perinet), *D. sakaraha* (Sakaraha), *D. nosivola* (Nosivola), *D. polioides* (Ambatondrazaka), *D. problema* (Perinet), *D. euthyzona* (Ampolomita), *D. perissa* (Anosibe), *D. leucopsaroma* (Fanovano), *D. griveaudi* (Anosibe), *D. perinetensis* (Perinet), *D. diæreta* (Ampijoroa), *D. titan* (Ampolomita); *APHOMŒOMA,* & type *A. mesembrinum* (Bekily); *Lymantria* (Perinet), *L. hypobolimæa* (Ambalarondra). [P. V.]

Common, I. F. B., "The occurrence of *Epinotia lantana* (Busck) (Lepidoptera: Olethreutidæ) in Australia." *Proc. Linn. Soc. N. S. Wales,* vol. 82: pp. 230-232, 2 figs. 1957. *E. lantana,* which was introduced in 1914 to control *Lantana,* is now established in eastern Australia from Cairns to Maclean. Genitalia figured and synonymy stated. [I. C.]

Common, I. F. B., "A revision of the pink bollworms of cotton (*Pectinophora* Busck (Lepidoptera: Gelechiidæ)), and related genera in Australia." *Austral. Journ. Zool.,* vol. 6: pp. 268-306, 1 pl., 9 figs. 1958. Describes as new *P. endema* (Rockhampton, Queensland); *PEXICOPIA* (type *Gelechia desmanthes* Lower), *P. mimetica* (Grey Range, Queensland), *P. proselia* (35 mi. W. of Kihee, Queensland), *P. diasema* (Noccundra, Queensland), *P. catharia* (40 mi. E. of Tibooburra, New South Wales), *P. cryphia* (Kihee, Queensland), *P. arenicola* (Cobham Lake, New South Wales), *P. pheletes* (Roma, Queensland), *P. dascia* (Mundubbera, Queensland), *P. paliscia* (Kihee, Queensland); *MACRACÆNA,* & type species *M. adela* (Springsure, Queensland), *Decatopseustis cataphanes* (Five Fords, Australian Capital Territory). Wing venation of each genus, genitalia of both sexes and wings figured. [I. C.]

Common, I. F. B., "The Australian cutworms of the genus *Agrotis* (Lepidoptera, Noctuidæ)." *Austral. Journ. Zool.,* vol. 6: pp. 69-88, 3 pls., 5 figs. 1958. Records nine species and describes as new *A. cygnea* (Western Australia). Genitalia of both sexes and wings figured. [I. C.]

Common, I. F. B., "The genera of the Australian Tortricidæ (Lepidoptera)." *Proc. 10th internat. Congr. Ent.,* vol. 1: pp. 289-295, 7 figs. 1958. Erects new subfamily EPITYMBINÆ. General discussion of subfamilies and representative genera, including phylogeny. [P. B.]

Comstock, W. P., & E. I. Huntington, "An annotated list of the Lycænidæ (Lepidoptera, Rhopalocera) of the Western Hemisphere." *Journ. New York ent. Soc.,* vol. 66: pp. 103-118. 1958. List of genera with original citations and type species, with other references. Part I. More to follow. [W. C.]

Condamin, M., "Description d'une espèce nouvelle de *Mycalesis* (Lep. Satyridæ) (Mission P. L. Dekeyser et B. Holas au Libéria, 1948)" [in French]. *Bull. Inst. franç. Afrique noire* (A), vol. 20: pp. 1348-1351, 2 figs. 1958. Description of the satyrid *M. dekeyseri* (Touzon, Liberia). [P. V.]

Condamin, M., "Description de la femelle de *Mycalesis dekeyseri* Condamin (Lep. Satyridæ)" [in French]. *Bull. Inst. franç. Afrique noire* (A), vol. 21: pp. 1223-1226, 3 figs. 1959. Description of neallotype female of this African satyrid. [P. V.]

Condamin, M., "Quelques mises au point sur la synonymie de *Mycalesis* (Lep. Satyridæ)" [in French]. *Bull. Inst. franç. Afrique noire* (*A*), vol. 21: pp. 653-657, 2 figs. 1959. Note on the synonymy of some spp. of African *Mycalesis*. [P. V.]

Crosson du Cormier, A., & P. Guérin, "Deux races nouvelles de *Boloria aquilonaris* Stichel (Nymphalidæ)" [in French]. *Alexanor,* vol. 1: pp. 65-67. 1959. Descriptions of two new subspecies: *B. a. ericeti* (Lower Seine, Forges les Eaux, Epinay Wood) and *B. a. toulgoëti* (Switzerland, Punt-Muraigl, 1800 m.). It is a pity to see, at this modern time, the holotypes in a private collection. [P. V.]

Curtis, W. Parkinson, "Proposed use of the Plenary Powers to validate the specific name *dardanus* Brown, 1776, as published in the binomen *Papilio dardanus* (Class Insecta, Order Lepidoptera)." *Bull. zool. Nomencl.,* vol. 17: pp. 253-254. 1960. Request for suppression of *dardanus* Cramer, 1775, which applies to a castniid and is a junior synonym, not in use. [P. B.]

Daniel, Franz, "Monographie der palæarktischen Cossidæ III. Das Genus *Holcocerus* Stgr." [in German]. *Mitt. münchner ent. Ges.,* vol. 49: pp. 102-160, 4 pls. 1959. Describes as new *H. holosericeus darwesthana* (Darwesthan, 500 m., SW Afghanistan). Reviews known forms, repeating earlier descriptions. Genitalia ignored. [P. B.]

Das, G. M., "A new psychid on tea from Assam (Lepidoptera, Heterocera)." *Entomologist,* vol. 92: pp. 198-200, 2 figs. 1959. Describes as new *Orophora triangularis* (Tocklai, Assam). [P. B.]

Diakonoff, A., "Microlepidoptera from Madagascar." *Mém. Inst. scient. Madagascar, ser. A,* vol. 1: pp. 22-30, 8 figs. 1948. Describes as new: (Tortricidæ) *Cacœcia megalogona* (Ranohira, S. Madagascar); *Syndemis metallochroma* (Mahatsinjo, central Madagascar), *S. erratica* (central Madagascar); *SICLOBOLA* (type *unifasciana* Duponchel), *S. placida* (Tananarive); *Cnephasia imitans* (Nosy Be, N. Madagascar); (Eucosmidæ) *Enarmonia serratula* (Bekily, S. Madagascar); (Yponomeutidæ) *Ethmia oculimarginata* (Lambomakandro, S. Madagascar). [P. V.]

Diakonoff, A., "A note on the Chlidanotidæ and allies, with descriptions of new species (Lepidoptera)." *Acta physiol. pharmacol. neerland.,* vol. 6: pp. 410-418, 5 figs. 1957. Describes as new *Metrernis tencatei* (N. Molluccas, Ternate Is., Ake Abdas, 1500 m.); (Schœnotenidæ) *Diactenis barbaræ* (same locality). Redescription of *M. ochrolina,* & record of *Schœnotenes helioconis* from Celebes [P. B.]

Diakonoff, A., "Remarks on *Cryptophlebia* Walsingham and related genera (Lepidoptera, Tortricidæ, Olethreutinæ)." *Tijdschr. Ent.,* vol. 100: pp. 129-146, 23 figs. 1957. Describes as new *PHANEROPHLEBIA* (subgenus of *Cryptophlebia*) & type *C.* (*P.*) *perfracta* (Nongkodjadjar, 1300 m., Tengger Mts., E. Java), *C.* (*P.*) *sumatrana* (Padang Highlands, Fort de Kock, 920 m., Sumatra). Redescribes *Cryptophlebia* & its type *C. ombrodelta, C. farraginea* (transferred from *Argyroploce*), & the related nearctic genera *Ecdytolopha* & *Pseudogalleria;* discusses phylogeny in this group. [P. B.]

Diakonoff, A., "Zeller's types of African Tortricidæ and Glyphipterygidæ in the Stockholm Museum." *Ent. Tidskr.,* vol. 78, suppl.: pp. 69-80, 11 figs. 1958. Redescribes *Eccopsis wahlbergiana* (lectotype selected), *Sericoris scabellana, Grapholitha spissana, Syndemis saburrana, Bactra stagnicolana,* & *Choreutis australis* (all from holotypes); gives data on types. [P. B.]

Diakonoff, A., "Additions to descriptions of new Olethreutidæ and Carposinidæ in the British Museum (Natural Hstory)." *Bull. Brit. Mus.* (*Nat. Hist.*), *Ent.,* vol. 8: pp. 121-126, 6 pls., 2 figs. 1959. Describes as new *PERAGRARCHIS* (type *Meridarchis rodea*). Transfers *Meridarchis drachmophora* to *Blipta, M. dryas* to *Mesodica.* Figures adults, & describes & figures genitalia, of 8 spp. described by him in 1950. [P. B.]

Diakonoff, A., "Entomological results from the Swedish expendition 1933 to Burma and British India. Microlepidoptera. II." *Ark. Zool.,* ser. 2, vol. 12: pp. 165-182, 7 pls., 6 figs. 1959. Author now regards Ceracinæ as subfamily of Tortricidæ;

proposes ATTERIINI, new tribe of Ceracinæ, for the South American *Atteria* & relatives. Describes as new: *LAMBERTIODES* (Sparganothidinæ; type *Capua harmonia*); *SOCIOSA* (Tortricinæ; type *Peronea macrographa*); (Olethreutinæ) *Phæcasiophora* (*P.*) *jubilans; P.* (*MEGASYCA*) (type *P. fernaldana*), *P.* (*M.*) *cornigera burmensis; BRACHIOCERA* (monobasic), *B. gonioptera; SEMNOSTOLA* (monobasic), *S. mystica;* (Tineidæ) *TRIGONARCHIS* (monobasic), *T. hypoplecta.* Localities not given in this paper. Transfers *Eucosma athica* & *Argyroploce astrosema* to *Phæcasiophora.* In an appendix describes as new *P.* (*Megasyca*) *walshinghami* (Mt. Gedé-Panggrango, 1400 m., Tjibodas, W. Java), *P.* (*M.*) *latior* (Ft. de Kock, 520 m., W. Sumatra), *P.* (*M.*) *cornigera* (Khasias, Cherva Punji, Assam), *P.* (*SYCACANTHA*) (monobasic), *P.* (*S.*) *auriflora* (Voljung Kulon, Tjigeunteur, W. Java); gives a key to spp. of *P.* (*Megasyca*). [P. B].

Diakonoff, A., "Mabille's types of Malagasy Tortricidæ." *Rev. franç. Ent.*, vol. 26: pp. 167-186, 22 figs., 2 pls. 1959. In this paper the types of Mabille of Tortricidæ from Madagascar are redescribed and figured with their genitalia. [P. V.]

Diakonoff, A., "Meyrick's types of Tortricidæ from Madagascar in the Vienna Museum." *Ann. naturhist. Mus. Wien*, vol. 63: pp. 409-413, 1 pl., 8 figs. 1959. Redescribes *Capua crocograpta, Batodes euryplaca, Goniotorna chersopis,* & *Argyroploce astrogenes;* figures types & genitalia. [P. B.]

Diakonoff, A., "Revision of *Cryptaspasma* Walshingham 1900 (Lepidoptera, Torticidæ)." *Zool. Verhandel.*, Leiden, no. 43: 60 pp., 13 pls., 14 figs. 1959. Describes as new *C.* (*ANAPHORODES*) (type *Olethreutes anaphorana*), *C.* (*A.*) *anisopis* (Neu Bremen, Santa Catharina, Brazil); *C.* (*C.*) *athymopis* (Oconeque, 7000 ft., Carabaya, Peru), *C.* (*C.*) *microloga* (Neu Bremen); *C.* (*Allobrachygonia*) *syostoma* (Mt. Gedé-Panggrango, 1400 m., Tjibodas, W. Java), *C.* (*A.*) *glebæcolor* (Darjeeling, Assam), *C.* (*A.*) *hesyca* (Hights Place, 7000 ft., Panai, Luzon), *C.* (*A.*) *debeauforti* (Mt. Dayman, 2230 m., Maneau Range, Papua), *C.* (*A.*) *d. brachyptera* (Mt. Goliath, 5000-7000 ft., Netherlands New Guinea), *C.* (*A.*) *geina* (Parangbobo Goa, Mt. Lompobattang, S. Celebes), *C.* (*A.*) *ochrotricha* (Mt. Gede-Panggrango, 1400 m.), *C.* (*A.*) *triopis* (Commander Marianas' Hill, Guam), *C.* (*A.*) *haplophyes* (Saiko, 5500 ft., Bubu R., upper Waria R., Br. New Guinea), *C.* (*A.*) *peratra* (Mt. Rossel, 2100 ft., Rossel Is., New Guinea), *C.* (*A.*) *orphnina* (Dampier Is., New Guinea), *C.* (*A.*) *pelagia* (Aneityum, 3 mi. NE of Anelganhat, 1200 ft., Red Crest, New Hebrides); *C.* (*METASPASMA*) (type *Acharneodes atrinodis*), *C.* (*M.*) *subtilis* (Diego Suarez, N. Madagascar). Redescribes known spp. in above subgenera & in subgenus *Microcorses;* some new combinations. Also discusses some superficially similar spp.; describes as new: *Collogenes plumbosa* (New Hannover, Bismarck Islands), *C. pseusta* (Lindu Palu, 3700 ft., Palu Distr., W. central Celebes); *MESOCALLYNTERA,* & type *M. squamosa* (Lindu Palu), *M. s. loricata* (Hydrographer Mts., 2500 ft., Br. New Guinea), *M. siderostola* (Araucaria Camp, 800 m., Snow Range, central Netherlands New Guinea); *Cryptophlebia macrops* (Amshaw, King Williamstown, Cape Colony, S. Africa); (Copromorphidæ) *Copromorpha macrolepis* (Lindu Palu). Also redescribes *Collogenes percnophylla, Cryptophlebia cnemoptila,* & *C. encarpa.* Corrects description of *Melanalopha lathræa* & sinks his family Melanalophidæ to Laspeyresiini. [P. B.]

Drenovsky, A. K., "*Cripsedra niphopasta* Obth. ssp. n. *bulgarica* aus Bulgarien" [in Bulgarian; Russian & German summaries]. *Bull. Inst. bulg. Acad. bulg. Sci.*, vol. 2: pp. 373-376, 1 fig. 1953. New ssp. is discovered in the environs of Sofija (Vitosa Mt.); a short diagnosis in German. [J. M.]

Dufay, Cl., "Contribution à l'étude des *Abrostola* paléarctiques et africaines (Lep. Noctuidæ Plusiinæ)" [in French]. *Bull. mens. Soc. linn. Lyon*, vol. 27: pp. 156-162, 1 pl. 1958. Contribution to study of the palearctic and African *Abrostola.* Describes as new *A. ussuriensis* (Ussuri, Nikolsk) and *A. congolensis* (Belgian Congo, Elisabethville). Note on the geographical repartition of *A. agnorista.* [P. V.]

Dufay, Cl., "Contribution à l'étude des *Nycteola* Hb. (*Sarrothripus* Curt.) françaises (Lep. Noct. Nycteolinæ) (Contribution à l'étude des Noctuidæ Quadrifinæ IX)" [in French]. *Lambillionea*, vol. 58: pp. 21-27, 1 fig. 1958. Summarizes color & pattern characters, variation, & local distribution of the 5 spp. (6 sspp.) found in France; names an "ab." of *N. asiatica*. [P. B.]

Dufay, Cl., "Mise au point de la synonymie des *Nycteola* Hb. (*Sarrothripus* Curt.) européennes (Lep. Noctuidæ Nycteolinæ)" [in French]. *Bull. mens. Soc. linn. Lyon*, vol. 27: pp. 108-120. Note on the synonymy of the European spp. of this genus. The author has examined some types. [P. V.]

Dufay, D., "Révision des *Nycteola* Hübner (*Sarrothripus* Curtis) paléarctiques (Lep. Noctuidæ Nycteolinæ)" [in French]. *Ann. Soc. ent. France*, vol. 127: pp. 107-132, 3 pls., 12 figs. "1958" [1959]. Revision of the palearctic spp. of this genus, with the study of the variation of the coloration of the anterior wings and description of some new "forms". [P. V.]

Dufay, Cl., & Ch. Boursin, "Description d'une nouvelles espèce d'*Hoplodrina* Brsn. du Midi de la France (Lep. Noctuidæ, Amphipyrinæ) (Note préliminaire)" [in French]. *Bull. mens. Soc. linn. Lyon*, vol. 29: pp. 28-29. 1960. Description of a new species from south France: *H. hesperica* (Basses-Alpes, St.-Michel-l'Observatoire). [P. V.]

Dufrane, Abel, "Microlépidoptères de la faune belge (huitième note)" [in French]. *Bull. Inst. Roy. Sci. nat. Belg.*, vol. 33, no. 32: 16 pp., 3 figs. 1957. Describes as new *Elachista postremella* (Ciply, Belgium); also "forms" of many spp. New to Belgium: *Eupista æripennis, Stigmella pyri, Narycia astrella*. Notes on distribution, variation, & biology of many spp. [P. B.]

Ehrlich, Paul R., "The comparative morphology, phylogeny and higher classification of the butterflies (Lepidoptera: Papilionoidea)." *Univ. Kansas Sci. Bull.*, vol. 39: pp. 305-370, 64 figs. 1958. Comparative morphological study of some 300 spp. of butterflies, belonging to all major groups, with some other Lepidoptera for comparison. Characters studies are mainly external. Primitive and specialized conditions are specified for many characters. Only 5 families, with 19 subfamilies, are recognized. Among noteworthy points are the inclusion of Styginæ and Riodininæ under Lycænidæ, and of *Heliconius* and relatives under Nymphalinæ. The Papilionidæ are shown to be highly specialized rather than primitive. This conservative but comprehensive treatment of the superfamily deserves recognition in future classifications. Keys to families and subfamilies. [P. B.]

Ehrlich, Paul R., "A note on the systematic position of the butterfly genus *Calinaga* (Nymphalidæ)." *Lepid. News.*, vol. 12: p. 173. 1959.

Ehrlich, Paul R., & Harry K. Clench, "A new subgenus and species of *Callophrys* (s. l.) from the southwestern United States (Lepidoptera: Lycænidæ)." *Ent. News*, vol. 71: pp. 137-141, 1 pl. 1960. Describes as new *C.* (*SANDIA*), & type *C.* (*S.*) *mcfarlandi* (La Cueva Canyon, elev. 6300 ft., Sandia Mts., Bernalillo Co., New Mexico). Larvæ on flower heads of *Nolina microcarpa*. [P. B.]

Evans, David, "A revision of the genus *Enypia* (Lepidoptera: Geometridæ)." *Ann. ent. Soc. Amer.*, vol. 53: pp. 560-574, 30 figs. 1960. Redescribes genus & the 4 spp. *E. venata, E. griseata, E. packardata,* & *E. coolidgi*. Sinks *perangulata* Hulst to *venata* & *moillietti* Blackmore to *griseata*. Descriptions of early stages & biology, & parasite records, are included. [P. B.]

Evans, W. H., "Notes on Hesperiidæ (Lepidoptera) from Madagascar." *Natur. malgache*, vol. 4: pp. 87-88, 1 fig. 1952. Description of ♂ of *Fulda imorina* Evans; describes as new *F. bernieri pauliani* (Tsaratanana Mt.). [P. V.]

Ferguson, Douglas C., "A nearctic race of *Syngrapha microgamma* Hübner, with remarks on the status of *montana* Packard (Lepidoptera: Phalænidæ)." *Bull. Brooklyn ent. Soc.*, vol. 50: pp. 23-27, 10 figs. 1955. Describes as new *S. m. nearctica* (Goodwood, Prospect Road, Halifax Co., Nova Scotia; in sphagnum bog). *S. montana* is a distinct sp. [P. B.]

Ferguson, Douglas C., "The status of *Perizoma grandis* Hulst (Lepidoptera, Geometridæ)." *Bull. Brooklyn ent. Soc.*, vol. 50: pp. 54-56, 2 figs. 1955. Distinguishes *P. grandis,* which occurs in the eastern U. S. & Canada as well as on the Pacific coast, from *P. basaliata,* on pattern & ♀ genitalia. [P. B.]

Fletcher, D. S., "A revision of the genus *Carecomotis* (Lep. Geometridæ)." *Ann. & Mag. nat. Hist.*, ser. 12, vol. 6: pp. 100-142, 4 pls. 1953. Describes as new *C. cucullata* (Assam, Naga Hills, 1500-2000 ft.), *C. c. fusconebulata* (Sumatra, Lebong Tandai), *C. monodactyla* (Dutch New Guinea, Faf-Fak, 1700 ft.), *C. purissima* (New Ireland), *C. batillata* (Philippines, Luzon, Benguet, Klondyke, 800 ft.), *C. onycha* (Assam, Naga), *C. o. amplissima* (S. India, Kanara), *C. o. hasata* (E. Java, Djoenggo Ardjoeno, 4500 ft.), *C. o. cultrata* (Sumbawa), *C. o. serrata* (W. Celebes, Paloe, G. Tompoe, 2700 ft.), *C. o. limitata* (Philippines, Luzon, Los Banos), *C. o. acuata* (Br. New Guinea, Upper Aroa R.), *C. taprobana* (Ceylon, Uva Prov., Mandulsima), *C. kalisi* (E. Java, Kletak Tengger, 6000 ft.), *C. biclavata* (W. Sumatra, Lebong Tandai), *C. inornata* (Java), *C. fasciata* (SW Sumatra, N. Karintji Valley, 5000 ft.), *C. olivata* (SW Celebes, Pangean, near Maros, 2000 ft.), *C. propulsaria fieldi* (Philippine Is., Mindanao, Surigao), *C. olivomaculata* (W. Celebes, G. Tompoe, 2700 ft.), *C. rostrata* (E. Java, Trettes, 3000 ft.), *C. r. moniliata* (Queensland, Townsville), *C. falculata* (S. India, Travancore, Permed), *C. tenebrata* (Naga Hills, 1500-3000 ft.), *C. t. acutiorata* (E. Java, Nongkodjadjar, 4000 ft.), *C. t. arcuata* (SW Celebes, Pangean, near Maros, 2000 ft.), *C. t. buruensis* (central west Buru, Gamoe 'Marapat, 5000 ft.), *C. t. fumata* (Dutch New Guinea, central Arfak Mts., Ninay Valley, 3500 ft.), *C. t. parviorata* (Queensland, S. of Cooktown, Cedar Bay), *C. inoffensa cinereomarginata* (Assam, Khasia Hills), *C. i. glaucata* (Sumatra, Ft. de Kock, 920 m.), *C. i. minorata* (Philippines, Los Banos), *C. i. exsilata* (Solomon Is.), *C. indiga* (central Buru, Kako Tagalago, 2700 ft.), *C. costiplaga* (Br. New Guinea, Upper Aroa R.), *C. c. flaviorata* (Dampier Is.), *C. c. ferrata* (New Britain, Talesea), *C. c. eichhorni* (St. Matthias Is.), *C. c. umbrata* (Queensland, S. of Cooktown, Cedar Bay), *C. pupillata fuliginata* (W. Celebes, Paloe, G. Tompoe, 2700 ft.), *C. p. luzonensis* (Philippines, Luzon, Benguet, 800 ft.), *C. buxtoni* (New Hebrides, Santos Is., Hog Harbour), *C. perfumosa extendata* (Dutch New Guinea, central Arfak Mts., Ninay Valley, 3500 ft.), *C. forficulata* (New Ireland), *C. levata* (Solomons, Tulagi Is.), *C. albobrunneata* (Rook Is.), *C. a. cordata* (New Ireland), *C. sabulata* (Dutch New Guinea, Sawia), *C. s. inconspicuata* (Australia, Brisbane), *C. contiguata brooksi* (Sarawak, Bidi), *C. c. imparata* (E. Java, Djoenggo Ardjoeno, 4500 ft.), *C. c. bigladiata* (Philippines, Luzon, Mt. Makiling). Also names two "abs." Redescribes genus & known spp.; figures genitalia of many. Gives key based on ♂ genitalia. [P. B.]

Fletcher, D. S., "Notes on North American species of *Nycteola* (Lepidoptera, Noctuidæ)." *Journ. New York ent. Soc.*, vol. 67: pp. 51-52, 1 pl. 1959. Figures ♀ genitalia of *N. frigidana, N. columbiana, N. cinereana,* & *N. scriptana,* & ♂ genitalia of last. Sinks *Subrita latifasciella* to *N. frigidana, S. metaspilella* to *N. scriptana; N. lintnerana* (type lost) perhaps a synonym of *N. frigidana.* An unnamed sp. occurs in SW U. S. [P. B.]

Fletcher, D. S., "Three new species of Heterocera from northern Ethiopia." *Entomologist,* vol. 92: pp. 45-48, 1 pl., 6 figs. 1959. Describes as new: (Hadeninæ) *APOSPASTA,* & type *A. sabulosa* (Simien, Lori) (9 other spp. placed here); (Acronictinæ) *Mimleucania oreias* (Simien, above Lori, 12,000 ft.); (Ennominæ) *Epigynopteryx scotti* (Simien, near Mindigabsa, 10,000 ft.). [P. B.]

Fox, Richard M., "A postscript on the ithomine tribe Tithoreini." *Journ. New York ent. Soc.*, vol. 68: pp. 152-156, 1 fig. 1960. Describes as new *Patricia demylus gemellus* (Taunas, Bolivia, 5400 ft.). Some new synonymy & records in *Patricia* & *Tithorea,* & revised key to *Patricia.* [P. B.]

Franclemont, J. G., "Four undescribed moths from eastern North America, with notes on closely related species (Lepidoptera, Phalænidæ *olim* Noctuidæ)." *Bull. Brooklyn ent. Soc.*, vol. 47: pp. 123-137, 4 pls. 1952. Describes as new: *Euagrotis forbesi* (Claremont, New Hampshire); *Leucania linda* (Arlington, Virginia); *Eupsilia cirripalea* (Arlington, Virginia); *Apamea smythi* (Montgomery Co., Virginia). Redefines *Euagrotis lubricans, E. illapsa, Eupsilia sidus, & E. vinulenta,* with figures of genitalia. [P. B.]

Franclemont, J. G., "A new species of *Copablepharon* (Lepidoptera, Noctuidæ, Noctuinæ)." *Bull. Brooklyn ent Soc.*, vol. 49: pp. 25-27, 3 figs. 1954. Describes as new *C. hopfingeri* (Bar, Washington). [P. B.]

Franclemont, John G., "The identity of *Homoptera lineosa* Walker (Lepidoptera, Noctuidæ, Catocalinæ)." *Bull. Brooklyn ent. Soc.*, vol. 49: p. 120, 1 fig. 1954. Synonym of *Zale minerea; Z. "lineosa"* of Franclemont, 1950, should be known as *Z. galbanata.* [P. B.]

Franclemont, John G., "A new species of *Abagrotis* (Lepidoptera, Noctuidæ)." *Bull. Brooklyn ent. Soc.*, vol. 50: pp. 44-46, 3 pls. 1955. Describes as new *A. crumbi* (White Swan, Washington), & *A. c. benjamini* (East New York, N.Y.).]P. B.[

Franclemont, John G., "The genus *Euclidia,* with the description of a new species (Lepidoptera, Noctuidæ, Catocalinæ)." *Bull. Brooklyn ent. Soc.*, vol. 52: pp. 5-15, 1 pl., 11 figs. 1957. Describes as new *E. ardita* (Mt. San Hedrin, Mendocino Co., Calif.). Discusses nomenclature (strictly speaking *Euclidia* should replace *Schinia* & this genus should be known as *Ectypa*); distinguishes genus from *Gonospileia;* gives synonymy & notes on the other 3 spp. [P. B.]

Freeman, H. A., "A revision of the genera of the Megathymidæ, with the description of three new genera." *Lepid. News,* vol. 12: pp. 81-92, 1 pl. 1959. Describes as new *AGATHYMUS* (type *Megathymus neumoegeni*); *TURNERINA* (type *M. hazelæ*); & *STALLINGSIA* (type *M. maculosus*).

Freeman, H. A., "Notes on *Agathymus* in Texas, and the description of a new species from Mexico (Megathymidæ)." *Journ. Lepid. Soc.*, vol. 14: pp. 58-62, 1 pl. 1960. Describes as new *A. fieldi* (Guadalajara, Mex., Highway 15, Kilometer 724, 4400 ft.).

Friese, Gerrit, "*Bryophila divisa* Esp., *Ocnerostoma copiosella* Frey, *Depressaria eremitella* Stt., neu für Nordost- Deutschland (Lepidoptera)" [in German; English & Russian summaries]. *Beitr. Ent.*, vol. 9: pp. 196-198, 2 figs. 1959. New records for Berlin area. *O. copiosella* is distinguished from *O. pinariella.* [P. B.]

Friese, Gerrit, "*Dysauxes punctata* (F.) und *famula* (Frr.) und ihre Rassenkreise (Lep. Syntomidæ)" [in German]. *Deutsche ent. Zeitschr., N. F.*, vol. 6: pp. 250-259, 2 figs. 1959. Describes as new *D. f. pontica* (Slatnite Pjasтzi, near Varna, Bulgaria), *D. f. haberhaueri* (Taurus). Distinguishes *famula* from *punctata;* reassigns & redefines sspp., sinking several names. [P. B.]

Friese, Gerrit, "Revision der paläarktischen Yponomeutidæ unter besonderer Berücksichtigung der Genitalien (Lepidoptera)" [in German; Russian & English summaries]. *Beitr. Ent.*, vol. 10: pp. 1-131, 3 pls., 91 figs. 1960. Describes as new *PSEUDOCALANTICA* (type *Niphonympha anas*); *Kessleria albanica* (Nika, Albania), *K. tatrica* (Tatra), *K. pyrenæa* (Mt. Canigou, E. Pyrenees), *K. caucasica* (Kirala, W. Caucasus), *K. longipenella* (Petrosawodsk, Karelia); *NORDMANIANA* (type *Zelleria ribesiella*); *PSEUDOSWAMMERDAMIA* (type *Tinea combinella*); *PARASWAMMERDAMIA* (type *Swammerdamia lapponica*), *P. iranella* (Keredi, Elburs Mts.), *P. ornichella* (Sarepta, S. Russia); *BANGHAASIA,* & type *B. ildefonsella* (S. Ildefonso, Spain). A complete revision of the family, based on all available palearctic material, including many types, and taking into consideration external morphology, genitalia, larval structure, & biology. Earlier classifications are criticized; the family is redefined, Plutellidæ & Argyresthiidæ are distinguished, and some 15 genera are transferred to other families, leaving 13 genera & 47 spp. in palearctic Yponomeutidæ. Keys to genera & spp.; redescriptions & figures of genitalia. Numerous new synonyms. [P. B.]

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(Complete contents on back cover)

21 March 1962

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TAXONOMIC AND DISTRIBUTIONAL STUDIES ON THE WESTERN COMPONENTS OF THE *APODEMIA MORMO* COMPLEX (RIODINIDÆ)

by PAUL OPLER and JERRY A. POWELL

Apodemia mormo (Felder & Felder) is a widely distributed butterfly species occurring throughout the arid regions of the western United States and northern Mexico. Due to pronounced geographic variation in wing pattern and color, various segregates of the species were considered separately by the early workers. Thus by the turn of the century nine names had been variously applied, and the complex was generally considered to consist of five allopatric species: *mormo* in Utah, Nevada and northern California; *virgulti* Behr in southern California; *cythera* Edwards in Arizona; *mejicanus* Behr in New Mexico and Sonora; and *maxima* Weeks in the cape district of Baja California. However, since the time of the treatment by STICHEL (1911) most writers have considered the complex to consist of a single species. Further collecting gradually developed a more complete picture of the geographic ranges of the various components and resulted in the recognition of two additional restricted races in California, *deserti* Barnes & McDunnough (1918) and *langei* Comstock (1938).

In bringing together a large number of records during the past few years, further illustration of the distribution patterns has been possible through defining areas of blend zones between subspecies, sampling geographic areas where gaps in the known distribution existed, and accumulating more complete samples of the variation within populations. We hope in the present paper to clarify some of the problems and errors extant in the literature through a presentation of the overall distribution pattern. A great number of records are available from California, resulting in a relatively complete picture, and we have much information on Baja California Norte and Arizona. However, less material from the eastern and northern portions of the range of the complex has been available for study, and these areas are not discussed in detail now.

Apparently all the races of *A. mormo* are associated with *Eriogonum,* the foodplant in all known cases. BROWN (1955) has given the habitat of the populations in Colorado as "moist canyon bottoms and valleys". However our observations, and those of GRUNDEL (1905) and COMSTOCK (1927) in California, indicate that populations of this butterfly typically occur in close association with the foodplant on exposed, well drained, dry slopes, such as on beach or desert sand dunes areas, young alluvial fans, rocky ridges and peaks, and chaparral slopes. A similar habitat is reported by BROWNING (1901) in the vicinity of Salt Lake City, Utah. Little has been reported on the early stages of the species. Life history studies are cited under the subspecies concerned. Additional data concerning flight periods and foodplants has been compiled by WRIGHT (1906), COMSTOCK (1927, 1938), MARTIN and TRUXAL (1955), and BROWN (1955). In general the populations have two or three overlapping generations in areas characterized by a long dry season but are limited to a single annual flight in most areas of the northern portion of the range.

Due to the localized nature of the flight habits of the adults, together, at least in part, with the disjunct nature of the distribution of areas to which the species and foodplants are adapted, populations of *A. mormo* tend to be restricted. Thus the species occurs across a broad range, but to a large extent in scattered colonies with little interbreeding. Therefore, within the more widely ranging among the recognized subspecies, divergence within populations has occurred, resulting in a mosaic of segregates, expressed by both locally distinctive populations and more widely distributed forms.

The separation and naming of the various entities has been based entirely on the phenotypic expression of wing color and pattern. However, this expression appears to be constant within geographic areas, the color pattern being a qualitative difference between subspecies, except within the relatively narrow blend zones between the major races. Although there is a more or less uniform combination of weather conditions during the period of time when the adults fly, the dry and hot season of *Eriogonum* bloom, the early stages of the various populations are adapted to a wide range of variation in ecological factors, particularly the temperature and moisture extremes. Thus a high degree of correlation between the wing pattern and genotypic variation is suggested in this case.

It was hoped that a study of the male genitalia would offer further characters for the definition of subspecies. Specimens from the various major populations were studied by dissection and clearings of the abdomen in caustic solution. Individuals showed some remarkable differences, especially in the shape of the gnathos arms and the form of the distal margin of the uncus. The latter structure was selected as an index since it offers a character which can be studied on the whole insect by merely denuding the terminalia with a fine brush, thus facilitating the study of numbers of individuals. There appear to be tendencies within each subspecies towards a general type of form of the uncus margin. However, after studying a number of specimens from each of several different populations, it was decided that the individual variation is too great to enable the use of this character in subspecies definition. Presumably the other genital structures which have less conspicuous differences will also show individual variation.

In that the entities have already been named, we feel that the subspecies concept has served greatly to clarify the relationships within the complex. Further subdivision of more wide-ranging subspecies seems unwarranted in view of the present status of knowledge of the group. However, relatively restricted races and even a local population in the case of *A. mormo langei* have received names when these were not referable to any of the existing subspecies. During the course of our investigations, two additional montane populations have been found which seem so distinct that including them in previously named races is not possible.

Discussion and locality records of the distribution for each race is given under the subspecies heading. We have examined all of the specimens for which localities are given. Localities are listed, in general, by state and county in a north to south sequence.

Certain of the data are listed below under putative "blend-zones". It is our opinion that these represent populations exhibiting unstable characteristics due to an influence of gene flow from the more stable populations of the named races which adjoin them. These areas are restricted to relatively narrow bands, and it seems likely that this is due to the occurence of narrow geographical features which act as isolating barriers to the subspecies and define the areas of ecological conditions to which the populations have responded through phenotypic and presumably genotypic variation.

In addition to the California Insect Survey, University of California Berkeley, and our personal collections, material has been studied from a number of other sources. We wish to acknowledge the helpful cooperation of the following in making available specimens of the private and institutional collections in their care: JOHN M. BURNS, Berkeley; CHARLES F. HARBISON, San Diego Natural History Museum; R. L. LANGSTON, Berkeley; MILFORD LUNDGREN, Oakland; M. J. MCKENNEY, San Diego; R. A. MACKIE, San Diego; C. DON MACNEILL, California Academy of Sciences; LLOYD M. MARTIN, Los Angeles County Museum; JOHN C. MONTGOMERY, Menlo Park; DON and BILL PATTERSON, Atherton; DR. F. H. RINDGE, American Museum of Natural History; and DR. J. W. TILDEN, San Jose. Additional thanks are due to F. MARTIN BROWN, Colorado Springs, Colorado for advice and assistance on the problem, and to JOHN M. BURNS and DR. E. G. LINSLEY, University of California, Berkeley for reading the manucript and offering helpful suggestions.

Apodemia mormo mormo (Felder & Felder)

Lemonias mormo Felder & Felder, 1859, *Wiener ent. Monat.* 3: 271; Bates, 1868, *Journ. Linn. soc. London, zool.* 9: 448; Wright, 1906, *Butterflies West Coast*: 201, pl.27, fig.294b.

Apodemia mormo, Felder & Felder, 1865, *Reise Freg. Novara, Zool.* 2: 302; Holland, 1931, *Butterfly book,* rev. ed.: 212, pl.28, fig.7; Leighton, 1946, *Univ. Washington publ. biol.* 9: 59.

Apodemia mormo mormo, Stichel, 1911, *Genera insectorum,* fasc.112: 287; Barnes & McDunnough, 1918, *Contr. nat. hist. Lepid. North America* 4: pl.12; Seitz, 1924, *Macrolep. world* 5: 700, fig.141e; Comstock, 1927, *Butterflies California*: 149, pl.47, fig.4; Stichel, 1930, *Lepid. catalogus* 41: 586; McDunnough, 1938, *Mem. so. California acad. sci.* 1: 23; Comstock, 1938, *Bull. so. California acad. sci.* 37: 129, fig.4; Hoffmann, 1940, *An. inst. biol. Mexico* 12: 700; Brown, 1955, *Proc. Denver mus. nat. hist.* 5: 118, fig.

Chrysobia mormo, Scudder, 1876, *Bull. Buffalo soc. nat. sci.* 3: 103.

Lemonias virgulti, Grundel, 1905 (not Behr, 1865), *Ent. news* 17: 86 (biology).

Chrysobia mormonia Boisduval, 1868, *Ann. soc. ent. Belgique* 12: 52; Scudder, 1876, *Bull. Buffalo soc. nat. sci.* 3: 103 (synonymy).

Nemeobius dumeti Behr, 1865, *Proc. California acad. sci.* 3: 178; Bates, 1868, *Journ. Linn. soc. London, zool.* 9: 448 (synonymy).

Male. — Length of forewing 12.5 to 15.0 mm. *Head*: labial palpus exceeding head by length of head as seen from above, tapering from broad base to narrow third segment; second segment white exteriorly, brownish at apex, third segment brownish; antenna about three-fifths wing length, shaft black, segment bases annulate with white, entirely whitish apically below, club red-brown interiorly and below, tip orange; head scaling erect, greyish, whitish marginal to eye. *Thorax*: black with brownish scaling above; collar tinged with orange, scales erect; underside white, densely covered with scaling and hair tufts; legs white, meso- and metathoracic tibiæ and tarsi with two rows of conspicuous black spines ventrally. *Forewing*: conspicuously marked by two pairs of white spots in basal half, and two transverse rows of white spots in apical half; ground color blackish, infused with orange-brown through central portion to submarginal spot row, costal and anal margins blackish, the latter sometimes broadly; basal pair of white spots just before one-third the distance from base to apex, above and below median vein, second pair before middle, upper at end of discal cell, largest of the four; basal pair and discal margined inwardly and outwardly with a darker black than ground color, lower median spot and subterminal row margined inwardly only; subterminal row at apical one-third of wing, consisting of seven subtriangular spots between the veins, the fourth from costa smallest, the final three nearer to base, fifth nearest; orange-brown suffusion sometimes extending slightly beyond fifth and sixth; terminal row parallel to margin, the spots round, of subequal size and shape, smaller than smallest of subterminal row, faintly margined outwardly darker; fringe of ground color, marked with white. Underside pattern as above, in general paler, orange more extensive, extending along veins between spots of submarginal band, apical area pale brownish to whitish, terminal white spots at times extended to margin. *Hindwing*: spot pattern essentially as on forewing, ground color blackish with a greyish tinge in central area, sometimes with a tinge of orange before second pair of spots or outside submarginal band; first and fourth spots of submarginal band reduced to white specks, third elongate; underside, spots of above reproduced conspicuously and nearly completely outlined with black, two additional large spots on costa, first at base, second at about middle; second and third spots of submarginal band fused into the largest spot of the pattern; ground color pale greyish to brownish, a white suffusion from base to apex through the area of the large spot; area below this whitish before submarginal band; terminal area greyish to whitish; terminal band of spots usually not evident. *Abdomen*: blackish above, some whitish scaling at segmental bases; whitish below, pleural areas rough scaled.

Female. — Length of forewing 15.0 to 16.5 mm. Wings appearing broader, marked as in male, ground color more extensive, the white spots and orange suffusion reduced; orange lacking from hindwing except at extreme base. Underside more heavily suffused with white; hind wing nearly entirely whitish except an indistinct band exterior to submarginal spots.

The above description is made from specimens from Beaver and Juab Counties, Utah.

The original specimens of *mormo* came from the area of the Great Salt Lake, Utah. As presently conceived, the subspecies is the most wide ranging of the complex, occurring from central and eastern Washington south into California, in the Coast Ranges as far as San Luis Obispo County and in the Sierra Nevada as far as Mono Basin; east in the Great Basin, through Utah, to western Colorado; south through most of Arizona and west in the Mojave Desert to the foothills of the transverse ranges of southern California. Although records are lacking for Oregon and Nevada, scattered colonies of *mormo* are to be expected throughout the Great Basin portions of both states.

Information on the life history of the nominate subspecies is lacking except for the report by GRUNDEL (1905) on a colony in the Santa Cruz Mountains of coastal California. COOLIDGE (1924) has reported several *Eriogonum* species and forms as the native food plants of *A. mormo virgulti* in a restricted area, so that it seems logical to assume that *mormo mormo* utilizes a variety of *Eriogonum* species across its wide geographic distribution.

Within this broad range, there are populations which have diverged in wing color and pattern. Several segregates seem worthy of mention, although at present they are not well defined, at least in part due to insufficient sampling.

1) Specimens from Washington and northern California are larger in size than those from central Utah (forewing length 14.6 to 18.2 mm.) and have the ground color of the underside of the hind wings darker, with the white spots well defined.

2) Consistently in several series of 15 or more specimens from populations of coastal central California, the greyish overscaling of the upper sides is lacking, and the ground color is darker, so that the wings appear nearly coal black. A similar effect is produced on the undersides by a reduction of the white and the presence of a blackish area between the submarginal and marginal white spot bands, especially on the forewing. In the Vallejo population the marginal white spots are elongated into thin dashes, giving an especially distinctive appearance.

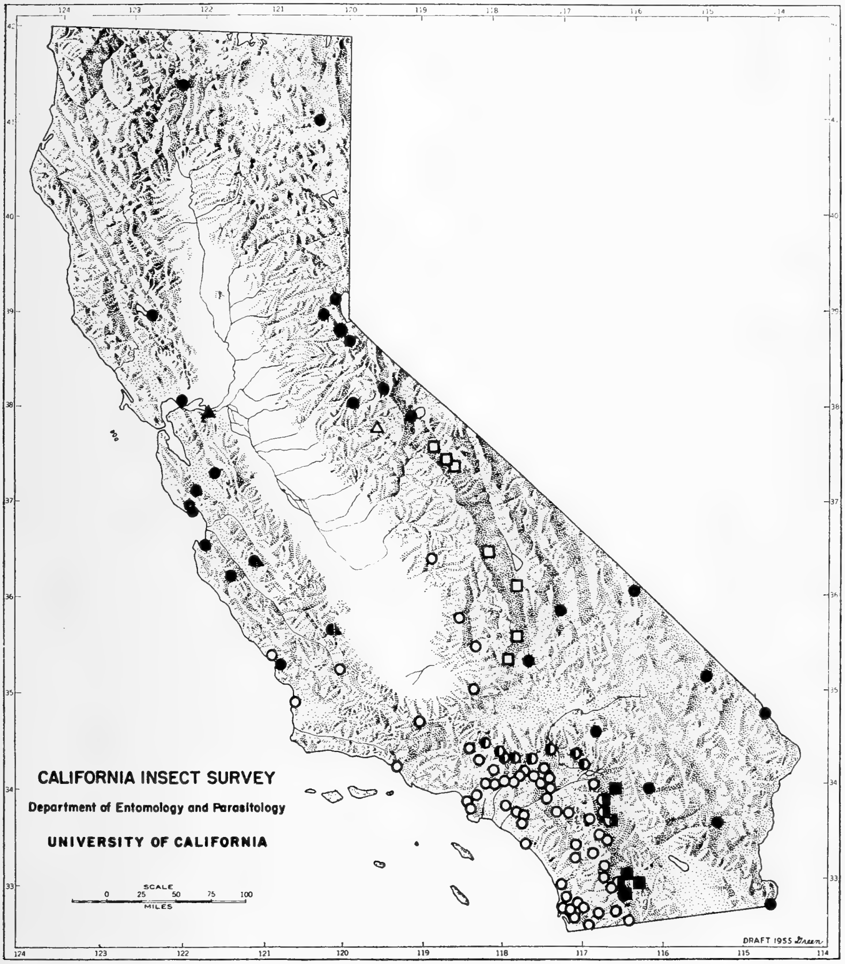
3) A series of 13 specimens from Mono Lake shows consistently larger white spots than is typical of Utah specimens. The underside tends to show a greater white overscaling in the ground color, but this is somewhat variable, as it is to some extent throughout the subspecies.

4) Numerous specimens from eastern Mojave and Sonoran Desert areas (New York Mts., Hualapai Mts., Ajo, Covered Wells, Sells) are larger in size (forewing length 17.1 to 19.2 mm.), have a tendency toward larger white spots and a more conspicuous grey upperside ground color, and, at times, have somewhat more extensive or subdued, almost infuscated areas of orange on the forewings.

5) Populations of the western Mojave Desert (Argus Mts., Ord Mtn., Twentynine Palms) usually show an extensive, often pale orange, and have a tendency towards enlarged terminal band spots, relating them to *mormo deserti* of the Colorado Desert, but the latter consistently show a pale aspect due to more conspicuous pale grey scaling in the hind wing ground color and more extensive white scaling on the underside.

6) A limited amount of material from central and eastern Arizona indicates that populations in these areas (Sunflower, White Mts.) have the orange of the forewings very restricted, nearly lacking in some individuals. In addition, the white spots are restricted as in Utah specimens, so that there is a great extent of blackish ground color.

The most striking of the previously mentioned "blend-zones" is the area along the northeastern slope of the San Gabriel Mountains, adjoining the Mojave Desert, from Palmdale, Los Angeles County, eastward to the north side of the San Bernardino Mountains. Here the colonies are extremely heterogeneous; some individuals phenotypically resemble *A. mormo mormo* of the Mojave; others very nearly approach *m. virgulti;* and all degrees of intermediate variation are present. Thus single or few specimen samples from these areas frequently appear to indicate a population of one or the other subspecies and in some instances may actually represent a relatively constant local population, but we have considered all records from this area as representing the blend zone in treating the data. The best examples studied illustrating the situation are 24 specimens comprising three collections from Littlerock and a single day collection of 30 specimens from Desert Springs.



Distribution of *Apodemia mormo* in California. Symbols indicate localities as follows: closed circles = *A. mormo mormo;* open circles = *A. m. virgulti;* open squares = *A. m· cythera;* closed squares = *A. m. deserti;* closed triangle = *A. m. langei;* open triangle = *A. m. tuolumnensis.* Divided symbols indicate putative blend zone localities.

A second possible blend zone exists along the inner side of the Coast Range of California, south of the San Francisco Bay area. Occasional examples are taken (Paraiso Springs, Pinnacles, Cholame) along with typical appearing *m. mormo* phenotypes which suggest a relationship with *A. m. langei* by the distinctive orange suffusion of the discal white spot of the forewing, a characteristic which does not occur elsewhere in the complex.

Another possible blend zone, that with *A. m. mejicanus* to the south, is exhibited in our material by a few intermediate appearing specimens from the Santa Catalina Mountains, Arizona, and from Catron County, New Mexico. However, a general lack of material from this whole area limits our conclusions.

Data from material examined:—WASHINGTON.—Okanogan Co.: Brewster, VIII-19-35 (Hovanitz Collection), VIII-11-35 (P. S. Remington), IX-1-40 (J. C. Hopfinger). Yakima Co.: Yakima, VIII-23-57 (J. Longworth); Mill Creek, 1800′, VIII-19-58 (Newcomer); Tampico, VIII-30-58 (Newcomer). MONTANA.—Valley Co.: 1½ mi. S. Saco, VIII-11, 20-51 (W. Wheaton). IDAHO.—Bear Co.: Montpelier, VIII-10-31 (W. J. Gertsch). UTAH.—Juab Co.: Eureka, VIII-1, 3-20 (T. Spalding). Beaver Co.: Wildcat Vy., "VIII" (Dodge). CALIFORNIA.—Siskiyou Co.: Mt. Shasta City, VIII-20-58 (Powell); "Siskiyou Co.", VIII-3-14 (W. Wholey). Lassen Co.: 8 mi. N. Madeline, IX-7-57 (B. J. Adelson). Placer Co.: Chipmunk Ridge, El Dorado Nat'l. For., VIII-17, IX-1-47 (Langston); Deerpark, 7900′, VIII-20-10 (Newcomer). El Dorado Co.: Horsetail Falls, 7000′, VIII-23-47 (MacNeill); Grass Lake, 8000′, VIII-27-47 (H. P. Chandler). Tuolumne Co.: Strawberry Lake, IX-1-30, V-2-31 (R. G. Wind). Mono Co.: Mono Lake, VIII-20-52, VII-28-54 (Powell); Pickle Mdw., 6800′, VII-28-39 (Rindge). Inyo Co.: Argus Mts., IV-'91 (Koebele); Argus Mts., 14 mi. N. Trona, IV-8-60 (Langston); 9 mi. E. Shoshone, IV-12-60 (Opler); E. branch Last Chance Cnyn., IV-10-60 (K. Toschi). San Bernardino Co.: Ivanpah Mts., IX-22-39 (Rindge); New York Mts., VIII-4,5-36 (Comstock); Barnwell, N. Y. Mts., IX-3-45 (C.I. Smith); Needles, IV-10-38 (Tilden), IV-25-49 (MacNeill); nr. Needles, IV-7-39 (Comstock); 6 mi. S. Twentynine Palms, 3000′, III-23-48 (Smith); Mojave R. bed nr. Daggett, "VIII-30" (no collector); Ord Mtn., 4000′, IV-19-60 (J. Lawrence, Powell, J. R. Powers), IV-20-60 (Burns). Riverside Co.: Desert Center, VI-30-52 (Tilden). Lake Co.: nr. Clearlake Highlands, IX-27-37 (Hovanitz). Solano Co.: Hunter's Hill, 2 mi. NE. Vallejo, VIII-21-56 (Opler). Santa Clara Co.: Alum Rock Park, VIII-6-51 (Tilden), VIII-28-54, VIII-12-55, VIII-26-57 (Patterson); Arroyo Bayo, Mt. Hamilton, IX-8-53, VIII-7-54, IX-11-55 (Tilden);

San Antonio Vy., Mt. Hamilton, VIII-25-56 (TILDEN); Saratoga, VIII-31-44 (T. B. BLEVINS). Santa Cruz Co.: Alma, IX-30-05 (GUNDER); Santa Cruz Mts., no date (GUEDET); Mt. Hermon, VIII-12-51 (MACNEILL); Santa Cruz, "VIII-15" (KLOTS), VII-20-31, VII-27-39, VIII-28-39 IX-8-39 (TILDEN). Monterey Co.: Seaside, X-14-29 (G. HEID), VII-4-59 (POWELL); Monterey, VII-15-28 (no collector); Paraiso Spr., IX-26, 29-34 (L. S. SLEVIN); San Luis Obispo Co.: Morro Bay, VIII-30-45 (MELANDER). ARIZONA.—Navajo Co.: 15 mi. NW. Kayenta, 6560′, VII-19-33 (S. BEE., H. N. HULTGREN). Coconino Co.: Todd's Lodge, Oak Cr. Cnyn., IX-29, X-3-48 (SPERRYS); Mohave Co.: Hualapai Mts., X-1-55 (MARTIN). Yavapai Co.: Congress, IV-14-57 (PATTERSON); Yarnell, VI-21-51 (MCKENNEY). Maricopa Co.: nr. Sunflower, X-25-59 (MARTIN & TRUXAL). Greenlee Co.: Coronado Trail, 5 mi. S. Rose Peak, 7000′, VI-6-59 (BURNS). Pinal Co.: Apache Jct., V-10-33 (SPERRYS); Oracle, 4000′, V-29-37 (no collector). Pima Co.: Bear Cnyn., Santa Catalina Mts., IX-14-49 (L. I. HEWES); Tucson, IX-12-31 (no collector); Covered Wells, IV-30-50, IV-12-54 (MARTIN); Ajo, VIII-26-55 (TILDEN); 20 mi. SE. Ajo, IX-2-59 (BURNS); Sells, VIII-26-55 (TILDEN); SE. Growler Vy., Organ Pipe Cactus Nat'l Mon., XII-10-39 (HARBISON); La Abra Vy., Organ Pipe Cactus Nat'l Mon., XI-30-39 (HARBISON). Santa Cruz Co.: Nogales, "VI" (OSLAR). Yuma Co.: Yuma, XI-27-08 (C. PLATT). NEW MEXICO.—McKinley Co.: Ft. Wingate, VII-22, VIII-17-07, IX-29-09, VII-22- to VIII-8-10 (W. P. COMSTOCK).

Blend zones. — With *langei*: CALIFORNIA. — San Benito Co.: Pinnacles Nat'l Mon., IX-7-28, IX-26-26 (no collector). Kern Co.: 5 mi. E. Cholame, San Luis Obispo Co., IX-18-57 (W. E. FERGUSON). With *mejicanus*: ARIZONA.—Pima Co.: Molino Basin, Santa Catalina Mts., VI-7-58 (PATTERSON); Madera Cnyn., VIII-25-55 (PATTERSON), XI-11-51 (MARTIN). NEW MEXICO.—Catron Co.: Whitewater Cnyn., 4 mi. NE. Glenwood, VIII-20-52 (H. B. LEECH & J. W. GREEN). With *virgulti*: CALIFORNIA.—Los Angeles Co.: 6 mi. W. Palmdale, IV-20-32 (E. P. VAN DUZEE); Palmdale, V-8-41 (no collector); Littlerock, IV-2-32, VII-1-32 (G. & R. BOHART), IV-21-35 (G. HEID), III-16-48 (LANGSTON), IV-9-51 (MACNEILL), III-28 to IV-6-53, IV-11-54 (OPLER), IV-8-55 (PATTERSON); Pearblossom, IV-1-59 (J. R. POWERS); nr. Llano, III-27-32 (COMSTOCK); S. of Llano, IV-6-46 (C. I. SMITH); Valyermo, IV-28-35 (G. HEID), IV-13-48 (STERNITSKY); Pallett Cr., IV-22-50 (MACNEILL); Desert Spr., V-5-56 (POWELL). San Bernardino Co.: Phelan, V-3-32, (C. M. DAMMERS), IV-18-50 (SPERRY); Adelanto, IV-28-49 (SPERRY), IV-15-57 (TILDEN); Victorville, V-8-31 (L. I. HEWES), IV-23-55 (R. O. SCHUSTER); 15 mi. SE. Victorville, IV-11-60; 22 mi. SE. Victorville, IV-10-60 (MONTGOMERY); Sheep Cr., IV-27-24 (no collector), V-25-30 (DAMMERS).

Apodemia mormo cythera (Edwards), NEW STATUS

Lemonias cythera Edwards, 1873, *Trans. Amer. ent. soc.* 4: 345; Mead, 1875, *in*: Wheeler, *Rept. geogr. expl.* 5: 786, pl.36, Figs.3, 4; Cockerell, 1893, *Trans. Amer. ent. soc.* 20: 354; Brown, 1957, *Journ. N. Y. ent. soc.* 65: 231.
Chrysobia cythera, Scudder, 1876, *Bull. Buffalo soc. nat. sci.* 3: 103.
Apodemia mormo virgulti (part, not *virgulti* Behr, 1865), Stichel, 1911, *Genera insectorum*, fasc.112: 288 (synonymy); Barnes & McDunnough, 1916, *Contr. nat. hist. Lepid. North America* 3: 103 (synonymy); Stichel, 1930, *Lepid. catalogus* 41: 588 (form); McDunnough, 1938, *Mem. So. California acad. sci.* 1: 23; Hoffmann, 1940, *An. inst. biol. Mexico* 12: 700; Martin & Truxal, 1955, *Los Angeles Co. mus., sci. ser.* 18, *zool.* 8: 20 (form).
Apodemia cythera, Holland (part), 1931, *Butterfly book*, rev. ed.: 212, pl.28, fig.5.

Apodemia mormo cythera is characterized by a greater extent of orange on both the upper and lower surfaces of the forewing, the orange subterminal band of the hindwing, and the pale, whitish underside of the hindwing.

Length of forewing, male 12.5 to 15.5 mm; female 15.0 to 16.5 mm. *Forewing*: white spots large; the orange area extending beyond the submarginal band, reaching the terminal spots in lower half of wing, partially replacing the subterminal band spots, and at times entirely replacing the third and fourth spots; the orange usually lacking the reddish quality of *mormo* and *virgulti*, of an ochreous-orange shade and rather pale; blackish ground color greatly reduced to the apical area and a narrow terminal and anal margin. Underside at times nearly entirely ochreous-orange, the spots sometimes flushed with yellowish; termen whitish. *Hindwing*: above similar to *virgulti*, the subterminal band spots more or less replaced by orange; underside ground color pale greyish ochreous, the spots not well defined; a broad white diffuse streak from base to apex through center and along anal margin.

The name *cythera* was first applied to three males taken by the 1871 Wheeler Expedition which traveled in eastern California, southern Nevada and Utah, and northern Arizona. The locality was recorded by EDWARDS as "in Arizona", and this same statement is given in the MEAD report (1875) of the expedition. However, BROWN (1957b) has stated that all material from the expedition was labeled from Arizona in spite of evidence that much of it came from elsewhere. The citation "Arizona" misled most subsequent writers to apply the name *cythera* to the *mejicanus* populations of the mountains of southern Arizona, an area not reached by the Wheeler Expedition. The latter apparently represents the only orange hindwing form in Arizona. The situation was somewhat clarified by COMSTOCK (1927) who first listed *mejicanus* for southern Arizona, and most authors since have therefore followed STICHEL (1911) in treating *cythera* as a synonym of *virgulti* because of the similar upper wing surface pattern and because the true source of *cythera* remained unknown.

BROWN (1957a) has given an itinerary of the activities of FERDINAND BISCHOFF, naturalist with the Wheeler 1871 Expedition, together with a discussion of the butterfly species taken. BROWN proposes a locality near Truxton Springs in northern Arizona as a probable type locality for *cythera*, based on literature reports of the flight periods (the 1871 expedition did not arrive in Arizona until early October) and an assumption that there are probably scattered colonies of *mormo* throughout northwestern Arizona. However, our records for northern Arizona and the adjoining area of California (see map), together with the reports of GARTH (1950) and HASKIN (1914) indicate that this area is occupied by relatively uniform populations of *A. mormo mormo.* In view of the general uniformity of *m. mormo* over its entire range, with respect to hindwing color, it seems highly unlikely that a population of individuals fitting the description of *cythera* exists in northern Arizona.

In California, along the eastern foothills of the southern portion of the Sierra Nevada, occurs a population which has not previously been explained. Most of the individuals appear much like *virgulti* dorsally, but differ in having a heavy suffusion of whitish ventrally, much as was originally described for *cythera.* In addition, some specimens show suffusion of orange on the forewing to a greater extent than is found in *m. virgulti,* and in fact, extreme examples in this regard are indistinguishable from the original description of *cythera.*

The itinerary of BISCHOFF's activities includes a stay at Independence, Inyo County, from July 18 to August 10, and as suggested by BROWN (1957a), he doubtless collected in a fairly broad area from this camp, including the foothills to the west. In that our records for the above described population include localities both to the north and south of Independence, and the seasonal dates are also coincident, it is our suggestion that the original collection of *cythera* actually took place within the area of this population.

In at least one instance (*i.e., Ochlodes yuma* Edwards), a type locality for a species "from Arizona" has actually been set in the area of Independence, California, in view of the present knowledge on the distribution (Brown, 1957b). We do not propose to set a type locality for *cythera;* however, it seems quite realistic to apply the name to this eastern California population.

As indicated above, individuals within populations of *cythera* are variable, and most have a greater development of white spots than that described by EDWARDS. In addition, of 18 specimens from several collections at Rock Creek (near Tom's Place) three lack all but a trace of the orange on the hindwings, thus phenotypically resembling *A. m. mormo.* The proximity of the nominate subspecies to the east is unknown, but it does not seem likely that *cythera* ranges far eastward. A single specimen from Haiwee Summit closely resembles *virgulti* on the upper surface, and a series of 27 specimens from Walker Pass includes three or four individuals which are nearly indistinguishable from *virgulti,* suggesting the possibility of a relationship with *m. virgulti* populations across the southern end of the Sierra. The exact nature of this relationship is at present obscure, due in part to the lack of records from the area, and in part to the lack of knowledge of the flight periods. To the south, *virgulti* has a long flight season including at least two generations; to the north *cythera* is restricted to a single summer flight. The Walker Pass series was taken in September, and a single specimen from nearby Dove Springs was taken in April, indicating that there are two flights in this area, and there may be two generations at any given locality. The Dove Springs specimen is of a darker, brick red and has an extreme amount of whitish overscaling on the underside. Thus, in addition to the possibility of this area being an intergrade zone, there is also a possibility of some seasonal variation, although the latter does not seem to be the case in other areas of the complex.

BROWN (1955) has applied the name *cythera* to a form occurring in north and south central Colorado, specimens of which we have not seen. This designation, however, creates a situation which is not tenable, since that area is isolated from any region visited by the Wheeler 1871 expedition by intervening areas with populations of *mormo mormo*. It seems possible that the Colorado race has a relationship with *A. mormo mejicanus* to the south, the nearest geographic race having the orange hindwing phenotype.

Data from material examined.—CALIFORNIA.—Mono Co.: Casa Diablo, VII-4-47 (MACNEILL); Rock Cr., 1 mi. S. Tom's Place, 7200′, VIII-20-56 (BURNS, MACNEILL); Rock Cr., VIII-8-26 (T. CRAIG), VIII-10-58 (LUNDGREN); Sherwin Summit, VII-31-59 (OPLER). Inyo Co.: Bishop Cr., VII-22-34 (C. RUDKIN); Bishop Cr., 15 mi. SW. Bishop, VII-28-52 (POWELL); 5 mi. E. Lake Sabrina, VII-30-59 (OPLER); Whitney Portal, 7000′, VII-24-39 (RINDGE); nr. Haiwee Summit, VI-1-47 (C. I. SMITH). Kern Co.: Walker Pass, IX-23-56 (TILDEN); Dove Springs, IV-15-60 (K. TOSCHI); "Tehachapi Mts.", VII-24-34 (MARTIN).

Apodemia mormo mejicanus (Behr)

Nemeobius mejicanus Behr, 1865, *Proc. California acad. sci.* 3:179.

Lemonias mejicanus, Bates, 1868, *Journ. Linn. soc. London, zool.* 9: 448; Edwards, 1884, *Trans. Amer. ent. soc.* 11:294.

Apodemia mejicanus, Godman & Salvin, 1886, *Biol. Cent. Americana, Lepid. Rhop.* 1: 467; Barnes & McDunnough, 1917, *Checklist Lepid. Boreal America*: 13 (treated as synonym of *duryi*); Tilden, 1953, *Lepid. news* 7: 72.

Apodemia mormo mejicanus, Seitz, 1924, *Macrolep. world* 5: 700; Comstock, 1927, *Butterflies California*: 151, pl.47, figs.13, 14; Stichel, 1930, *Lepid. catalogus,* 41: 589; McDunnough, 1938, *Mem. so. California acad. sci.* 1: 23; Comstock, 1938, *Bull. so. California acad. sci.* 37: 129; Hoffmann, 1940, *An. inst. biol. Mexico* 12: 700.

Apodemia sonorensis Felder & Felder, 1865, *Reise Freg. Novara, Zool.* 2: 303 (NEW SYNONYMY).
Lemonias virgulti (part, not Behr, 1865), Bates, 1868, *Journ. Linn. soc. London, zool.* 9: 448; Godman & Salvin, 1886, *Biol. Cent. Americana, Lepid. Rhop.* 1: 467; McDunnough, 1938, *Mem. so. California acad. sci.* 1: 23 (treated *sonorensis* as synonym of *virgulti*).
Apodemia mormo virgulti, (part, not Behr, 1865) Seitz, 1924, *Macrolep. world,* 5: 700; Hoffmann, 1940, *An. inst. biol. Mexico,* 12: 700.
Lemonias duryi Edwards, 1882, *Papilio* 2: 47; Cockerell, 1899, *Can. ent.* 31: 65.
Apodemia duryi, Barnes & Benjamin, 1926, *Bull. so. California acad. sci.* 25: 16 (synonymy); Holland, 1931, *Butterfly book,* rev. ed.: 213, pl.28, fig.10 (as valid species); McDunnough, 1938, *Mem. so. California acad. sci.* 1: 23 (synonymy).
Apodemia mormo druryi (error), Stichel, 1911, *Genera insectorum,* fasc. 112: 288; Seitz, 1924, *Macrolep. world,* 5: 700, fig.14le.
Lemonias cythera, (not Edwards, 1873) Edwards, 1883, *Papilio* 3: 9; Wright, 1906, *Butterflies West Coast*: 201, pl.27, fig.295; Stone, 1921, *Ent. news* 32: 114.
Apodemia cythera (not Edwards, 1873), Godman & Salvin, 1886, *Biol. Cent. Americana, Lepid. Rhop.* 1: 467; Holland, 1931, *Butterfly book,* rev. ed. : pl.28, fig.4.
Apodemia mormo cythera (not Edwards, 1873), Seitz, 1924, *Macrolep. world* 5: 700, fig.14le; Stichel, 1930, *Lepid. catalogus* 41: 589 (in part); Brown, 1955, *Proc. Denver mus. nat. hist.* 5: 118, fig.

Apodemia mormo mejicanus is characterized by the yellow-orange color of the upper surface which replaces the black ground color from the base of the wings almost to the terminal row of white spots, including, at least in part, the basal half of the hind wing.

Length of forewing, male 13.0 to 17.0 mm., female 16.0 to 18.0 mm. *Forewing*: orange ground color from base to terminal row of spots having a yellowish quality; inner costal spot in basal area tending to be infused with ground color; terminal row of white spots bordered by small patches of black scales inwardly and outwardly, contrasting with the remainder of the terminal area which has scattered white scales. *Hindwing*: basal half of wing having ground color varyingly infused with yellowish orange, not often invading the white spots. Subterminal band with yellowish ground color tending to obscure white spots. Underside of hindwing greatly variable. Some specimens exhibit a very whitish appearance underneath with large spots similar to *mormo deserti,* others show an orange scaling in varying amounts, and others have reduction of black scaling, the ground color being a mixture of grey and white scaling with white along the terminal margin, giving a uniform appearance.

HOLLAND (1930, pl.28) referred to his figure 4 as the female type of *cythera,* an error since *cythera* was described from three males. This figure apparently is of a specimen of *mejicanus.*

The race was described by BEHR from the Sierra Madre Occidental near Mazatlan, Sinaloa, Mexio. From the type locality, the race apparently ranges northward into southern Arizona and New Mexico. We have not seen material from localities south of Mazatlan. In the United States *mejicanus* is found from the Baboquivari Mountains of southern Arizona eastward to the Davis Mountains in Texas, and northward in New Mexico. It is likely that derivative populations which exhibit phenotypic expressions similar to *mejicanus* range into Colorado.

Although we have seen relatively few specimens from scattered localities, it is evident that *mejicanus* is highly variable. Specimens from the mountain ranges in southern Arizona indicate that variation both within populations and between populations is pronounced. This is especially notable in the amount of orange scaling and in the development of the pattern of the underside of the hindwing. Much of the variation in certain populations (*e.g.*, Santa Rita Mountains) may be due to influence from *mormo mormo* populations of lower elevations at the northern margin of the *mejicanus* range in Arizona. However, we have not had material in series from these areas for study.

Data from material examined.—ARIZONA.—Pima Co.: Baboquivari Mts., VI-(1-15)-24, IX-7-23 (O. C. POLING); Brown Cnyn., Baboquivari Mts., III-20-38 (TILDEN); Box Cnyn., Santa Rita Mt., VIII-2-59 (TILDEN). Santa Cruz Co.: Patagonia, III-23-38, III-24-38 (TILDEN); Canelo, VIII-24-53 (TILDEN). Cochise Co.: Huachuca Mts., "V-1" (W. G. WRIGHT); Ramsey Cnyn., IX-3-52, IX-1-53 (MARTIN), IX-9-49, VIII-31-52, VIII-24-53 (TILDEN). NEW MEXICO.— Colfax Co.: Raton, VII-26-52 (J. R. MERRITT). Bernalillo Co.: Juan Tabo, Sandia Mts., 7000', VIII-1-44 (GRIESEL). Grant Co.: 2 mi. NE. San Lorenzo, Black Range, 6200', V-28-59 (BURNS). Dona Ana Co.: San Agustin Pass, 5600', Organ Mts., IV-27-59 (BURNS). Eddy Co.: White's City, VII-8-54 (CAZIER & GERTSCH). TEXAS. —Jeff Davis Co.: Davis Mts., nr. Fort Davis, 5000', V-(1-10)-28, VI-(1-15)-28, VII-(15-30)-28 (O. C. POLING). MEXICO.—Sonora: Monument Bay, Tiburon Is., IV-1-39 (RINDGE); 20 mi. N. Guaymas, X-29-58 (PATTERSON).

Apodemia mormo langei Comstock

Apodemia mormo langei Comstock, 1938, *Bull. so. California acad. sci.* 37: 129, fig.1, 2.

Apodemia mormo langei is characterized by invasion of orange scaling into the discal spot of the forewing and onto the basal half of the hindwing.

Length of forewing, male 12.0 to 14.5 mm., female 14.0 to 15.5 mm. *Forewing*: the four spots in basal half invaded by orange scaling, particularly in discal spot, less on inner anal spot. *Hindwing*: basal half infused with orange scaling except on veins, nearly covering spots in this area, extending to subterminal row of white spots. Underside characterized by reduction of black scaling, the ground color being of brown and white scaling; margins whitish, spots not greatly contrasting.

A. m. langei is the most recently described of the previously recognized subspecies, and, so far as is known, is endemic to the Antioch sand dunes. The species feeds there on *Eriogonum latifolium* Sm. (*sens. lat.*), larvæ having been taken by OPLER in June 1957. These dune areas adjoin the San Joaquin River, thus offering an ideal site for industrial expansion, which, during the past decade has reduced the once extensive dunes to a few isolated portions. Most of the sampling of the *langei* population during the past few years has place at one small colony. Upwards of 200 specimens must have been taken on September 5, 1954, when members of the Pacific Slope Branch of the Lepidopterists' Society collected in the area, so that the locality, although restricted, was capable at least as recently as six years ago, of supporting quite a large colony.

As mentioned under the discussion of *A. m. mormo*, specimens showing phenotypic affinities with *langei* occur along the inner coast range to the south. The collection listed from near Cholame consists of three males which are discernible from the typical *langei* phenotype only by the darker ground color and reduction of the basal orange of the hind wings, and a similar female which has the discal spot white. The colony thus shows a definite relationship with the coastal *m. mormo* populations to the north. Therefore it appears possible that the *langei* phenotype will be found in isolated populations along the western foothills of the San Joaquin Valley.

Data from material examined.—CALIFORNIA.—Contra Costa Co.: Antioch, VIII-18-33, VIII-14-38 (W. H. Lange) (type series), VIII-30-36, VIII-15-37, VIII-21-38, VIII-10-41, VIII-16-42 (E. C. Van Dyke), IX-25-37 (Hovanitz), VIII-27-38 (no collector), VII-17-47 (T. W. Davies), IX-8-48 (P. D. Hurd), VIII-14-54 (Tilden), VIII-21-54 (Langston), IX-5-54 (Martin, Opler, Patterson, Powell, Tilden), IX-7-54 (MacNeill), IX-18-55 (Burns), VIII-23-56, VIII-20-57 (Patterson); Oakley, IX-5-37 (Van Dyke).

APODEMIA MORMO TUOLUMNENSIS Opler & Powell, NEW SUBSPECIES

A Sierran population characterized by a great extent of orange on the upperside together with reduction of white spots, and dark underside.

Male.—As described above for the nominate subspecies, differing by the following characteristics. Length of forewing 13.3 to 14.0 mm. Antennal club orange to dull brown below. *Forewing*: white spots greatly reduced; orange infusion of an ochreous-orange color, greatly expanded, replacing the black on entire wing surface from base to terminal spot band and leaving only a narrow black band on anal margin below lower white spots, at times surrounding subterminal spots in lower half of wing, nearly replacing white spots of subterminal band, the latter usually reduced to a trace in first, second and fifth spot loci, rarely these larger and traces present at all seven loci; spots of terminal band small, at times nearly lacking. Underside similarly marked, the extensive ochreous-orange paler; terminal area brownish-grey. *Hindwing*: white spots reduced; orange infusion varying from a replacement of the subterminal band, as in *virgulti*, to a nearly complete replacement of the basal, median and subterminal interspaces, similar to *mejicanus;* subterminal white spots entirely replaced or reduced to traces; terminal spots small. Underside dark brownish grey, the spots rather distinctly contrasted as in *virgulti;* some whitish infusion along anal and terminal margins.

Female.—Length of forewing 14.5 to 16.0 mm. Essentially as described for male, the white spots tend to be not so reduced, the orange paler and consistently more extensive on the basal half of the hindwing.

HOLOTYPE male and ALLOTYPE female: Grand Canyon of the Tuolumne, Yosemite National Park, Tuolumne County, California, August 1, 1959 (P. A. OPLER). Fifteen PARATYPES: nine male and two female same data as holotype; two male and two female same data except August 20, 1954. Holotype, allotype, and series of eight paratypes deposited in the California Academy of Sciences, single specimens deposited at American Museum of Natural History and Los Angeles County Museum, remainder in authors' collections.

So far as is known the subspecies is restricted to a population along a four mile area of the Pate Valley trail from about 4500′ to 7000′. It seems likely that *tuolumnensis* is a segregate from *virgulti*, its nearest geographic relative, which probably occurs in scattered colonies through the lower foothills to the west.

Due to the forewing pattern, the subspecies appears superficially much like *A. m. cythera*, from which it differs by the reduced white spots above and the dark underside of the hindwings. The hindwings of some individuals appear much like those of *virgulti;* however, the great extension of orange on the forewings will at once distinguish it from any specimen of *virgulti* we have seen.

Apodemia mormo virgulti (Behr)

Nemeobius virgulti Behr, 1865, *Proc. California acad. sci.* 3:178.

Lemonias virgulti, Bates, 1868, *Journ. Linn. soc. London, zool.* 9: 448; Wright, 1906, *Butterflies West Coast* :201, pl·27, fig.296.

Apodemia mormo virgulti, Stichel, 1911, *Genera insectorum,* fasc.112: 288; Barnes & McDunnough, 1916, *Contr. nat. hist. Lepid. North America* 3: 103; Seitz, 1924, *Macrolep. world* 5: 700, fig.14le; Coolidge, 1924, *Trans. Amer. ent. soc.* 50: 324 (biology); Comstock, 1927, *Butterflies California*: 149, pl.47, fig.6; Wright, 1930, *Trans. San Diego soc. nat. hist.* 6: 21; Stichel, 1930, *Lepid. catalogus* 41: 587; McDunnough, 1938, *Mem. so. California acad. sci.* 1: 23; Comstock, 1938, *Bull. so. California acad. sci.* 37: 129, fig.3; Hoffmann, 1940, *An. inst. biol. Mexico* 12: 700; Rindge, 1948, *Proc. California acad. sci.*, 4th ser. 24: 299; Powell, 1958, *Lepid. news* 12: 29.

Apodemia vergulti (error), Anonymous, 1927, *Journ. zool. ent.* (Pomona Coll.) 9: 136.

Apodemia virgulti, Holland, 1931, *Butterfly book,* rev. ed.: 212, pl.28, fig.6.

Apodemia mormo virgulti is characterized by the distinct orange submarginal band of the hindwing, the reduced terminal band spots, and the more uniform lack of white scaling in the black ground color of the underside of the hindwing with the accompanying sharply contrasted white spots.

Length of forewing, male 10.0 to 13.5 mm., female 14·5 to 17.0 mm. *Thorax*: dorsal scaling grey and blackish, often with mixed orange scales. *Forewing*: white spots of terminal bands reduced, those of subterminal mostly replaced by orange, those of terminal nearly replaced by surrounding ground color, especially in male; black scaling of anal margin often extends to lower edge of cell, especially in male. *Hindwing*: subterminal spot band usually nearly entirely replaced by orange;

terminal band spots very reduced. Underside, white scaling mostly lacking from ground color except along margins; spots thus very contrasting, bordered by darker black lines.

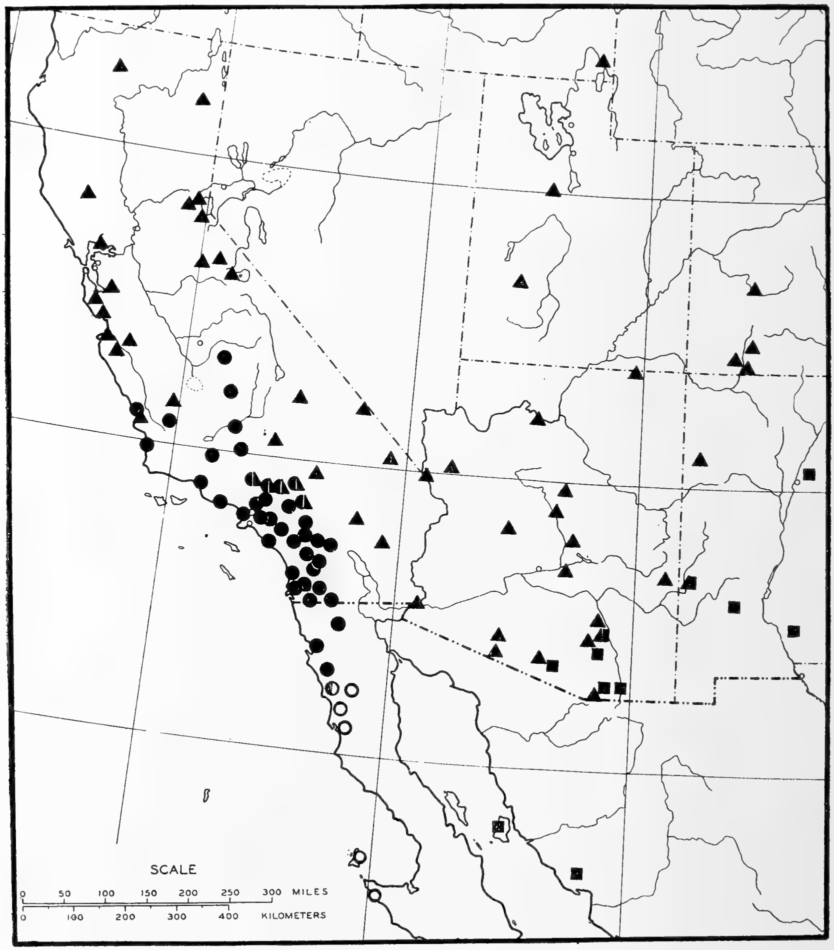
The name *virgulti* was proposed when BEHR described specimens from near Los Angeles. BATES erroneously synonymized *sonorensis* under *virgulti*, listing the distribution as Los Angeles and Sonora, and this form of synonomy has been followed by all subsequent writers. We have not seen the original specimens of *sonorensis*, but on the basis of distribution patterns we believe that it certainly must be a synonym of *mejicanus*.

The distribution of *virgulti* is confined to coastal southern California and Baja California Norte, and along the foothills on the west slope of the Sierra Nevada at least as far north as Mariposa County. COMSTOCK (1928) states that *virgulti* is found north to the Sacramento Valley, but we have not seen specimens from this area. Three specimens of the *virgulti* phenotype, labeled San Antonio Valley, Mt. Hamilton, Santa Clara County, were apparently collected along with *mormo mormo* in an area remote from any of the known *virgulti* populations. The relationships and variation of populations in this area are in need of further clarification.

The subspecies is abundant throughout the chaparral zones of cismontane southern California in association with *Eriogonum fasciculatum* Benth. COOLIDGE (1924) has described the early stages from Mt. Wilson, Los Angeles County, where it is double brooded. COOLIDGE found them on *E. fasciculatum* var. *foliolosum* Stokes and var. *porifolium* P. as well as *E. elongatum* Benth.

At least in many areas *virgulti* does not seem to be confined to restricted local populations as is *A. mormo mormo* to the north, and throughout coastal California and northern Baja California populations of *virgulti* are very similar in phenotypic expression. However, as one observes the subspecies proceeding southward along the west coast of Baja California populations gradually lose the orange of the hindwing, and the individuals take on a very dark aspect. At Arroyo Seco a sample of six specimens indicates the population is about half composed of individuals with little or no hindwing orange. Further south, in the areas of Colonia Guerrero and San Quintin, only occasional individuals show even a faint trace of orange; most have entirely black ground color. In addition, the underside is darker, with the spots strongly contrasting. Worn specimens from Cedros Island and San Bartolime Bay, some distance to the south, appear to have similar characteristics. As mentioned previously (Powell, 1958), these dark populations may warrant subspecific recognition when more information becomes available on their relationships to the south and east. However, at present it does not seem likely that the black hindwing is due to influence from *mormo mormo* populations to the east, as postulated previously, but it is more likely that the dark form is a southern derivative of *A. mormo virgulti.*

As has been discussed under *mormo, virgulti* forms a blend zone with *mormo* on the lower desert slopes to the east and north of the San Gabriel Mountains. In these areas *virgulti*-like individuals invariably exhibit a pronounced replacement of the orange submarginal band by white, and the underside ground color tends to be suffused with white.



Distribution of the major subspecies of *Apodemia mormo* in the southwestern Nearctic region. Triangles indicate localities for *A. mormo mormo,* squares for *A. mormo mejicanus,* and circles for *A. mormo virgulti;* open circles indicate the dark southern segregate of *virgulti.*

Due to the abrupt topographical change from the mountain to the desert areas of Riverside and San Diego Counties, there is a sharp demarcation between ecological areas inhabited by *A. mormo virgulti* and *A. m. deserti.* Thus one expects a possible blend zone between these to be geographically restricted. Evidence of this population is shown by specimens labeled "Palm Springs". Most of these collections are typical *deserti,* but some separately collected specimens resemble *virgulti* in some respects. These probably have been collected at somewhat differing localities in the canyons west of Palm Springs. It seems likely that an intergrade population exists in varying expressions throughout the canyons of the eastern foothills of the San Jacinto Mountains (*i.e.,* Snow. Cr., Chino Canyon, Tahquitz Canyon, Palm Canyon, south to Pinon Flat), as well as in scattered colonies on the east side of the Santa Rosa Mountains and the mountains of San Diego County.

Data from material examined.—CALIFORNIA.—Mariposa Co.: Yosemite Vy., no date (Hy. Edwards). Tulare Co.: "Sheep Cr., Calif." [prob. nr. Kaweah, Tulare Co.], IV-12-50 (Patterson); California Hot Spr., V-16-37 (E. C. Van Dyke). Kern Co.: Havilah, no date (Hy. Edwards); Tehachapi, VII-7-18 (Comstock). San Luis Obispo Co.: Cayucos, V-23-28 (L. S. Slevin); Oso Flaco Lake, VII-13-59 (C. A. Campbell); 7 mi. W. Simmler, VIII-7-55 (Powell). Ventura Co.: Ventura, VIII-2-26 (G. Heid), VII-6-27 (T. Craig); 5 mi. W. Frazier Park, VII-21-56 (Tilden). Los Angeles Co.: Bouquet Cnyn., V-20-59 (Powell); Mint Cnyn, IV-20-32 (Van Duzee), IV-14 to 30-23, V-3-45 (Comstock); Soledad Cnyn., IV-24-46 (Martin); Pacoima Wash, 1060′, VI-23-13 (Grinnell); Nichol's Cnyn., IV-21-43 (Langston); Cloudburst Cnyn., VII-12-41 (Langston); Switzer's Trail, San Gabriel Mts., VIII-'07 (Grinnell); Switzer's, VII-17-37 (W. A. Evans); Arroyo Seco, VIII-20-07; (Grinnell); Mt. Lowe, VIII-21-16 (no collector); Mt. Wilson, VIII-2-04 (Grinnell); Santa Anita Cnyn., VII-20-30 (no collector); Sierra Madre nr. Los Angeles, VIII-23-16 (no collector); Azusa, IX-17-40, IV-3-45 (C. I. Smith); Glendora, V-5-31, IV-2-32, IV-2-33 (L. Hulbirt), III-29-31, IV-22-30, V-27-30,VI-6-30, X-19-30 (no collector); Glendora Mtn., VIII-2,11-56 (Tilden); Tanbark Flat, V-13-57 (Tilden); Padua Hills, IX-12-49 (Tilden); San Antonio Cnyn., 3000′, VII-6 to 16-25, IX-1-25, IX-9-27 (T. Craig); San Antonio Wash, VII-2-52 (Tilden); Claremont, III-17 to IV-28-26 (T. Craig); Pasadena, V-21-04, V-22-07, IV-6-09 (Grinnell); Griffith Park, III-12,24-35, V-5-35 (G. Heid); Los Angeles, VII-30-48 (Vaurie); Venice, IX-5-26 (Comstock); El Segundo, VII-25-21 (Comstock); Manhattan Beach, VII-25-21 (Comstock). Orange Co.: La Habra, IX-28-20 (T. Craig); Laguna Beach, VIII-24-30 (no collector); Orange County Park, III-31-28 (T. CRAIG); Santa Ana Cnyn., IX-17-32 (L. HULBIRT); Silverado Cnyn., III-30-47 (LANGSTON); Gypsum Cnyn., III-16-28 (C. M. DAMMERS). San Bernardino Co.: W. fork Cucamonga Cnyn., VII-13-23, VII-6-25 (T. CRAIG); Baldy Mesa, IX-19-39 (RINDGE); Oak Glen, V-4-39 (RINDGE); Rialto, IX-17-38 (P. D. HURD); Etiwanda, IV-14-27 (T. CRAIG); Verdemont, Cajon Pass, VI-27-35 (E. P. VAN DUZEE); Forest Home, VI-19-28 (VAN DYKE); "San Bernardino Mts.", IX-1-20 (COMSTOCK). Riverside Co.: Riverside, IX-16-32 (DAMMERS); Perris, V-26-52, VIII-2, 21-52, III-15,22-53 (no collector), Rancho La Sierra, V-12-38, IV-23-39 (RINDGE); Gavilan Hills, IV-18-37 (ANDREWS & MARTIN), IV-19-57 (TILDEN); Hemet, IV-28-49 (MACNEILL); Idyllwild, VI-'36 (E. S. ROSS), VI-18-52 (CAZIER); 10 mi. SW. Coahuila, V-21-27 (T. CRAIG); Keen Camp, VI-9-17 (VAN DUZEE); San Jacinto Cr., IV-7-31 (L. I. HEWES); Nightingale, IV-28-49 (MACNEILL); Pinon Flat, IV-27-55 (D. J. BURDICK); "San Jacinto Mts.", IX-1-20 (COMSTOCK); Anza, IX-17-40 (C. I. SMITH); Santa Rosa Mts., 6000′, "VI-25" (GRINNELL); Temecula, IV-11-50 (HURD). San Diego Co.: 10 mi. S. Temecula, Riverside Co., no date (J. W. MACSWAIN); Mt. Palomar, 5400′, I-26-36 [?] (RINDGE), VII-10-52 (MCKENNEY); Nellie, [Mt. Palomar], IV-1-17 (G. HALL); Mt. Palomar, 3700′, V-20-39 (RINDGE); Warner Spr., 3000′, IV-15-51, VI-22-51 (POWELL); San Felipe turnoff, VIII-4-55 (TILDEN); Santa Ysabel, "IV-20" (W. G. WRIGHT); Julian, (no further data); Pine Vy., (no further data); Rancho Santa Fe, III-30-30 (no collector), III-13-33 (L. I. HEWES); hiway 395, 15 mi. N. San Diego, IV-13-55 (PATTERSON); Mission Gorge, II-28-52, IV-15-52; "S" [COWLES] Mt., V-3-52; Lakeside, IX-14-51, VI-9-52, IX-4-52, X-12-52; Flinn Spr., VII-21-51 (all POWELL); 2 mi. SE. El Cajon, V-18-52 (F. T. THORNE);La Mesa, III-28-43 (E. W. CLARK), VII-22-54 (F. X. WILLIAMS); Fairmount Cnyn., IV-25-48 (G. A. MARSH); San Diego, VII-27-07, III-21 to IV-24-08, VII-11, 27-08, IX-19-08, V-13-13, IV-18-14 (no collector), IV-7, 11-18 (COMSTOCK), VII-21-24 (PATTERSON), IX-19-26 (THORNE), IV-14-39 (W. P. MEDLAR); Sweetwater Lake, X-28-50 (LANGSTON); Camp Minnewawa [Dulzura Cr.], X-28-50 (LANGSTON); Dulzura IV-17-08 (no collector); Jacumba, IV-26-29 (MORAND), IV-25-51 (MACNEILL), III-31-53 (MCKENNEY). MEXICO.—Baja California Norte: Sierra Juarez, mesa W. of Canyon del Tajo, X-9-53 (HARBISON); Ensenada, VII-2,5-05 (F. X. WILLIAMS); 7 mi. SE. Santo Tomas, V-25-58 (PATTERSON); nr. Arroyo Seco, IV-5-55 (PATTERSON); Socorro, Sierra San Pedro Martir, 4000′, V-26-58 (PATTERSON, POWELL); trail nr. Las Encinas, Sierra San Pedro Martir, 5000′, V-27-58 (PATTERSON); Santo Domingo, VIII-14-54 (POWELL); Colonia Guerrero, IV-5-55 (PATTERSON); Santa Maria Vy., VIII-11-54 (POWELL); San Simon, IX -6 to 10 -55 (MCKENNEY); Cedros Is., VII-14-38, XI-10-48 (no collector); San Bartolime Bay, VI-1-25 (H. H. KEIFER).

Blend zone with *deserti*: CALIFORNIA.–Riverside Co.: Palm Springs, XI-1-20 (COMSTOCK), IV-20-32 (GUEDET); Coachella Vy. nr. Indian Well, X-15-20 (COMSTOCK). San Diego Co.: San Felipe Vy., IX-29-49 (STERNITSKY).

Apodemia mormo deserti Barnes & McDunnough

Apodemia mormo deserti Barnes & McDunnough, 1918, *Contr. nat. hist. Lepid. North America* 4: 75, pl.12, figs.1,2; Comstock, 1927, *Butterflies California*: 151, pl.47, figs.8, 12; Stichel, 1930, *Lepid. catalogus* 41: 589; McDunnough, 1938, *Mem. so. California acad. sci.* 1: 23; Comstock, 1938, *Bull. so. California acad. sci.* 37: 129.

Lemonias mormo, Wright, 1906 (in part, fig.294a) (not Felder & Felder, 1859), *Butterflies West Coast*: 201.

Apodemia mormo mormo, (not Felder & Felder, 1859), Comstock, 1927 (in part), *Butterflies California*: pl.47, fig.5: Wright, 1930, *Trans. San Diego soc. nat. hist.* 6: 21; Rindge, 1948, *Proc. California acad. sci.* 24: 299 (in part?).

Apodemia mormo var. *deserti*, Holland, 1931, *Butterfly book*, rev. ed.: 212 (synonymy); Hoffmann, 1940, *An. inst. biol. Mexico* 12: 700.

Apodemia mormo deserti is characterized by a general pale aspect due to paler ground color, enlarged white spots, particularly those of the terminal band, and extensive white scaling on the hindwing underside. Worn or greasy specimens, or those discolored by over-relaxing, lose some of the whitish appearance.

Length of forewing, male 11.0 to 13.5 mm.; female 13.5 to 15.5 mm. *Thorax*: white with mixed orange scales. *Forewing*: upperside, white spots large, those of terminal row nearly equal in size to those of subterminal row; black scaling of costal and anal margins reduced; orange area pale. *Hindwing*: white spots large, especially notable in terminal band; ground color greyish, a pale grey in central area. Underside characterized by extensive white scaling on ground color areas, especially in median area. *Abdomen*: dorsal scaling a mixture of white and orange or black and white with a few orange scales; underside white.

This race was described from three specimens collected in La Puerta Valley on the western edge of the Colorado Desert in San Diego County. BARNES and McDUNNOUGH mentioned additional specimens from Palm Springs, but, unfortunately, referred to this as the "borders of the Mohave Desert". Palm Springs is situated in the Coachella Valley at the northern end of the Colorado Desert and is separated from the Mojave Desert plateau by the Little San Bernardino Mountains. A general conception about the race developed, collectors referring any specimens from desert areas, including the Mojave, to *deserti*, and the distinctness of the race has become obscured in the literature because pale (especially faded or worn) specimens from *m. mormo* populations of various areas of the Mojave Desert have been used as a basis for reference to *deserti*.

Although COMSTOCK (1927) accurately represented the race in his figures and probably understood the distribution, he did not give a clear picture of it by "the southern arid regions" of California. HOLLAND

(1930) apparently did not consider *deserti* as a geographic race and erroneously gave the locality as "southwestern California". These two reports doubtless resulted in much of the uncertainty which has existed through subsequent years concerning the occurrence of the subspecies over desert regions in general.

We do not believe that the name *deserti* is applicable to any of the several desert populations discussed above under *mormo mormo*. Each of these, as well as the northern segregates of *m. mormo* are separable on a comparable level. Populations of the western Mojave Desert are distinguishable from *m. deserti* of the western Colorado Desert foothills only in being darker, since the spot size of the terminal band is not consistently smaller. The populations from Pima County, Arizona, are pale with greyish ground color, but are distinguishable by larger size of the butterflies and by smaller spots of the terminal band, yet are as different from the western Mojave populations as from *deserti*. Therefore it would seem that use of the name *deserti* is of little value, but if used, its application should be restricted to populations along a narrow band of the foothills on the western edge of the Colorado Desert. Specimens of the dark *mormo mormo* phenotype from the southern Mojave Desert (Ord Mtn., Twentynine Palms) and the Colorado River basin (Needles, Yuma) support this concept.

BROWN (1955) indicates that specimens resembling *deserti* will probably be found in Colorado. If populations with the *deserti* phenotype occur in eastern portions of the range of the species, it would appear that they should not be referred to the *deserti* of Barnes & McDunnough of the western Colorado Desert foothills.

The foodplant of *deserti* is listed as *Eriogonum inflatum* by COMSTOCK and DAMMERS (1934), who collected larvæ in the desert foothills of Riverside County, and they state that the larva and pupa are indistinguishible from those of *virgulti*. Apparently there is usually at least a partial spring and fall emergence in most localities. However, the time of flight and number of generations per year probably vary greatly with the seasonal conditions, particularly the rainfall, in any given locality.

Data from material examined.—CALIFORNIA.—San Bernardino Co.: Morongo Vy., V-1-29 (C. M. DAMMERS); III-17-40, IV-28-40 (RINDGE). Riverside Co.: Tahquitz Cnyn., IV-4-55 (OPLER); Palm Springs, III-11-33, III-11-35, XI-6-32 (C. M. DAMMERS), VIII-10-33, X-15-33 (L. HULBIRT), III-27-37, IV-20-38 (no collector), IV-3-35 (COMSTOCK); Palm Springs Canyon, IV-4-25 (VAN DYKE). San Diego Co.: Borrego Vy., X-10-39, IV-8-39 (RINDGE); "Borrego", [10 mi. SE. Borrego Springs], III-21-51 (POWELL); 3 mi. W. Yaqui Well, Anza Desert, IX-16-51, X-14-51 (LANGSTON); XI-12-45 (MELANDER); "Borrego", IV-11-41, IV-27-46, III-

17-40, XI-7-45, XI-11-45, XII-16-45, I-19-46, (SPERRYS), III-14-53 (POWELL); "Borrego", [nr. Sentenac Cnyn.], IX-5-51, IX-10-51, X-12-51, VI-6-52 (POWELL); Sentenac Cnyn., IV-14-51, X-14-51, VIII-25-55 (LANGSTON), VIII-16-35, IX-4 to X-17-35 (C. M. DAMMERS); 1 mi. E. Sentenac Cnyn., IX-12-59 (MACKIE); Scissor's Crossing, VIII-4-55 (TILDEN); IX-4-55 (LANGSTON); San Felipe Wash, X-28-36, X-24-36, X-30-36 (COMSTOCK); "Box Cnyn." [7 airline mi. SE. Banner], VIII-25-55 (LANGSTON), III-30-52 (MCKENNEY), IV-8-52, VII-11-52 (POWELL), IX-12-59 (MACKIE); Mason Vy., VIII-27-52 (MACKIE); LaPuerta Vy., VII-1911 (G H. FIELD); Vallecito, XI-12-45 (COMSTOCK); County unknown: "Colorado Desert", X-28-33 (no further data).

APODEMIA MORMO DIALEUCA Opler & Powell,

NEW SUBSPECIES

Apodemia mormo complex, "population", Patterson & Powell, 1960, *Journ. lepid. soc.* 13: 233.

A Baja California montane race characterized by greatly enlarged white spots and an accompanying reduction of orange.

Male.—As described above for the nominate subspecies, differing by the following characteristics. Length of forewing 12.3 to 15.0 mm. *Forewing*: inner three white spots greatly enlarged, subequal in size to discal spot; subterminal band spots large, all well developed; terminal band spots small or large; black ground color little replaced by orange suffusion, varying from an obscure tinge between discal spots and outside fifth subterminal spot to reduced but bright orange interspaces between the veins and the broad black spot margins above the median vein. Underside, orange similarly restricted; termen and anal margin broadly bordered with pale grey. *Hindwing*: spots large; ground color dark grey; orange infusion varying from a trace to a well defined submarginal band partially replacing the white subterminal spots. Underside pale appearing due to the large white spots and a general whitish infusion centering between veins; ground color grey, the spots distinct, at times partly margined with black.

Female.—Length of forewing 15.0 mm. Essentially as described for male; the orange of forewing varying to slightly more extensive, appearing outside the fourth, fifth and sixth subterminal spots.

HOLOTYPE male, Sierra San Pedro Martir, 5 miles northeast of La Encantada, 9000', Baja California Norte, Mexico, May 31, 1958 (J. POWELL), and ALLOTYPE female, Sierra San Pedro Martir, La Encantada, 7000', May 30, 1958 (W. D. PATTERSON), deposited in the California Academy of Sciences. Eighteen PARATYPES, all from the same area, as follows: nine male, same data as holotype; five male and one female same data except PATTERSON collector; two male same data as allotype except J. POWELL collector; one male, trail between La Grulla and La Encantada, 7000', May 30, 1958 (W. D. PATTERSON). Two additional males apparently also referable to this subspecies but not designated as paratypes, labeled Sierra San Pedro Martir, "La Sanja, May 28, 1958"

(PATTERSON). A representative series of ten males deposited in the California Insect Survey Collection, University of California, Berkeley, single specimens at the American Museum of Natural History and Los Angeles County Museum, and the remainder in the Patterson and authors' collections.

The holotype has about an average amount of orange infusion, most specimens have somewhat more, some have less, but it is unusual in having a relatively greater reduction of orange in the basal area of the forewing, so that the subterminal band of the hindwing is the most conspicuous orange area of the upperside.

The greatly enlarged white spots and reduction of orange give the specimens a striking black and white checkered appearance unlike that of any other known member of the complex. The orange and the rather contrasting spots of the underside of the hindwing together with the geographic proximity suggest a derivation from *virgulti*. However, certain individuals which lack nearly all traces of the orange on both wings recall certain representatives of *mormo mormo* from the mountains of eastern Arizona, and a relationship with the fauna of the mountains of southern Arizona for certain other Lepidoptera of the Sierra San Pedro Martir is known (Patterson & Powell, 1960).

The series was collected on rocky slopes marginal to the southwest side of La Encantada meadow and in a wash southwest of the Tres Palomas peaks in association with a small prostrate *Eriogonum*, presumably *E. hastatum* Wiggins.

Apodemia mormo maxima (Weeks)

Lemonias maxima Weeks, 1891, *Ent. news*, 2:104; Weeks, 1905, *Ill. diurn. Lepid.* 1: 3, pl.1, fig.4.

Apodemia mormo maxima, Seitz, 1924, *Macrolep. world* 5: 700, fig.14le; Stichel, *Lepid. catalogus* 41: 589; Rindge, 1948, *Proc. California acad. sci.*, 4th ser. 24: 300.

Apodemia mormo maxima is characterized by its large size, large white spots, and extensive brownish-orange ground color in both wings.

Length of forewing, male 16.0 to 17.5 mm.; female 19.0 to 21.0 mm. *Forewing*: ground color pale brownish-orange and appearing dull, extending beyond subterminal row of white spots; spots on basal half of wing pure white; spots of subterminal band rounded, not triangulate in appearance. *Hindwing*: ground color from base of wing almost to terminal row of white spots and not much infuscated. White spots on underside narrowly edged with black, white scaling along costal margin adjoining spots of terminal row and at base of costal margin. Remainder of wing with brownish scaling.

This subspecies was described from the southern tip of Baja California. Subsequent records, mostly already given by RINDGE (1948), indicate that the race occurs along the southern half of the peninsula. RINDGE mentions collections of "the species" under his discussion of *A. mormo maxima,* from the coast of Sonora, Mexico. According to material we have seen from the latter area it seems likely that this record represented populations of *mormo mejicanus.* The two are very close phenotypically.

Data from material examined.—MEXICO.—Baja California, Territorio Sur: 15 mi. N. San Ignacio, IX-29-41 (Ross & Bohart); 10 mi. E. San Ignacio, IX-30-41 (Ross & Bohart); Coyote Cove, Concepcion Bay, X-1-41 (Ross & Bohart); Pulpito Bay, I-2-39 (Rindge); La Paz, XI-9-52 (Harbison), III-25-56 (Patterson); Muertos Bay, III-23-39 (Rindge); Los Frailes Bay, XII-28-38 (Rindge); Cape San Lucas, XII-25-38, XI-13-39 (Rindge); Agua Verde, V-26-21 (E. P. Van Duzee).

Synonymic Checklist of the *Apodemia mormo* Complex

Apodemia
- mormo mormo (Felder & Felder), 1859
  - *dumeti* (Behr), 1865
  - *mormonia* (Boisduval), 1868
- mormo cythera (Edwards), 1873
- mormo mejicanus (Behr), 1865
  - *sonorensis* Felder & Felder, 1865
  - *duryi* (Edwards), 1882
  - *druryi* Stichel, 1911
- mormo langei Comstock, 1938
- mormo tuolumnensis Opler & Powell, 1962
- mormo virgulti (Behr), 1865
  - *vergulti* Anonymous, 1927
- mormo deserti Barnes & McDunnough, 1918
- mormo dialeuca Opler & Powell, 1962
- mormo maxima (Weeks), 1891

Literature Cited

Barnes, W. & J. McDunnough, 1918. Notes and new species. *Contr. nat. hist. Lepid. North America*: 60-208.

Brown, F. M., 1955. The butterflies of Colorado, part III, Libytheidæ, Riodinidæ Lycænidæ. *Proc. Denver mus. nat. hist.* 5: 113-176.

................1957a. Itineraries of the Wheeler Survey Naturalists 1871 – Ferdinand Bischoff. *Journ. N. Y. ent. soc.* 65: 219-234.

................1957b. The type locality for *Ochlodes yuma. Lepid. news* 11: 153-154.

Browning, G. W., 1901. Collecting in the vicinity of Salt Lake City with a list of Rhopalocera taken. *Ent. news* 12: 297-304.

Comstock, J. A., 1927. *The butterflies of California.* Los Angeles, Comstock, 334 pp., 63 pls.

................1938. A new *Apodemia* from California. *Bull. so. California acad. sci.* 37: 129-132.

..............& C. M. Dammers, 1934. Additional notes on the early stages of Californian Lepidoptera. *Bull. so. California acad. sci.* 33: 25-34.

Coolidge, K. R., 1924. Life history studies of some Californian Rhopalocera. *Trans. Amer. ent. soc.* 50: 319-335.

Garth, J. S., 1950. Butterflies of Grand Canyon National Park. *Bull. Grand Canyon nat. hist. assoc.* 11: 52 pp.

Grundel, J. G., 1905. Life history of *Lemonias virgulti*. *Ent. news* 16: 86.

Haskin, J. R., 1914. Butterfly collecting in Mojave County, Arizona. *Ent. news* 25: 300-307.

Holland, W. J., 1931. *The butterfly book,* revised edition. Doubleday & Co., Garden City, N. Y. 424 pp., 77 pls.

Martin, L. M., & F. S. Truxal, 1955. A list of the North American Lepiodoptera in the Los Angeles County Museum, Part I. Butterflies. *Los Angeles Co. mus. sci. ser.* 18, *zool.,* no.8: 35 pp.

Mead, T. L. 1875. Report upon the collections of diurnal Lepidoptera made in portions of Colorado, Utah, New Mexico, and Arizona during the years 1871, 1872, 1873, and 1874, with notes upon all species known to inhabit Colorado. *in*: Wheeler, G. M., *Report upon geographical and geological explorations and surveys west of the one hundredth meridian, zoology* 5: 737-794, pls.35-40. Government Printing Office. Washington, D. C.

Patterson, D., & J. A. Powell, 1960. Lepidoptera collecting in the Sierra San Pedro Martir, Baja California. *Journ. lepid. soc.* 13: 229-235.

Powell, J. A., 1958. Additions to the knowledge of the butterfly fauna of Baja California Norte. *Lepid news* 12: 26-32.

Rindge, F. H., 1948. Contributions toward a knowledge of the insect fauna of Lower California. No.8, Rhopalocera. *Proc. California acad. sci.* 24: 289-312.

Seitz, A., 1923. The American Rhopalocera. *Macrolepidoptera of the world* 5: 1139 pp., 203 pls.

Stichel, H., 1911. Family Riodinidæ, Allgemeines, Subfamily Riodininæ. *Genera insectorum,* fasc.112: 452 pp.

Weeks, A. G., 1905. *Illustrations of diurnal Lepidoptera, with descriptions.* Vol.I. Boston Univ. Press, Cambridge. 117 pp., 45 pls.

Wright, W. G., 1906. *The butterflies of the west coast of the United States,* 2nd ed. San Bernardino, Wright. 257 pp., 32 pls.

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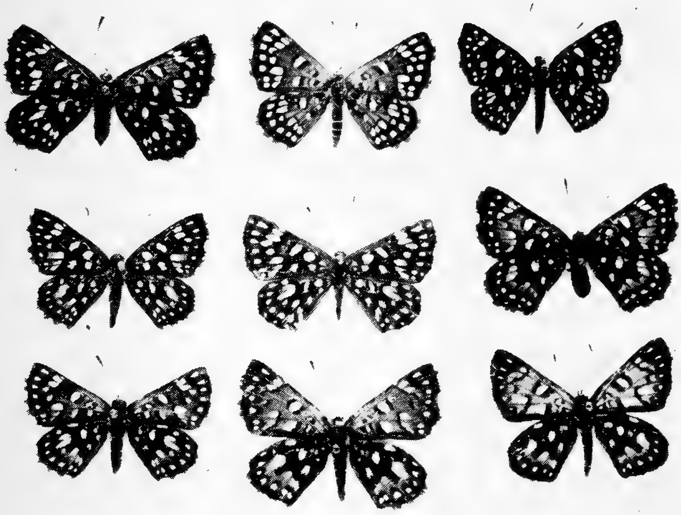
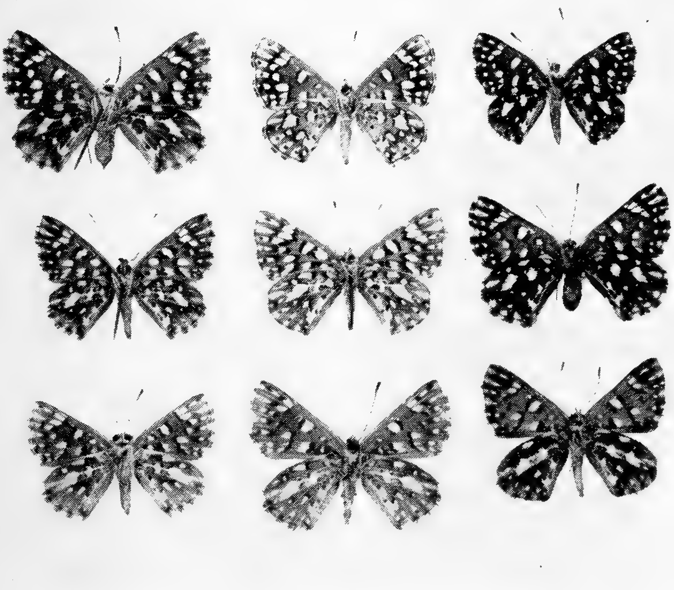
EXPLANATION OF PLATE

Top three rows: uppersides of *Apodemia mormo* subspecies. TOP ROW: (left), *A. m. mormo,* coastal California race, Seaside, Monterey Co., VII-4-59, J. Powell collector; (middle), *A. m. deserti,* Borrego, San Diego Co., Calif., X-12-51, J. Powell collector; (right), *A. m. virgulti,* dark southern race, Santa Maria Valley, Baja California Norte, Mexico, VIII-11-54, J. Powell collector. SECOND ROW: (left), *A. m. dialeuca,* Holotype, Sierra San Pedro Martir, 9000′, 5 mi. NE. La Encantada, Baja California Norte, Mexico, V-31-58, J. Powell collector; (middle), *A. m. dialeuca,* Allotype, Sierra San Pedro Martir, 7000′, La Encantada, Baja California Norte, Mexico, V-30-58, W. D. Patterson collector; (right), *A. m. virgulti,* Mission Gorge, San Diego Co., Calif., II-14-53, J. Powell collector. THIRD ROW: (left), *A. m. cythera,* Rock Creek, Mono Co., Calif., VIII-10-58, M. Lundgren collector; (middle), *A. m. cythera,* 5 mi. E. Lake Sabrina, Inyo Co., Calif., VII-30-59, P. Opler collector; (right), *A. m. tuolumnensis,* Holotype, Grand Canyon of the Tuolumne, Tuolumne Co., Calif., VIII-1-59, P. Opler collector.

Bottom three rows: undersides of *Apodemia mormo* subspecies, the same specimens as figured for uppersides, arranged in the same sequence.





NOTES ON THE EARLY STAGES OF *DARITIS* (*HOWARDI?*) (PERICOPIDÆ) FROM CABEZON PEAK, NEW MEXICO

by Noel McFarland

Through the kindness of Sam L. VanLandingham I received a most unusual lepidopterous larva, by mail, in October 1958. It proved to be a member of the genus *Daritis* Wlk., probably *Daritis howardi* Hy.Edw. (see Dyar's description of the larva of *Daritis howardi* in *Proc. ent. soc. Washington* 4: 407; 1900.)

Mr. VanLandingham was on a geological expedition to Cabezon Peak (el. 7898′), Sandoval Co., New Mexico. On Oct.11, 1958, he was "on Cabezon Peak, approximately half way up the steep western slope, at about 7200′. The terrain was rocky and covered with much basaltic debris. Vegetation was sparce, low, and patchy." In this environment he discovered the boldly-colored larva, on a rock near its foodplant. No specimens of the foodplant were obtained, and its identity remains unknown. I am fairly certain (from fragments received in the box with the larva) that it was some type of dwarf shrub (possibly *Brickellia* sp.?).

I received the larva when I was in Lawrence, Kansas, in Oct. 1958. Upon arrival, it had eaten all but a few scraps of the foodplant and had recently molted; it was much in need of food. For two days I was unable to locate any plant which it would accept as a substitute for its New Mexican foodplant. During this period without food it did an unusual thing, which gave me several more days. It settled down and prepared to molt again, even though it had recently molted and had by no means "filled out" in its present instar. I have observed this phenomenon in some arctiid larvæ when they are deprived of food; most other larvæ would die of starvation under such conditions.

Next, I decided to look for any available Composite genera close to *Brickellia* (the possible foodplant). The nearest relative in Lawrence, Kansas, proved to be *Eupatorium rugosum* (*E. urticæfolium* in some books). This was offered to the larva as soon as it molted. After one day of crawling about, it suddenly settled down and began to feed ravenously, eating both day and night. It continued to thrive on *Eupatorium for* 22 days. During this period it molted two more times, reaching a length of fully 3⅜ inches before it ceased feeding and wove a cocoon. It had increased in length by approximately 1¼ inches since I received it in the mail on Oct.15; all this growth was completed on the substitute plant, *E. rugosum*. The photograph shows the larva in the penultimate instar, after it had ceased feeding in that instar and was about to molt.

In captivity, this larva did not give any indication that it was strictly nocturnal. It was active and feeding both by day and by night. It had a rather rapid, "lumbering" gait, and would never curl up when handled.

On Nov.11, when nearly all available *Eupatorium* had been frost-killed and I was desperately wishing that the larva would stop growing and pupate, it did cease feeding and began to crawl restlessly about in search of a place to pupate. It was placed in a cigar box which had a layer of sand on the bottom, and was loosely-filled with dead leaves and shreds of Kleenex. About 12 A.M., Nov.13, it began to weave its cocoon,

Larva and pupa of *Daritis* (*howardi*?).

having settled down on the lid of the box where it had woven a silk-mat upon which to cling (3″ in diameter, approximately). From this up-side-down position on the lid of the box it hollowed out an open space by pushing away all the dry leaves and shreds of Kleenex and crudely weaving them into place with a fairly tough, colorless silk. This cleared space was approximately 4″ in diameter, and extended from the top of the cigar box (which was 1¾″ deep) to the sand-covered floor. Particles of sand were picked up and woven to the sides of the "clearing." When this was finished, a flimsy, basket-like (and very open) cocoon was started. The "basket" was supported by 13 tough strands of silk, all of which were anchored to the lid of the box. When completed, the "basket" hung suspended from the lid and nearly reached the floor of the cigar box, but did not touch at any point. It was about 1¼″ deep at the middle and about 1¾″ in diameter where it was attached to the lid. Over the bottom and sides of the "basket" were many cross-strands of silk, which filled it in somewhat and gave added strength; the appearance was that of a very open mesh. On Nov.17, the larva dropped from its silken mat on the lid of the box, and into the "basket." On Nov.21, 12 A.M., it molted into the pupal stage. The pupa pushed the old larval skin out of the "basket." It was quite capable of slow movement of the abdominal segments. The flimsy "basket-cocoon" sagged with the weight of the pupa, but none of the tough, colorless strands broke. No larval hairs were used in construction of this cocoon. During the winter, the pupa died, probably due to poor wintering conditions. It was not parasitized.

Last instar larva: the general appearance is well-depicted in the photograph, which, although of the penultimate instar, is an exact representation of the final instar in regard to pattern and coloration. The light areas are creamy yellow, the dark bands black. The long, soft, shiny black hairs arise from large tubercles; where these tubercles are on the light background they are yellow-orange; where the tubercles are on black bands, they are black with a cold blue-black iridescence. Lateral shields on the prolegs are of the same blue-black iridescence. True legs are black. Head is shining black. Length, approx. 80 mm.

Pupa: very dark blackish with a faint reddish tinge when held up to light. Faintly glossy. Abdominal and thoracic regions sparsely covered with short, stiff rusty brown hairs (not visible in the photograph). Maximum length, 35 mm.

The photograph of the larva was taken from a 35 mm. color transparency by Carl Rettenmeyer. Both prints were made by S. L. Van-Landingham.

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A STUDY OF INTERSPECIFIC HYBRIDS IN BLACK SWALLOWTAILS IN JAPAN

by Shigeru Albert Ae

There are four species of black swallowtails in Japan, which resemble each other somewhat closely. They are *Papilio protenor demetrius* Cramer, *P. macilentus* Janson, *P. helenus nicconicolens* Butler, and *P. memnon thunbergii* von Siebold, and all are Rutaceæ feeders. Any combination of interspecific crossing of these swallowtails may produce hybrid butterflies and they may give some data on genetics of characters which separate species, and on evolutionary processes in these species, as in the study of the *Papilio machaon* group (Clarke & Sheppard, 1953, 1955a, 1955b, 1956a, 1956b; Remington, 1958, 1960; Ae, 1960). There are two other species of black swallowtails in Japan, *P. bianor dehaanii* C. & R. Felder and *P. maackii tutanus* Fenton, which have brilliant green and blue scales all over the upper side of the fore and hind wings. They resemble each other, and both are Rutaceæ feeders. Hybridization studies of these species may also give data of the kind which was noted above.

The writer started to work on hybridization of the above black swallowtails at Nanzan University, Nagoya, Japan, in 1959 and obtained hybrid adults (Figs. 2a & 5a) between *P. helenus* (Fig. 1a) and *P. protenor* (Fig. 3a) and between *P. bianor* (Fig. 4a) and *P. maackii* (Fig. 6). The work will be continued to obtain more data. However, the obtained data clarified the main characters of the F_1 hybrids of the above two kinds and gave some indications of interspecific relations. Therefore, the writer presents these data here.

P. protenor is very common and *P. helenus* is somewhat uncommon in Japan. A mixed flight of several individuals of each species on a flowering plant is not an unusual sight in certain localities. *P. helenus* is distributed in Japan, Taiwan, Philippines, South and West China, Thailand, Burma, India, Malaya, Sumatra, Java, and Borneo, etc., and divided into many subspecies. *P. protenor* is distributed in Japan, Korea, Taiwan, Middle and West China, Burma, and North India, etc., and divided into several subspecies. *P. bianor* is common all over Japan and *P. maackii* is also found all over Japan except most of the lowland of the southern half, but is not so common as *P. bianor*. *P. bianor* is distributed in Saghalien, Korea, Manchuria, China, Taiwan, and North Burma besides Japan. *P. maackii* is distributed in Korea, Manchuria, Amur, and Taiwan besides Japan.

MATERIALS

In May, two females of *P. protenor*, R-7-8 and R-7-10, were successfully hand-paired with a wild *P. helenus* male which was collected at Jokoji, near Nagoya. The above two females emerged from overwintering pupæ of Brood R-7, which was obtained from eggs laid by a female collected in Nagoya. The larvæ of this brood were reared on Inuzansho (*Fagara schinifolia* Engl.). In July, six females of *P. protenor*, R-15-1, R-15-2, R-16-5, R-16-8, R-16-14 and R-16-16, were successfully hand-paired with six males of *P. helenus*, of which five were collected at Hirayama and Nagao region near Shizuoka, Shizuoka Prefecture, and one at Jokoji. These six females emerged from pupæ of Broods R-15 and R-16, which were obtained from eggs laid by females collected respectively in Nagoya, and at Jokoji. In September, a female of *P. helenus* was successfully hand-paired with a wild male of *P. protenor*, which was collected in Nagoya. This female emerged from pupæ of Brood N-9, which was obtained from eggs laid by a female collected at Hirayama and Nagao region. The individual designation of a female was also used as the designation of its brood. The designation of a brood was used as the prefix of individuals in the brood.

On May 30, the writer collected a male of *P. maackii*, spring form, at Tsubame Hot Spring, Mt. Myoko, Niigata Pref. The butterfly was brought back to Nanzan University in good condition and hand-paired with 3 females of Brood D-9 of *P. bianor*: to D-9-13 on May 31, to D-9-14 on June 1, and to D-9-15 on June 2. The mother of Brood D-9 was collected at Jokoji in August, 1958. The larvæ, which hatched from eggs laid by this female, were reared on Inuzansho and they overwintered in the pupal stage. The pupæ were kept in the ice box until May 7 and brought out to the laboratory.

DURATION OF COPULATION

The technique of hand-pairing (Clarke & Sheppard, 1956b) was used for all matings. Minutes *in copulo* in Table 1 shows the approximate duration of copulation in *protenor* × *helenus* and *maackii* × *bianor* matings, from which eggs were obtained later. It is not certain what is a minimum effective duration of copulation. In the writer's many inter- and intra-specific matings in hand-pairings as well as in usual cage matings, a sufficient duration is usually 60 minutes, when copulation is normal. However, some copulations of less than 60 minutes were also fertile. REMINGTON's data in *Papilio* (1960) show a sufficient duration can be 30 minutes. There may be a great difference according to the kinds of crossing. In the writer's experiments reported here, when a couple separated within 15 minutes, another attempt at hand-pairing was made and was usually successful immediately or some time later. The five *P. protenor* females which copulated with *P. helenus* males for more than 30 minutes did not lay any eggs and these data are omitted from the Table 1. The *P. bianor* female, D-9-14, above mentioned, also laid no egg.

Fertility of Matings

Table 1 shows the fertility of matings. An egg has yellowish white color, when it is laid. If it starts to develop, a brown mottling or ring appears in *P. protenor* and *P. helenus* and in the hybird between them. This color change was used for an indicator of fertilization. However, no color change appears in *P. bianor* and *P. maackii* nor the hybrid between them in an early stage of development. The writer has as yet found no way to detect fertilization from superficial observation in these species. When a larva is well formed within the egg shell, the egg of these species and their hybrid turns black.

All or a part of the copulations in Table 1 which resulted in no fertile eggs may have been abnormal, although they are indistinguishable from other copulations which resulted in some fertile eggs. *P. protenor* females R-7-8 and R-7-10 were hand-paired with the same wild *P. helenus* male, N-1, firstly to R-7-8 and secondly to R-7-10. This male was previously hand-paired with three *P. xuthus* Linné females, and two of these females laid a few fertile eggs in spite of the wide crossing. The mate of *P. helenus* female, N-9-4, was a wild *P. protenor* male and was previously also hand-paired with a *P. bianor* female. This male may have copulated previously in the field. Therefore, the low fertility of the above three matings could have been the result of the shortage of spermatozoa. However, the data are by no means sufficient to conclude this. Although no data are available on intraspecific hand-pairings of the parental species at present, fertility of wild females shows some indication as a control (Table 1). Wild females of *P. protenor* had high egg fertility and hatchability in this experiment. However, a female of *P. helenus*, N-20, had very low fertility. This may also probably be the shortage of spermatozoa, since this female was collected toward the end of the flying season. Egg fertility, 98.2%, in Brood R-16-8 may indicate that egg fertility in hybrid *P. protenor* × *helenus* is as high as in intraspecific

Table 1. FERTILITY OF THE MATINGS.

Brood	Eggs laid	Eggs fertile	Eggs blackened	Eggs hatched	Minutes *in copulo*
	A. *P. protenor* × *P. helenus*				
R-7-8	47	23	22	22	140
R-7-10	34	6	1	0	65
R-15-1	33	0	–	–	50
R-15-2	106	0	–	–	120+
R-16-5	1	1	1	1	68
R-16-8	113	111	98	93	60
R-16-14	17	0	–	–	60
R-16-16	42	0	–	–	—
N-9-4	29	13	12	9	60
totals	422	154	134	125	
	B. Controls (wild *P. protenor*)				
R-15	112	112	112	112	—
R-16	138	136	136	135	—
R-28	38	38	36	36	—
	C. Controls (wild *P. helenus*)				
N-9	55	50	50	50	—
N-10	6	5	4	3	—
N-20	76	9	9	4	—
	D. ♀ *P. bianor* × ♂ *P. maackii*				
D-9-13	38	–	7	4	60-120
D-9-15	2	–	0	0	60-120
	E. Controls (wild *P. bianor*)				
D-14	69	–	57	57	—

matings in the best situation. The low egg fertility in other cases may be a mechanical failure and/or an effect of different compatibility against a partner of hybrid crossing by individual hereditary differences of parental species. Mechanical failure could involve hereditary differences in copulating organs besides a mere shortage of spermatozoa. Therefore, at present one could say that a crossing between *P. helenus* and *P. protenor* in Japan has a high egg fertility in the best condition environmentally and probably hereditarily. However, using the technique of hand-pairing means a complete bypass of courting behavior, which is very important in natural matings. Therefore, wild hybrids may not be produced at all in spite of wide sympatry between the two species.

Data are too small to discuss fertility of matings between *P. bianor* and *P. maackii* in general. Hatchability of one crossing obtained is as low as 10.5%.

Developmental and Survival Rates

Table 2 shows the developmental rates of the hybrids and their controls. The rates of the fastest developing individuals on different foodplants were recorded. Because of irregular death rates due to virus diseases during development, reliable data on average and slowest developmental rates could not be obtained.

The rearing was carried out at the window side of the laboratory room. The morning sun shone in the room until a little before noon. Since the rearing was carried out at the room temperature, temperature differences during development must be considered. Comparison of four broods of *P. protenor* reared on Inuzansho gives an indication concerning the temperature differences; lengths of their larval stages were 36 days in May-June, 30 days in July - August, and 22 and 28 days in August - early September. The differences of developmental rates due to foodplant differences are prominent in *P. helenus* and the hybrid *P. helenus* × *P. protenor*. Only Inuzansho was used for the rearing of *P. protenor*, because of the shortage of the other food plants. The developmental rates of the hybrids between *P. helenus* and *P. protenor* seem to have no prominent difference in comparison with the parental species, although constant temperature rearing conditions are desirable for more accurate data.

P. bianor and the hybrid between *P. bianor* and *P. maackii* seem to have approximately the same developmental rate. A little delay in *P. bianor* may be seasonal, because the rearing of *P. bianor* was started 9 days earlier than the hybrid.

Table 2. DEVELOPMENTAL RATES IN *PAPILIO* HYBRIDS AND CONTROLS.

Brood	Kind of matings*	Date first egg laid	Duration of egg	Duration of larva	Duration of pupa	Foodplant used
R-7-8	R × N	May 21	4	38	13	Natsumikan
"	R × N	May 22	4	28	–	Inuzansho
"	R × N	May 23	4	33	–	Karatachi
"	R × N	May 23	4	29	12	Unshumikan
R-16-8	R × N	July 26	4	14	10	Natsumikan
"	R × N	July 26	4	15	9	Karatachi
"	R × N	July 27	4	14	10	Kihada
N-9-8	N × R	Sept. 9	4	22	16	Unshumikan
"	N × R	Sept. 9	4	24	20	Kihada
R-16	R × R	May 18	5	36	14	Inuzansho
R-28	R × R	July 12	5	30	12	Inuzansho
R-32	R × R	Aug. 8	4	28	12	Inuzansho
R-33	R × R	Aug. 12	4	22	11	Inuzansho
N-9	N × N	July 18	3	28	13	Natsumikan
"	N × N	July 19	3	35	–	Inuzansho
"	N × N	July 18	3	26	13	Karatachi
N-20	N × N	Aug. 17	3	28	diapause	Kihada
D-9-13	D × K	June 3	6	30	10	Inuzansho
D-14	D × D	May 25	7	31	13	Inuzansho

*Symbols in Tables 2-4: R=*P. protenor;* N=*P. helenus;* D=*P. bianor;* K=*P. maackii.*

Table 3 shows the survival rates in larval and pupal stages in the parental species and the hybrids when reared on the different foodplants. *P. helenus* and *P. protenor* are both Rutaceæ feeders. However, some specificity in foodplants is known in nature. According to SHIROZU (1959), in Japan *P. helenus* larvæ feed on Kihada (*Phellodendron amurense* Rupr.), Karasuzansho (*Fagara ailanthoides* Engl.), Karatachi (*Poncirus trifoliata* Rafin.), Sansho (*Xanthoxylum piperitum* DC.), Yuzu (*Citrus junos* Tanaka), Unshumikan (*Citrus unshiu* Marcov.), etc. *P. protenor* larvæ feed on Yuzu, Unshumikan, Karatachi, Sansho, Inuzansho,

Table 3. LARVAL SURVIVAL RATES IN *PAPILIO* HYBRIDS AND CONTROLS.

Brood	Kind of matings	Foodplant used	1st instar larvæ	Resulting pupæ	Survival rate
R-7-8	R × N	Inuzansho	12	1	8.3%
R-7-8	R × N	Natsumikan	3	1	33.3%
R-7-8	R × N	Unshumikan	2	1	50.0%
R-7-8	R × N	Karatachi	2	1	50.0%
R-16-8*	R × N	Inuzansho	49	0	0.0%
R-16-8*	R × N	Karatachi	10	2	20.0%
R-16-8*	R × N	Natsumikan	12	5	41.7%
R-16-8*	R × N	Kihada	2	1	50.0%
N-9-4	N × R	Unshumikan	4	2	50.0%
N-9-4	N × R	Kihada	2	1	50.0%
R-28	R × R	Inuzansho	35	5	14.3%
R-16	R × R	Inuzansho	53	23 (ads.)	43.4%
R-15	R × R	Inuzansho	29	10 (ads.)	34.4%
N-9	N × N	Inuzansho	30	1	3.3%
N-9	N × N	Natsumikan	15	5	33.3%
N-9	N × N	Karatachi	2	1	50.0%
D-9-13	D × K	Inuzansho	4	2	50.0%
D-14	D × D	Inuzansho	49	32	65.3%

* Larvæ of this brood reared on mixed food plants were omitted from this table.

Miyamashikimi (*Skimmia japonica* Thunb.), Karasuzansho, Goju (*Evodia rutæcarpa* Hook. fil. & Thoms.), Kinkan (*Fortunella japonica* Swingl.), etc. Data indicate that while *P. protenor* larvæ have rather high survival rates on Inuzansho, *P. helenus* larvæ have rather low survival rates on it. *P. helenus* larvæ have higher survival rates on Natsumikan (*Citrus natsudaidai* Hayata) and Karatachi than on Inuzansho. The hybrids showed the same tendency as *P. helenus*. The hybrids also showed good development on Kihada.

Keeping these results in mind, and reconsidering the data on Table 2, the slower developmental rates of *P. helenus* and the hybrids between

P. protenor and *P. helenus* on Inuzansho in comparison with the other food plants may also indicate the unsuitability of foodplant.

P. bianor larvæ feed on Kokusagi (*Orixa japonica* Thunb.), Karasuzansho, Kihada, Sansho, Inuzansho, Karatachi, etc. and *P. maackii* larvæ feed on Kihada, Hirohanokihada, Karasuzansho, Hamasendan, etc. *P. maackii* does not seem to be able to feed on more kinds of foodplants than *P. bianor.* It is known that in Japan *P. maackii* is distributed in warm lowlands only where its food plants are found and is absent from other warm lowlands in which only the foodplants used by *P. bianor* are found (Shirozu, 1959).

The larval hybrids between *P. bianor* and *P. maackii* were reared on Inuzansho and fed on it readily. However, since Inuzansho is not a usual foodplant of *P. maackii,* this plant may not be the most suitable foodplant for the hybrid.

Expression of Interspecific Differences in Hybrids

1. *P. protenor* × *P. helenus.*

Larval differences between *Papilio protenor* and *P. helenus* are very slight. A detailed study of large series will be necessary to show the differences. The writer's superficial observations on each of more than 20 larvæ of the parental species and the hybrids during the rearings showed a somewhat prominent difference only on the 5th instar larvæ (Figs. 1b, 1c, 2b, 2c, 3b, 3c); the stripe on the 6th abdominal segment is almost or entirely discontinuous at three points on *P. helenus* and is continuous on *P. protenor.* This stripe on the hybrid is usually discontinuous, and therefore it resembles *P. helenus.*

Pupæ of *P. helenus* and *P. protenor* are distinguishable only on the mid-ventral bend, on which the angle is sharper on *P. helenus* than on *P. protenor* (Figs. 1d & 3d). Pupæ of the hybrids (Fig. 2d) seem to be indistinguishable from pupæ of *P. helenus.*

Most of the hybrids emerged during the summer. They are much smaller than summer forms of wild *P. helenus* and *P. protenor.* However, butterflies reared in a laboratory are usually smaller than wild butterflies. Therefore, a comparison should be made with laboratory reared specimens. Pupal lengths of the reared specimens were measured for this purpose. Table 4 shows the results. The hybrids are not necessarily smaller than the parental species according to these data, although more data are necessary for a final conclusion.

In all, 15 hybrid butterflies were obtained, 2 from Brood R-7-8, 10 from Brood R-16-8, and 3 from Brood N-9-4 (Fig. 2a). All of them were males and some of them failed to extend their wings fully.

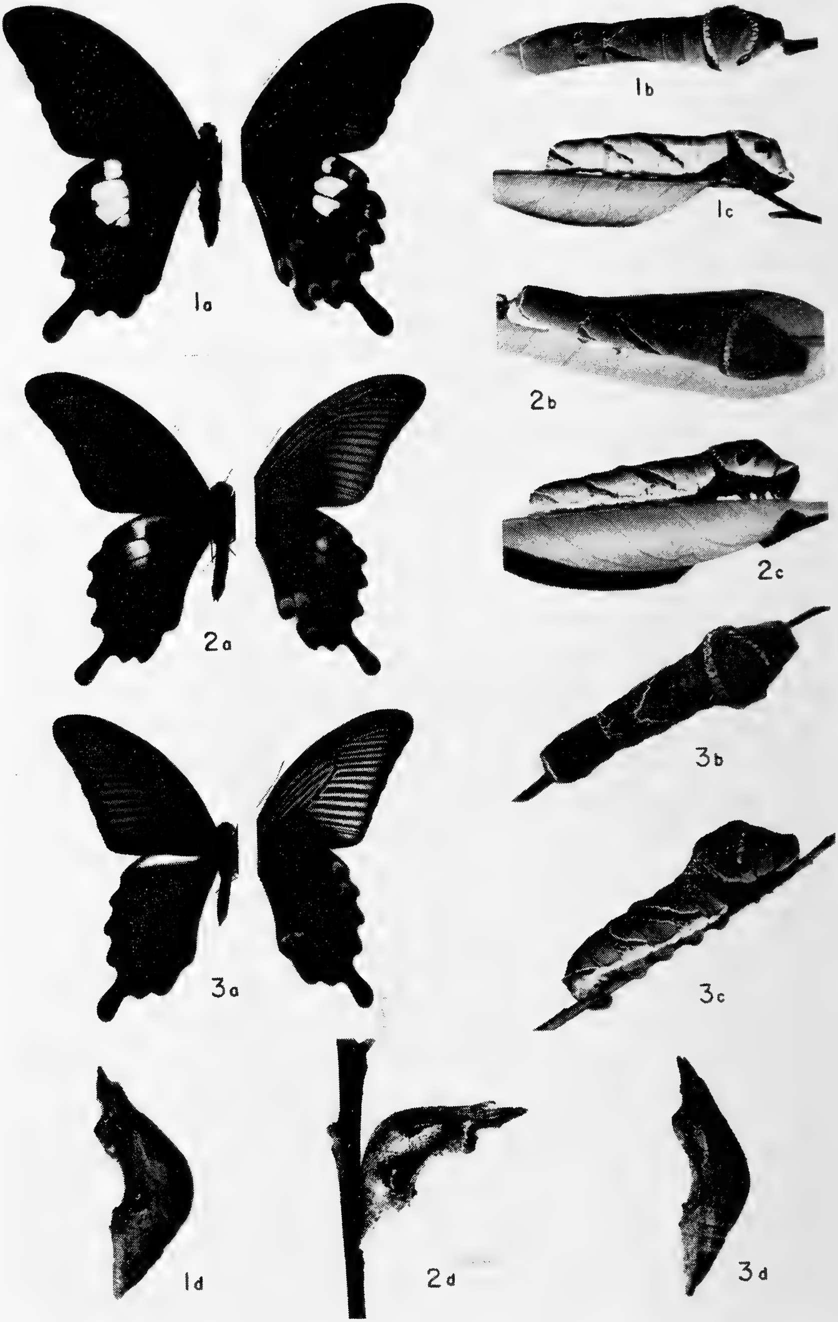
Table 4. PUPAL LENGTHS OF HYBRIDS AND PARENTAL SPECIES.

Brood	Kind of matings	Foodplant used	Pupæ obtained	Average pupal length (mm.)
R-7-8	R × N	Natsumikan	1	31.0
R-7-8	R × N	Unshumikan	1	34.0
R-7-8	R × N	Inuzansho	1	29.1
R-16-8	R × N	Natsumikan	5	31.38 ± 0.97
R-16-8	R × N	Karatachi	2	26.75 ± 4.31
R-16-8	R × N	Kihada	1	33.0
N-9-4	N × R	Unshumikan	2	27.55 ± 0.78
N-9-4	N × R	Kihada	1	30.1
R-16	R × R	Inuzansho	16*	35.64 ± 1.81
R-28	R × R	Inuzansho	5	29.64 ± 3.95
N-9	N × N	Natsumikan	5	33.02 ± 3.76
N-9	N × N	Karatachi	1	32.0
N-9	N × N	Inuzansho	1	30.9
D-9-13	D × K	Inuzansho	2	32.55 ± 0.91
D-14	D × D	Inuzansho	12**	33.48 ± 0.76

* Only part of the pupæ obtained were measured.

** Over-wintering pupæ were not measured.

The most prominent difference between adult *P. helenus* and adult *P. protenor* is the presence of white patches on the hind wings of *P. helenus*. These patches cover a part of cells Sc-R_1, R_2, and M_1, and extend quite often to a part of cells M_2, M_3, and M_4 (Fig. 1a). The "Comstock-Needham" system is applied here to name the cells. These patches do not exist in *P. protenor* (Fig. 3a), but in *P. protenor* the male has a white band in cell Sc-R_1 of the hind wing. The white patches of *P. helenus* are also seen on the under side of the wing, but the dorsal white band of *P. protenor* is not seen on the under side. These white patches and band appear in the hybrid, but their development is not as clear as in the parental species, especially on the boundaries of the patches and the band. In the hybrid the patch and the band on Sc-R_1 overlap but only partially; therefore the presence of both characters is


1a
1b
1c
2a
2b
2c
3a
3b
3c
1d
2d
3d

obvious. The white patches on cells M_2 and M_3 are very scant or disappear in the hybrids (Fig. 2a). In one hybrid specimen, all white patches are reduced to a trace on the under side of the wings, although they are clear on upper side.

The general shape of both the fore and hind wings is easily distinguishable between parental species. This shape in the hybrids resembles *P. helenus.*

All hybrids have more or less red scales on the basal parts of the white patches of the hind wings. These red scales are not seen either on *P. helenus* nor on *P. protenor.*

On the under side of the fore wing of both species, white scales are partially superimposed on the blackish scales which cover the whole wing. On the cells of R_5, M_1, M_2, M_3, and Cu_1 of *P. protenor,* white scales are superimposed on all areas except the wing margin and the central part of each cell (Fig. 3a). On the same cells of *P. helenus,* a scant white band of the same width is formed through the central part of each cell (Fig. 1a); therefore, no white scales are seen on the basal part of each cell, a clear difference from *P. protenor.* In the hybrids (Fig. 2a), the expression of these white scales is quite close to that of *P. protenor;* but the basal part of cell Cu_3 has no white scales, as in *P. helenus.*

On the abdomen of *P. helenus,* one lateral and three ventral white lines are usually distinct. The same lines are not clear or are absent on the abdomen of *P. protenor.* In the hybrids, the expression of these lines is somewhat intermediate between the parental species.

2. *P. bianor* × *P. maackii.*

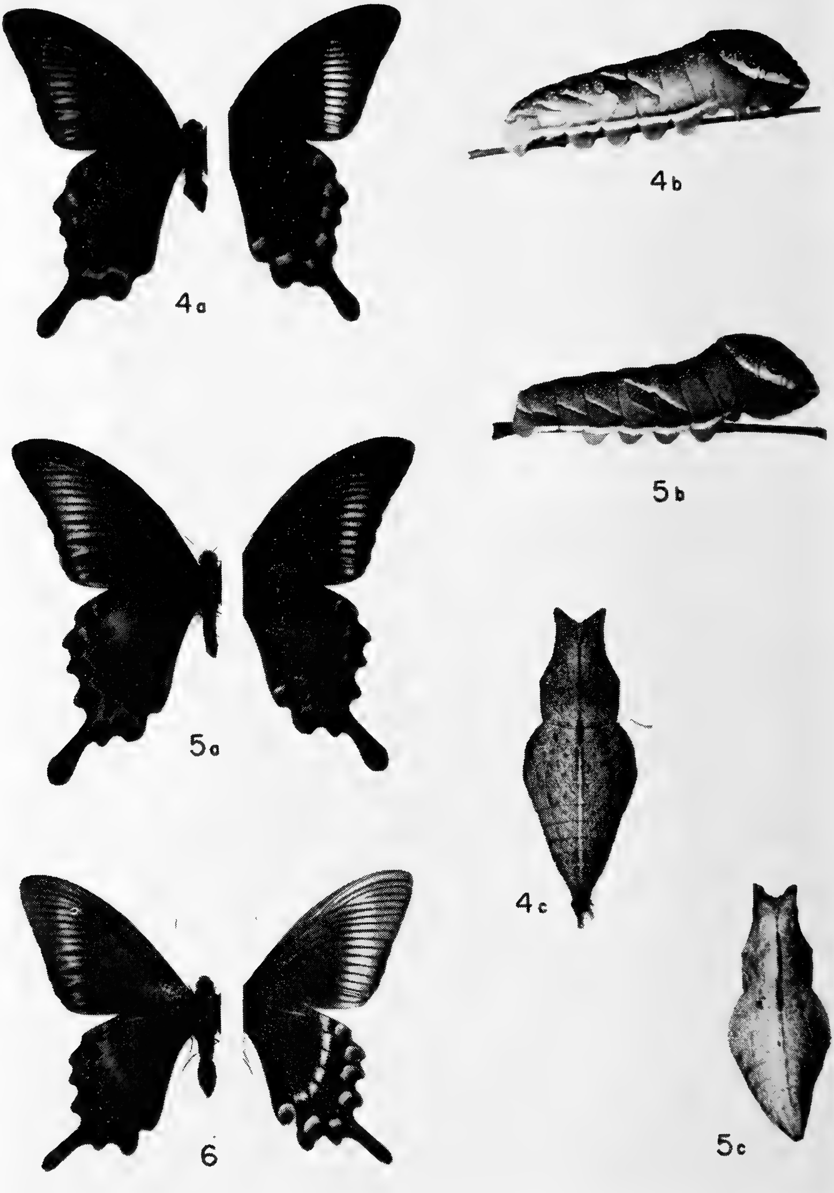
Larval differences between *P. bianor* (Fig. 4b) and *P. maackii* are very slight. Although there are many minor differences, the writer failed to compare them precisely, since he could not rear larvæ of *P. maackii* with *P. bianor* and the hybrid. The most prominent difference may be a pair of small processes at the 9th abdominal segment. These processes are more prominent in *P. maackii* than *P. bianor,* especially at the late larval stages. The hybrid seems to be intermediate or *maackii*-like (Fig. 5b).

EXPLANATION OF PLATE 1

PAPILIO HELENUS: 1a) adult ♂ (underside at right); 1b) mature larva, dorsal; 1c) same, lateral; 1d) pupa, lateral.

PAPILIO F_1 HYBRID (♀ *PROTENOR* × ♂ *HELENUS*): 2a) adult ♂ (underside at right); 2b) mature larva, dorsal; 2c) same, lateral; 2d) pupa, lateral.

PAPILIO PROTENOR: 3a) adult ♂ (underside at right); 3b) mature larva, dorsal; 3c) same, lateral; 3d) pupa, lateral.



PAPILIO BIANOR: 4a) adult ♂, summer form (underside at right); 4b) mature larva, lateral; 4c) pupa, dorsal.

PAPILIO F_1 HYBRID (♀ *BIANOR* × ♂ *MAACKII*): 5a) adult ♂, summer form (underside at right); 5b) mature larva, lateral; 5c) pupa, dorsal.

PAPILIO MAACKII: 6) adult ♂, spring form (underside at right).

The shapes of pupæ of *P. bianor* (Fig. 4c) and *P. maackii* are indistinguishable. However, coloration of pupæ is variable within and between species. Pupæ of *P. bianor* are usually green or brown, and the overwintering and non-overwintering forms are distinguishable. Besides these colorations, yellowish-brown and greenish-brown colors appeared in the writer's rearings. Yellowish-brown pupæ have a prominent median dorsal brown line, and this coloration resembles both of the hybrid pupæ (Fig. 5c) obtained. However, published figures of pupae of *P. maackii* seem to resemble more closely the hybrid pupæ.

The sizes of the two hybrids are smaller than wild summer specimens of *P. maackii* and most wild summer specimens of *P. bianor*. However, they are as large as *P. bianor* of Brood D-14 which were reared in the laboratory at approximately the same time as the hybrids.

Adults of *P. bianor* and *P. maackii* resemble each other very closely (Figs. 4a & 6). There is no single character which separates both species clearly. However, one can identify typical specimens easily. The characteristics which separate the species are as follows. 1) *P. maackii* generally has well developed bands of light color along the inside of the outermargin of the upper side of fore and hind wing; however, these bands become very scant or completely disappear from hind wing in some individuals. *P. bianor* lacks these bands completely. 2) *P. maackii* has a yellow band along the inside of the outer margin on the under side of the hind wing, and *P. bianor* never has this band. However, *P. maackii* lacking this band are sometimes found in the warmer regions of Japan. 3) A white band on the under side of the fore wing is wide at the apical area and becomes narrow toward the outer angle in *P. bianor*. This band has a uniform width in *P. maackii*. Since these characteristics of *P. maackii* are clearer in the spring form than in the summer form, a spring form is used for Fig. 6; the hybrids emerged in summer.

The expression of these characters in the two hybrids (Fig. 5a) obtained is as follows. 1) The bands of light color on the upper side are prominent in one individual and scant in the other. In both the boundaries of the bands are not as clear as in *P. maackii*. 2) The yellow band on the under side of the hind wing is absent in both. 3) The white band on the under side of the fore wing is somewhat wider toward the apical area and is intermediate between the condition in the typical parental species.

The Problem of Over-wintering

If *Papilio* larvæ are reared toward the end of the summer in a laboratory, usually part of the resulting pupæ emerge after a normal pupal period and others pass the winter and emerge the following spring.

In the writer's 1959 rearing, pupæ of Brood R-33 of *P. protenor,* which resulted from eggs laid at the middle of August, produced 6 adults from Sept. 13 to October 1; the remaining 14 pupæ overwintered. Pupæ of Brood N-9 of *P. helenus,* which resulted from eggs laid at the end of July, produced 5 adults from August 29 to Sept. 10; the 2 remaining pupæ overwintered. However, all three pupæ of Brood N-9-4 (hybrid *P. protenor* × *P. helenus*), which resulted from eggs laid at the beginning of September, emerged from October 21 to November 5. Although the data are still too small, the hybrid pupæ seem to lack the ability to "diapause", which is very important for survival of a species in winter.

Back-cross Attempts

Three hybrid males of Brood R-18-6 (*P. protenor* × *P. helenus*), which were reared on Natsumikan, were successfully hand-paired with females of the parental species. The first one copulated with a *P. protenor* female for about 30 minutes. The second also copulated with a *P. protenor* female, but this couple failed to separate from each other and were forced to separate after about 15 hours. These two females failed to lay any eggs. The third hybrid male copulated with a *P. helenus* female for about 1 hour. The formation of a spermatophore was observed from the outside just after separation. However, this female was very weak and died the next day without laying eggs.

One of the hybrid males between *P. bianor* and *P. maackii* was hand-paired with 2 females of *P. bianor,* Brood D-14. Both copulations lasted about one hour and the formation of spermatophores was confirmed just after the separation at the second mating. From the first and the second matings, 17 and 39 eggs respectively, were obtained. However, no egg turned black, and of course none hatched.

Discussion

The average egg fertility (35.5%) and the average egg hatchability (20.6%) of the hybrids between *P. protenor* and *P. helenus* may indicate that the relationship of the two species is not close. However, the high egg fertility (98.2%) and the somewhat high egg hatchability (82.3%) from one cross may indicate that at least some individuals of the two species still retain a somewhat close relationship. Since all 15 hybrid butterflies were males, Haldane's Rule applies in this hybrid combination. The female is presumed to be heterogametic in butterflies. The red scales on the basal parts of the white patches of the hind wing in the hybrid between *P. protenor* and *P. helenus* may be an example of an appearance of a concealed hereditary character through a change in gene background by a hybridization. If a hybrid lacks the ability to diapause, as the data suggest, this phenomenon would be an important factor in preventing the establishment of a hybrid population in nature.

Although the characters of the hybrids between *P. bianor* and *P.* maackii were clarified extensively by the two hybrid males obtained, the data are still too small to discuss the compatibility relation between the parental species.

Since *P. protenor* and *P. helenus* are sympatric in Japan, as are *P. bianor* and *P. maackii,* the existence of natural hybrids must be considered, although a hand-pairing by-passes normal courtship behavior completely, as previously stated. The writer sent photographs of the two kinds of hybrids to Dr. T. Shirozu, Kyushu University, and he wrote to the writer that he has never seen a specimen which resembles the writer's hybrid between *P. protenor* and *P. helenus,* but he has occasionally seen specimens which resemble the hybrid between *P. bianor* and *P. maackii.* Therefore, the difficulty in distinguishing wild *P. bianor* and *P. maackii* may be due partially to natural hybridization and resulting introgression.

Summary

1. Four fertile matings between *P. protenor* female and *P. helenus* male, one fertile mating by a reciprocal cross, and one fertile mating between *P. bianor* female and *P. maackii* male were obtained, using a technique of hand-pairing.

2. The durations of copulation in the hybrid matings were recorded, and those of the fertile matings lasted about one to two hours.

3. The average egg fertility in the five crosses between *P. protenor* and *P. helenus* was 36.5% and the average egg hatchability was 29.6%. The highest hybrid egg fertility was 98.2% and the highest egg hatchability was 82.3%.

4. The egg hatchability of the cross between *P. bianor* and *P. maackii* was 10.5%.

5. The developmental rates of the hybrids do not seem to differ extensively from the developmental rates of the parental species in the above two kinds of hybrid. Differences of developmental rate and larval survival due to foodplant differences were prominent in *P. helenus* and in the hybrids between *P. protenor* and *P. helenus.*

6. Characteristics of the hybrids between *P. protenor* and *P. helenus* and between *P. bianor* and *P. maackii* were compared to those of the parental species.

7. Haldane's Rule fits both hybrid combinations. All 15 hybrid *P. helenus* × *P. protenor* were males. The 2 hybrid *P. bianor* × *P. maackii* were also males.

8. The pupæ of the hybrid between *P. protenor* and *P. helenus* seem to lack the ability of diapause.

9. Three back-cross hand-pairings using the F_1 hybrids between *P. protenor* and *P. helenus* and two using a F_1 hybrid between *P. bianor* and *P. maackii* were obtained, but no eggs hatched and no fertilization could be found.

10. Existence of natural hybrids between *P. protenor* and *P. helenus* and especially between *P. bianor* and *P. maackii* must be considered.

ACKNOWLEDGEMENT

The writer wishes to express his sincere gratitude to Dr. CHARLES L. REMINGTON, Department of Zoology, Yale University, for reading this paper in manuscript and to Rev. FRANCIS BURES, S. V. D. for help in writing this paper. He is also grateful to Dr. T. IWASE and Mr. M. TAKAHASHI for help in collecting *P. helenus,* to Dr. T. SHIROZU for examination of the pictures of the writer's hybrids. A fund was supplied from the Ministry of Education in Japan in 1959.

Literature Cited

Ae, S. A., 1960. A study of hybrids between *Papilio xuthus* and the *P. polyxenes-machaon* group. *Journ. lepid. soc.* 14: 5-18, 2pls.

Clarke, C. A., & P. M. Sheppard, 1953. Further observations on hybrid swallowtails. *Entomologist's record* 65, supplement: 12 pp., 7 pls.

..............., 1955a. A preliminary report on the genetics of the *machaon* group of swallowtail butterflies. *Evolution* 9: 182-201, 5 figs.

..............., 1955b. The breeding in captivity of the hybrid swallowtail *Papilio machaon gorganus* Fruhstorfer ♀ × *Papilio hospiton* Gene ♂. *Entomologist* 88: 266-270, 4 pls.

..............., 1956a. A further report on the genetics of the *machaon* group of swallowtail butterflies. *Evolution* 10: 66-73, 1 fig.

..............., 1956b. Hand-pairing of butterflies. *Lepid. news* 10: 47-53, 3 figs.

Remington, C. L., 1958. Genetics of populations of Lepidoptera. *Proc. X. int. congress ent.* 2: 787-805, 13 figs.

..............., 1960. Wide experimental crosses between *Papilio xuthus* and other species. *Journ. lepid. soc.* 13: 151-164, 3 pls.

Shirozu, T., 1959. [The section of butterflies.] *Iconographia insectorum Japonicorum colore naturali edita*: Vol.1 (Lepidoptera).

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COLLECTING SPHINGIDÆ WITH A MERCURY VAPOR LAMP

by Richard W. Holzman

During the summer of 1959 a mercury vapor lamp was placed against a building near Columbiaville, Michigan, to note the effects of the light on Sphingidæ. The studies led to the design of a suitable light trap.

It was found that when a Sphinx sees the light it will approach it at a slow rate, flying close to the earth, sometimes with occasional stopping on the ground but still maintaining a rapid beat of the wings. The moth will approach until it comes very close to the light, stopping from one to four feet away. At a few hundred feet from the trap, observing the flight of the Sphingidæ approaching the light, it was seen that the moth never makes a spiral flight as thought by some collectors, but rather a seeming "bee-line." After the Sphinx was near to the light it would settle. When it had finally come to rest and had remained for about 15 minutes, it would appear to be in a rather drowsy condition. The lamp used is capable of 10,000 lumens; this means that at one foot the light is about equal to the intensity of the sun. It then follows that the moth would take this light to be the sun's and "sleep". Some of the moths that had been attracted to the light were released a number of feet away to see if they would return; most of them did return, showing that once the moth had seen the light it would just be a matter of time before it would land near it.

Since the use of the intense light source solved the problem of attracting the moths, the next step in preparing the trap was to find a way to group the attracted moths in a small space. It was decided that the simplest way to do this would be to let them fly into a small open box, the light being at the top of the opening. This box was 2′ × 2′ × 2′ and made out of one inch wood sticks forming a skeleton. After the wooden skeleton had been made, a round piece of sheet metal, 3 feet in diameter, was placed on top of the wooden framework. From the center of this piece of metal a circle, 2′ in diameter, was cut out. This hole was to be the entrance for the moths. The lamp was then mounted using a mogul base attached to a square piece of wood placed perpendicular to the center of the base of the box. The center of the lamp was 8″ from the top of the box. After the lamp and doughnut-shaped metal disc were mounted, a solid piece of sheet metal, 3′ in diameter, was mounted 16″ from the top of the box. This final stage has 3 purposes: first, to protect the lamp against rain, as it becomes very hot and he cold water could very easily crack the glass; secondly, to protect any moths against the rain so that they would stay in the trap and not fly off; and, finally, to use the bright surface as a mirror, directing intense light to all corners of the trap. Cloth 2′ × 2′ was tacked by its corners to the open trap. The purpose of the cloth was to form the sides of the box and also to give something for the moths to land on. Other materials such as screening or wood could have been used, but cloth is easiest to store when the trap is being moved.

The light that was used for the trap was a G. E. H 250-A5 mercury vapor lamp. To operate this lamp 240 volts at about 2 amps was needed. The power for the lamp was carried by 550′ of government surplus telephone cable. Although not the best, it was inexpensive and did not result in too great a voltage drop.

This trap, obviously, was by no means portable, the way some collectors like their units to be. The trap was very bulky, and the huge roll of cable was difficult to roll up after the summer's use. Also, all the electrical equipment, when mounted in one box, weighed about 80 pounds. So it can be seen that the trap would need modification for those who do spot collecting. Since the trap was at one location all summer, moving was not a prime consideration.

The trap was operated near a small forest, 1000 by 200 yards, 2 miles north of Columbiaville, in Lapeer County, Michigan.

The lamp was operated from about 9:30 in the evening till about 7:00 the next morning. The greatest noted occurance of Sphingidæ was from one to one-and-a-half hours after dusk. Though the light was allowed to run all night, very few moths were found in the morning (about 25 for the entire summer, the total catch being 288). This low number has partially been credited to the birds, as the remains of wings were sometimes found at the trap, the number depending on the results earlier in the evening. During the summer of 1959 the number found in the morning was about 40, and the total catch for 1959 was 190. No explanation has been found for this difference. It was thought that all moths attracted would fly or crawl inside the box. This did not happen; only about 50% were found there. The remaining ones were found very near to the trap.

During the entire summer of 1960 a complete record of the results was kept. It included the species and number of each caught that night and the weather for each day and night. For the period from June 25 to August 27, 1960, 288 Sphingidæ were taken, compared with 190 for 1959.

The following is a list of Sphingidæ and total of each species for the years of 1959 and 1960.

	1959	1960
Pholus pandorus	3	2
Phlegethontius quinquemaculatus	13	7
Ceratomia amyntor	8	8
undulosa	12	12
Sphinx chersis	5	4
gordius	6	2
drupiferarum	—	2
luscitiosa	—	1
eremitus	—	4
kalmiæ	1	—
Lapara bombycoides	14	13
Smerinthus jamaicensis	17	32
cerisyi	—	7
Paonias excæcata	56	85
myops	29	45
Cressonia juglandis	4	25
Pachysphinx modesta	8	7
Darapsa versicolor	3	4
myron	8	21
pholus	1	3
Celerio lineata	1	3

Careful examination of this table will yield many interesting facts. The only moths that were less common during 1960 than 1959 were *P. quinquemaculatus* and *S. gordius*. The other 4 decreases were only by one specimen. Moths that were much commoner in 1960 than 1959 were *S. jamaicensis*, *P. excæcata*, *P. myops*, *C. juglandis*, and *D. myron*. It should be noted that these increases are rather large. One *S. kalmiæ* was found in 1959 but none during 1960. Moths found in 1960 but not in 1959 were *S. drupiferarum*, *S. luscitiosa*, *S. eremitus*, and *S. cerisyi*. This discussion was not meant to conflict with itself but to show the advantage of using a trap rather than a bare lamp.

Among the other things caught were: 28 Saturniidæ, 40 *Catocala*, with some 300 Arctiidæ and 200 Noctuidæ. Thousands of other moths were observed as well as many beetles, wasps, and flies and an occasional swarm of small flying insects. Bats were also found along with a few toads and frogs who came to feast on the multitude of small insects.

The time of collecting and weather have a great deal to do with collecting. Note the following:

PERIOD	CATCH PER DAY							TOTAL	AVG. WEATHER
June 25-July 1	8	6	21	8	6	2	3	54	warm
July 2-8	4	0	2	–	4	2	2	14	cool
July 9-15	11	10	22	28	–	–	7	78	warm to hot
July 16-22	2	9	9	10	–	0	11	41	warm
July 23-29	7	5	7	4	6	13	5	47	warm
July 30-Aug. 5	4	6	4	7	2	2	0	25	cool
Aug. 6-12	7	0	0	–	0	1	–	8	cold
Aug. 13-19	4	2	1	2	4	1	1	15	warm to cold
Aug. 20-26	3	1	2	0	0	0	0	6	cold

The dash – indicates that the lamp was not operated, due to rain or various other reasons. The best nights for collecting were those following a warm, muggy, and cloudy day. The worst results were when sunny days were followed by clear cold nights. The best season for collecting was during July, the peak day being on July 12 (peak for 1959 was on July 4).

It is my opinion, therefore, that the trap described is the best method for the capture of Sphingidæ and most other moths. It is possible that other methods have resulted in a better *total* catch. However, it should be remembered that the locale was mostly northern farm land, not as rich in moths as in many of the southern regions.

It should be noted that this paper brings forth no scientific theory. The entire project was formed from the knowledge that during the night moths are attraced to light. In the future I hope to use my collecting techniques to make a study of why this happens.

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ESPECIALLY FOR FIELD COLLECTORS

(Under the supervision of FRED T. THORNE, 1360 Merritt Dr., El Cajon, Calif., U.S.A.)

THE CHLOROCRESOL METHOD FOR FIELD COLLECTING

by NORMAN B. TINDALE

For some years entomologists at the South Australian Museum, in Adelaide, Australia, have been using a novel method to preserve insect specimens, including butterflies, moths, and grasshoppers, as well as run-of-the-mill insect collections such as are gathered in the course of trapping with the aid of mercury vapor lamps. Because of the many specimens to be handled, new and rapid methods of preservation were necessary. At first the rather odorous chemical, tri-chlor-phenol, which is a substance of a dirty sugar-like appearance, was used. This was very useful in inhibiting development of moulds in containers with freshly killed specimens. Using refrigeration it was possible after sealing up the cans to keep them for several weeks without apparent deterioration, then take and set them up without necessity of relaxing in moist air.

When adopted by private collectors the odor of the preservation was not such as to encourage good home relations when the domestic refrigerator was used by the entomologist.

A casual shortage of tri-chlor-phenol later led Mr. R. H. FISHER to experiment by using granular crystals of Chlorocresol (name registered in the British Pharmacopeia). This almost inodorous chemical was an instant success, revolutionised collecting techniques, and has enabled the development of a quite novel method of preserving specimens in the field.

As currently developed, the system is as follows:—One takes a small flat container which can be sealed and places about a teaspoonful of Chlorocresol in the bottom. This is held in place with a thin layer of cotton covered by face tissue or other soft paper. Most collectors of butterflies will find that rectangular sandwich boxes of clear plastic, about five inches square and one and a half inches high, are ideal. These are on sale in drug stores in most cities. The freshly killed specimens are laid on the tissue just so they do not touch each other. A pencilled label is dropped in, a layer of tissue added, and so on in alternate succession of layers until the container is full. If the boxes have been prepared a day or so ahead of time the tissues will be sufficiently saturated with the vapours of the Chlorocresol that the container can be sealed immediately, using from one to three layers of Scotch Tape as sealer. In very hot humid weather it may be advisable to delay sealing the containers until night time when the atmospheric humidity is less. Under desert conditions the container should be sealed immediately so as to avoid undue loss of moisture. Assistants engaged in spreading specimens from the Great Western Desert of Australia noted that the cans which contained one or more large grasshoppers in addition to other insects arrived in particularly well relaxed condition indicating that the degree of moisture originally sealed in is important. The boxes should be kept out of the sun and away from heat to avoid possible over-volatilisation of the Chlorocresol and its subsequent recrystallisation. When home base is reached the containers may be kept in a refrigerator, so long as the sealing is adequate to ensure no loss of humidity.

The present writer used the method, for example, while collecting Lepidoptera in the United States during the Summer of 1959. A year later, after carrying them to Australia he is still able to open the sealed containers, and to take out what appear to be practically fresh material ready for mounting, it being only necessary to place them at once in a damp atmosphere to ensure that they do not dry out while awaiting their turn for spreading upon the drying boards.

Little discernable deterioration takes place in the specimens over long periods of time. It has become standard practice at the South Australian Museum to mail containers back to the institution where they are kept chilled until they can be processed. For such field work the square flat cans with hinged lids, used for packing pipe tobacco, are ideal, because they are unbreakable. Our cans are all prepared in advance of the expedition. Using the Chlorocresol method fresh material may be held for several months or even almost indefinitely. A very sensitive test of the usefulness of the method is shown by the fact that it is usually possible to hold Geometrid moths of delicate fugitive green and blue colors for many weeks without damage.

A virtue of the transparent plastic containers is that labels can be placed inside the boxes so as to be visible from outside the container. No breaking of seals is necessary until the specimens are to be processed. Good brands of plastic container are sufficiently strong to travel through the mails with minimum likelihood of damage and the fact that the specimens remain relaxed also helps to prevent damage. Care must be taken that the containers are so filled that no movement can take place.

During the past year it has been possible to send newly taken material from Australia to the United States for processing and also to have material taken in the island of Timor, carried for several days by jeep in the field, flown to Australia, and processed at the South

Australian Museum more than a month later, as fresh as though it had just been captured.

During a recent visit to the United States difficulty was encountered in finding suitable supplies of Chlorocresol. In Australia several chemical companies stock it. The most suitable grade is in the form of a white granular substance like sugar. This is sold, for example, by D. H. A. Laboratories, Pty. Ltd., Sydney, N. S. W., Australia, and costs approximately $7 per pound. This quantity should be sufficient to keep the average collector supplied for several years. Much of the chemical agent can be reclaimed from old containers, as there is little loss by evaporation.

The present writer's speciality is the study of the primitive moths of the family Hepialidæ. Freshly killed insects of this family can be sent to him from many places packed in this manner and arrive in perfect condition whereas previously their heavy bodies and brittle wing tissues made it difficult to ship dried and spread specimens without risk of injury.

South Australian Museum, Adelaide, AUSTRALIA

SPRING COLLECTING IN MEXICO: THE GOMEZ FARIAS REGION OF SOUTHWESTERN TAMAULIPAS

by Thomas C. Emmel

The lepidopterist traveling to Mexico generally chooses to plan his trip during the summer months of July to September in order to collect at the peak of the flight season, for after the summer rains have begun, even the most unobservant *tourista* cannot help but notice the great – often incredible – numbers of butterflies along the highways.

In the spring of 1959, the author was able to experience a different kind of collecting – traveling on a 5,000 mile expedition with L. Irby Davis, Research Associate of the Cornell Laboratory of Ornithology, into remote areas along the eastern coast of Mexico and the Yucatan Peninsula in the height of the dry season.

One of the most interesting collecting areas – and one that is readily accessible in a one-day journey from Texas – was in southwestern Tamaulipas, around the village of Gomez Farias. The dirt road to the village is found about 106 kilometers (64 miles) south of Ciudad Victoria on Highway 85 but we continued on the main highway to El Limon where we bought gas and supplies and then retraced our route 19.6 km. and turned west at the marked dirt road.

The rich farmlands around El Limon and Mante extended along the highway and for two kilometers on the Gomez Farias road. Principal crops were sugar cane, oranges, bananas, and papayas. At this season, the dry forest beyond the cultivated areas was leafless and indeed seemed lifeless; acacias, mesquite (*Prosopis*), and other thorny trees formed much of this lowland (elevation 200 to 300 feet) forest. Doubtless in the summer this forest abounds with Lepidoptera, but not in March.

At 9 kilometers we began to climb through the foothills of the Sierra Madre Oriental and the verdant forest became more dense and tropical; wild pineapples (*Bromelia pinguin*) grew under the trees in extensive patches. At 10.3 kilometers, collecting proved outstanding. Four species of Papilionids were collected in practically as many minutes: *P. pilumnus* Bdv., *Battus polydamus* L., a red-spotted species, and a demure, blue-spotted tailless papilio.

Pierids of every size and description fluttered by the collector in a bewildering array. *Eurema* species, including *gundlachia* Poey (*proterpia* spring form), *boisduvaliana* Feld., *nicippe* Feld., *mexicana* Bdv., *salome* Feld., and *daira* Latreille, mingled with *Colias cesonia* Stoll, *C. eurytheme* Bdv., and *Nathalis iole* Bdv. Pure white *Ascia* with the ever common *Pieris protodice* L. often managed to distract one's attention from the rare yellow females of *Pieris viardi* L. and its more common white males.

Giant *Anteos clorinde* Godart and *A. mærula* Fabricius floated high overhead; several *Adelpha* (nymphalid) species darted out at frequent intervals as if to challenge the collector's intrusion. A single fresh *Smyrna karwinskii* Geyer was taken (March 5) in this area; three or four heliconiid species swarmed about the blooming vines, along with *Dione butleri* Stich. and many *Phyciodes*. The prize species seen (but not collected) was *Speyeria nokomis cœrulescens* Holl. (?) – a perfect pair.

From here we moved on up the road four kilometers to the small town of Gomez Farias and the vegetation became more and more tropical; bananas and coffee trees grew out to the edge of the road. We found Gomez Farias a beautiful (and attractively clean) native Mexican village with huts of branches and thatched roofs. The people waved merrily as we passed by, and, as we found most everywhere in Mexico, courtesy extended to the Mexican citizen is returned in the friendliest manner.

Beyond the village the "road" became little more than a wide trail, passable only with a four-wheel drive in the lowest gears. The elevation increased sharply and we passed through lush tropical forest, where tangled lianas and Strangling Figs (*Ficus cotinifolia*) cascaded down in a confused maze from the towering tree-tops. Although we noticed only one worn *Morpho peleides* Koll., Sutton (1942) mentions that his ornithological party "frequently" observed them (March to May) in the lowland forests. Heliconiids, *Metamorpha stelenes* L., *Marpesia chiron* Fabr., and *Dryas* species swarmed along the roadside; the purple sheen of *Eunica monima* Cramer and *Myscelia ethusa* Bdv. flashed in the sunlit clearings, while back in the shadowy thickets delicate *Mestra* and satyrs floated cautiously. Occasionally a *Hamadryas* butterfly would dart with a sharp clicking noise from its camouflaged position on white bark. The brilliant yellows and oranges of *Phœbis* species (*P. sennæ* L. and *agarithe* Bdv. being the most common) created artificial patches of sunlight in the dark greenery. Several *Dismorphia cornelia* Feld. seemed to stumble awkwardly through the humid air in comparison with the rapid, smooth flight of the dark *Papilio* just beneath the forest canopy.

Soon, though, the road climbed to 3,200 feet and we entered part of the most northern cloud forest in Mexico. Tall, slender Sweet-gum trees were just coming into leaf during our visit; epiphytic bromeliads and small orchids were visible on the larger branches. We worked this area for several days, but fewer butterflies were flying than at the lower elevations. Common genera were: *Thecla, Phyciodes, Adelpha, Emesia* and other metalmarks, and *Pieris*. Several nice specimens of the oriental-looking *Catasticta nimbice* were taken, along with various satyrid species, *Celastrina argiolus*, and *Chlosyne janais* and *lacinia*.

We were fortunate in having generally good weather – morning clouds in the cloud forest areas but mostly sunny with the daytime temperatures ranging between 80° and 85°F. in the foothill region. At the higher elevations (3,600 feet) the night temperatures would drop to around 40°.

Although only five days were spent in this area of Tamaulipas, both ornithological and lepidopteral objectives were achieved. We recorded the voices of several resident birds and collected the imagos of many butterfly species, as well as keeping data on all species seen. We found that good collecting in northern Mexico is possible in the dryest part of the year, and the closeness of the Gomez Farias region to the United States border would seem to make a trip in this "off" season both feasible and worthwhile to collectors who wish a taste of the tropics.

Reference

Sutton, G. M., & O. S. Pettingill, Jr., 1942. Birds of the Gomez Farias region, southwestern Tamaulipas. *Auk* 59: 1-34.

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MINUTES OF THE SEVENTH ANNUAL MEETING OF THE PACIFIC SLOPE SECTION OF THE LEPIDOPTERISTS' SOCIETY

The meeting was called to order at 10 A.M., 27 Aug. 1960, by Dr. J. W. Tilden who presided at the opening session. Excellent facilities were provided in the Morrison Auditorium of the California Academy of Sciences in Golden Gate Park, San Francisco. Fred Thorne was elected Secretary-Treasurer *pro tem.* C. Don MacNeill extended a cordial welcome on behalf of the California Academy of Sciences.

Dr. Walter Forster, President of the Lepidopterists' Society, expressed his pleasure in being able to attend in person. His Presidential Message on the butterfly fauna of the Andean Cordillera appeared in the previous issue of the *Journal.*

The first invitational paper was presented by Dr. Thomas F. Leigh who told of basic field research for the University of California on the activities of *Colias eurytheme philodice* in response to physical environment. Flight occurs when body temperatures range from 70°F. to 95°F. as determined by thermocouples inserted through the anal end into the body. Air temperature, solar radiant energy, light intensity and relative humidity were all shown to influence field behavior of the butterflies. This interesting study was well conceived, using good instrumentation, and the results were ably presented with the help of colored slides and charts.

George T. Okumura, systematic entomologist with the California Bureau of Entomology, explained why specific determination of lepidopterous larvæ is essential in control programs. With a series of excellent diagrams he showed those particular morphological characters which are used to separate a number of families of Microlepidoptera, and those which can be used in distinguishing between closely related larvæ which infest fruit trees in California. He pointed out that the study of immature stages of Lepidoptera has attracted only a few serious students despite the usefulness of this information to economic entomologists and systematists, and urged greater interest in this work.

Paul Opler reported on a novel collecting arrangement with Keith Hughes and Ray Stanford, who worked as a team. By covering different areas of the state and dividing the catch during the 1959 and 1960 seasons, these three collectors obtained some 90% of the species recorded from California. A chronological record of areas visited and species taken was given, with precise locality records for choice species. A fascinating commentary on how to select collecting areas brought forth interesting discussion from the members present. There was agreement that liberal sharing of collecting information is most advantageous to all.

ELTON SETTE discussed the work that he and others have done on the various taxa in the genus *Mitoura* in southwestern United States. Efforts to find where *M. loki* and *M. siva juniperaria* may overlap have been fruitless thus far. *M. nelsoni muiri* appears to replace the *siva* moiety in similar ecological situations in central California. A fine series of colored slides showed distribution, habitats and examples of the taxons under discussion. This stimulating talk resulted from careful observations and data secured on numerous field trips and points up the large amount of field work which may be necessary for future taxonomic studies.

STANLEY JEWETT JR. offered some preliminary ideas on the challenging genus *Euphydryas*. The *anicia, editha* and *chalcedona* groups present the greatest difficulties, and this point was well presented and illustrated by colored slides. He pointed out that the problems cannot be fully appreciated unless the marked changes in habitats within short distances in the west are appreciated. Now that he has completed certain taxonomic work on the stoneflies, Mr. JEWETT plans to undertake extensive studies of this perplexing group.

The balance of the afternoon was spent in examining the extensive collections of Lepidoptera in the California Academy of Sciences entomology rooms. Mr. MACNEILL assisted members in finding any material of special interest to them.

A large group of members and their wives met for the annual banquet in one of the colorful restaurants in Chinatown, where everyone enjoyed this novel evening in exotic surroundings.

The program on the following day opened with the business meeting with Mr. SETTE presiding. Resolutions were passed thanking Dr. FORSTER for his attendance and the Program Chairman and his committee for an excellent program. The secretary was instructed to send letters of appreciation to Mr. W. LEVI PHILLIPS for his kind donation of the printed programs; to the California Academy of Sciences for the fine facilities provided; and to those whose papers were presented *in absentia*.

A suggestion that western meetings be held alternately in southern and northern California was well received. It was further suggested that an informal headquarters, where members and their families could gather during the meetings, might be designated by the local arrangements chairman. After lengthy discussion the Natural History Museum in Santa Barbara was selected for the meeting place in 1961 on August

26 and 27. The secretary was instructed to send a letter of appreciation to the San Diego Society of Natural History Museum for their cordial invitation extended by Mr. HARBISON, to hold the 1961 meeting there. Mr. LLOYD MARTIN was unanimously elected as Program Chairman, and NELSON BAKER, Chairman of Local Arrangements.

A resolution was adopted unanimously that each person who participated in the program should furnish a brief summary of his paper to the secretary for inclusion in the minutes. The question of whether proceedings of the meeting should be published was discussed, but no action was taken, nor did any action result from a discussion about requesting that the annual meeting of the Lepidopterists' Society be held in the western area. A motion that ways and means be studied to increase the income of the Society through creation of a patron class of membership, rather than increasing dues, was passed, and the secretary was instructed to communicate with appropriate persons on this subject.

LLOYD MARTIN gave the first paper of the day on the noctuid genus *Acontia*. Species in this interesting genus of moths cannot be separated reliably on the basis of color or maculation, but the value of the genitalia for specific determination was shown in a series of remarkable slides. Besides giving a comprehensive report on the North American *Acontia*, Mr. MARTIN also explained some of the techniques used in making genitalic slides and photographing these.

Dr. WILLIAM HOVANITZ gave a preliminary report on some unusual studies where species of pierids were raised on food plants normally more favored by other members of the genus. Within a few generations initial mortalities in the range of 95% were reduced to 5%, showing rapid accommodation to host plants not normally accepted in nature. Several facets of this significant work were discussed.

Dr. WALTER FORSTER presided at the afternoon session which began with the reading by Dr. TILDEN of a paper prepared by Dr. E. L. TODD of the U. S. Department of Agriculture, Washington, D. C., on moths of the genus *Gonodonta*. These are economically important because of the unusual ability of the adults to pierce the skin of fruits, resulting in rapid decay. While most *Gonodonta* are Mexican, four species occur in Florida and two in Texas, one of which ranges to California. In addition to preparing this fine paper, Dr. TODD was also kind enough to furnish copies of his bulletin on this genus for distribution to members.

JERRY POWELL presented the final paper of the meeting on the bionomics of California Tortricinæ. He gave a careful account of classification, seasonal life histories, food preferences, behavior, and other information on members of this subfamily which is represented by about 54 species in the state. A series of excellent slides was used to show life histories, and other aspects of this economically significant group.

The meeting adjourned in late afternoon with Dr. FORSTER expressing appreciation to those who had participated in the program. Dr. TILDEN voiced the gratitude of the group to Dr. FORSTER for his attendance and participation in the meeting.

The following members were present:

ROBERT ANDERSON	CHARLES HARBISON	JOHN MONTGOMERY
WILLIAM BAUER	RICHARD HART	PAUL OPLER
JOHN BUCKETT	WILLIAM HOVANITZ	DARRELL OWEN
JOHN BURNS	STANLEY JEWETT, JR.	JERRY POWELL
THOMAS DAVIES	NOEL LADUE	ELTON SETTE
J. R. EYER	ROBERT LANGSTON	JAMES SHIELDS
WALTER FORSTER	DON MACNEILL	FRED THORNE
WILLIAM HAMMER	LLOYD MARTIN	J. W. TILDEN

There were fifteen guests.

Respectfully submitted,
FRED THORNE
Secretary-Treasurer *pro tem.*

POWELL COLLECTION

The California Insect Survey of the Department of Entomology and Parasitology, University of California, Berkeley, is now in the process of accessioning the JERRY A. POWELL insect collection, consisting of about 33,200 specimens. The collection, accumulated during the years 1946-1960, is primarily Lepidoptera, containing over 14,000 pinned and over 4,000 papered specimens of this group, in addition to some 1400 preserved larvæ associated with rearing data. It is particularly rich in California Microlepidoptera and butterflies and includes paratypes of nearly all species described by POWELL, as well as the material basis for papers published on Baja California Norte Lepidoptera.

RECENT LITERATURE ON LEPIDOPTERA

(Under the supervision of Peter F. Bellinger)

B. SYSTEMATICS AND NOMENCLATURE

Bourgogne, J., "Mise au point relative à deux psychides éthiopiennes, *Acanthopsyche brunnescens* Gaede et *Kotochalia junodi* Heylaerts (Lepidoptera Psychidæ)" [in French]. *Bull. Inst. franç. Afrique noire* (A), vol. 21: pp. 1227-1236, 14 figs. 1959. The specific name *brunnescens* is a synonym of *junodi,* but this name may be conserved for the subspecies of West Africa. Fixation of a lectotype for *K. junodi.* [P. V.]

Bourgogne, J., "La position systématique de *Psyche calamochroa* Hampson (Lep. Psychidæ)" [in French]. *Bull. Soc. ent. France,* vol. 65: pp. 100-102, 5 figs. 1960. Note on the systematic position of this African psychid. The species belongs to the genus *Acanthopsyche.* [P. V.]

Bourgogne, J., "Remarques sur le genre *Monda* et sur l'espèce *Monda major* Heyl. Lep. Psychidæ)" [in French]. *Rev. franç. Ent.,* vol. 27: pp. 231-235, 8 figs. 1960. Notes on *Monda* Walker and the species *M. major;* this last is very near an *Oreopsyche.* [P. V.]

Boursin, Ch., "Eine neue *Euxoa* Hb. aus Spanien (Beiträge zur Kenntnis der 'Noctuidæ-Trifinæ', XCVIII (98)" [in German]. *Zeitschr. wiener ent. Ges.,* vol. 43: pp. 128-133, 152, 2 pls., 1 map. 1958. Describes as new *E. psimmithiosa* Huelva, Seville Prov., Spain). [P. B.]

Boursin, Ch., "Erwiderung an Herrn Agenjo zu seiner 'Antwort an Herrn G. Meyer betreffs Übergänge in der Genitalarmatur von *Bryophila algæ* (Fabricius 1775) und ihrer forma *pallida* (Bethune-Baker 1894) (Lep. Phal.)' in dieser Zeitschrift, 1957, p. 192. (Beiträge zur Kenntnis der 'Noctuidæ-Trifinæ', XCIX (99)" [in German]. *Zeitschr. wiener ent. Ges.,* vol. 43: pp. 176-181. 1958. Maintains that *algæ* & *pallida* are different spp.; points out genitalic differences, & denies that Agenjo's specimens show intergradation. [P. B.]

Boursin, Ch., "Eine neue Form von *Euxoa* (*Chorizagrotis*) *drewseni* Stgr. (Beiträge zur Kenntnis der 'Noctuidæ-Trifinæ' 101)" [in German]. *Zeitschr. wiener ent. Ges.,* vol. 44: pp. 169-171, 1 pl. 1959. Discusses systematic position, figures genitalia; describes new "form" from Greenland. Regards *dissona* & *westermanni* as true *Euxoa* spp. [P. B.]

Boursin, Charles, "Über zwei für Europa neue *Hadena*-Arten (=*Dianthœcia* B.), *Hadena clara* Stgr. (1901), *bona sp.!* und *Hadena urumovi* Dren. (1931), (1931), *bona sp.!* Beiträge zur Kenntnis der 'Noctuidæ - Trifinæ', C (100)" [in German]. *Zeitschr. wiener ent. Ges.,* vol. 44: pp. 113-131, 7 pls. 1959. Redescribes these spp., which have been confused with *H. cæsia,* & reviews races of the 3 spp., with new synonymy & new placement of some names. Describes as new *H. cæsia bulgarica* (Karlovska Hischa, above Karlowo, Jumruk-Tschal, 1800 m., Bulgaria) (=*urumovi* auctt.), *H. clara macedonica* (Petrina planina, 1600 m., Macedonia) (=*xanthophoba* auctt.), *H. clara alpina* (Aiguilles, Vallée du Quayras 1400-1500 m., France), *H. clara dujardini* (St. Martin-Vésubie, Alpes-Maritimes, 1000 m., France), *H. clara kuruschensis* (Kurusch, Schakh-Dagh, 2500 m., Dagestan), *H. u. scotophoba* (Drenovo, near Kavadar, S. Macedonia), *H. u. germaniciæ* (Marasch, Taurus, 1200 m.). [P. B.]

Boursin, Ch., "Nouvelles 'Trifinæ' d'Afghanistan de l'expédition Klapperich (3ème note) (Lep. Noctuidæ) (Diagnoses préliminaires)" [in French]. *Bull. mens. Soc. linn. Lyon,* vol. 29: pp. 136-152. 1960. Preliminary descriptions of new spp. of trifid noctuids collected in Afghanistan, with lists of palearctic spp. of some genera. Describes as new: *Conisania xanthothrix* (Badakhschan); *Hadena klapperichi* (Badakhschan); *Blepharita aphanes* (Paghman Mts.), *B. dufayi*

(Ferusch Tagan); *Polymixis polymorpha* (Ejan, Salang valley), *P. p. niviplaga* (Ferusch Tagan), *P. zophodes* (Ejan, Salang valley), *P. stictineura* (Ejan); *Bryopolia holosericea* (Ghorband valley), *B. orophasma* (Sarekanda); *Agrochola statira* (Ferusch Tagan); *Auchmis crassicornis* (Ferusch Tagan); *?Epipsammia constantialis* (Paghman Mts.), *?E. agrapha* (Bazarak), *?E. eudiopsis* (Nuristan); *Timora philbyi nuristana* (Asmar), *T. p. arabica* (El Riad). Unfortunately, except for *T. p. arabica,* all the types (holo—and allotypes) are in a private collection. [P. V.]

Boursin, Ch., "Nouvelles 'Trifinæ' d'Afghanistan de l'expédition Klapperich (4 éme note) (Lep. Noctuidæ) (Diagnoses préliminaires)" [in French]. *Bull. mens. Soc. linn. Lyon,* vol. 29: pp. 167-174. 1960. New series of preliminary descriptions of new species of trifid noctuids from Afghanistan: *Cryphia* (*Bryoleuca*) *diachorisma* (Paghman Mts.), *C.* (*B.*) *gigantea* (Badakhschan, Sarekanda); *C.* (*SCYTHOBRYA*) (type *C. subliterata* Filipjev; spp. listed), *C.* (*S.*) *icterica* (Nuristan, Achmed Dewane, Bashgul valley), *C.* (*S.*) *molybdea* (Ferusch Tagan, Khinjan valley), C. (?S.) *klapperichi* (Nuristan, Bashgul valley); *Œderemia octogesima* (Paghman Mts.). For the holo—and allotypes, same observation as above. [P. V.]

Box, Harold E., "New species and records of *Diatræa* Guilding and *Zeadiatræa* Box from Mexico, Central and South America (Lepid., Pyral.)." *Bull. ent. Res.,* vol. 47: pp. 755-776, 1 pl., 4 figs. 1956. Describes as new *D. colombiana* (Condoto, Choco Prov., Colombia), *D. balboana* (Summit Gardens, Canal Zone, Panama; reared from stalks of *Setaria paniculifera*), *D. veracruzana* (Teocelo, Vera Cruz, Mex.; reared from *Paspalum* spp.). Records of 22 other spp., with biological & systematic notes. [P. B.]

Bradley, J. D., "A new species of *Casmara* Walker, 1863, from Malaya (Lepidoptera: Œcophoridæ)." *Ann. & Mag. nat. Hist.,* ser. 12, vol. 6: pp. 319-320, 2 figs. 1953. Describes as new *C. diabolella* (Bukit Kutu, 3300 ft.). [P. B.]

Bradley, J. D., "A new species of *Harmaclona* Busck from Natal (Lep.: Arrhenophanidæ)." *Ann. & Mag. nat. Hist.,* ser. 12, vol. 6: pp. 767-768, 2 figs. 1953. Describes as new *H. natalensis* (Umkomaas, Natal). [P. B.]

Gaillard, R., "Grypocères et rhopalocères du Gard" [in French]. *Rev. franç. Lépid.,* vol. 13: pp. 299-311; vol. 14: pp. 35-39, 154-164. *Alexanor,* vol. 1: pp. 49-55, 81-86, 116-122. 1953-54, 1959. Catalogue of the Rhopalocera and Grypocera of the Gard area in south France. Description, in vol. 13, 1953, of the hesperiid *Pyrgus alveus subdecoloratus* Picard, and, in 1959, of the satyrids *Kanetisa circe gabalœ* & *Minois dryas spiripontis;* these subspecies described as "races". [P. V.]

Galliker, Pedro, "Morphologie und Systematik der präimaginalen Stadien der schweizerischen *Solenobia*-Arten (Lep. Psychidæ)" [in German]. *Rev. suisse Zool.,* vol. 65: pp. 95-184, 8 pls., 29 figs. 1958. Study of general and comparative morphology of egg, larva, pupa, and case in Swiss spp.; gives key to spp. based mainly on case. [P. B.]

Gardner, A. E., & E. W. Classey, "Report on the insects collected by the E. W. Classey and A. E. Gardner expedition to Madeira in December 1957." *Proc. Trans. South London ent. nat. Hist. Soc.,* 1959: pp. 184-206. 1960. Annotated list of some orders of insects, including 57 spp. of Lepidoptera. *Cobaliodes dubiosa* is transferred to *Euplexia.* [P. B.]

Goodwin, George H., jr., "Earlier dates for *Libythea bachmanii* and *Macroglossa balteata.*" *Lepid. News,* vol. 12: p. 123. 1959.

Gozmány, L. A., "Notes on the generic group *Symmoca* Hbn. (Lep. Gelechiidæ)." *Ann. Hist.-nat. Mus. nation. hung.,* n. s., vol. 8: pp. 325-346, 9 figs. 1957. Proposes SYMMOCINÆ, new subfamily. Describes as new S. (*CONQUASSATA*), & type S. (*C.*) *perobscurata* (Escorial, Madrid Prov., Spain), *S.* (*C.*) *attalica* (Attica, Greece); *APROMINTA* (type *cryptogamarum* Mill.); *CATASPHALMA* (type *kautziella* Rbl.): *PARTHENOPTERA* (type *virginella* Rbl.); *ACROSYNTAXIS* (type *angustipennis* Rbl.); *Eremica klimeschi* (Mistretta, Mercuore, Sicily, 700 m.); *AMSELINA*, & type *A. olympi* (Bithynia, Bolu); *HAMARTEMA* (monobasic), *H. marthæ* ("S. Gredos, Hoyos, D. Esp. Cast[ilia], 1400 m."); *Donaspastus mediterraneus* (S. Martino di Scala, Palermo, Sicily); *TELEPHIRIA* (type *quadrifariella* Mann); *NEOSPASTUS* (type *delicatellus* Wlsghm.); *THANATOVENA* (type *ægrella* Wlsghm.); *EXORGANA* (Timyridæ) & type *E. iranica* (Poin Schahkuch, N. Persia). Study of all spp. of "*Symmoca*" of which material was available, mainly from types; spp. are assigned to new or existing genera; venation of genera is figured; ♂ genitalia of spp. are figured when possible. The few spp. which could not be studied are listed. [P. B.]

Gozmány, L., "Notes on Hungarian Phycitidæ (Lepidoptera)." *Ann. Hist.-nat. Mus. nation. hung.*, vol. 50 (n. s., vol. 9): pp. 223-225, 5 figs. 1958. Describes as new *XENEPHESTIA* (type *Ephestia cautella*); *SYNALLOREMA* (type *triangulella* Rag.); *CYMBALORISSA* (type *CYMBALORISSA* (type *fuliginosella* Hein.); *CATACROBASIS* (type *obtusella* Hbn.); *KYRA* (type *cirrigerella* Zck.). [P. B.]

Gozmány, L. A., "A new moth from Hungary (Lepidopt.)." *Acta zool. Acad. Scient. hung.*, vol. 4: pp. 317-318, 3 figs. 1959. Describes as new *Infurcitinea finalis* (Kaposvár, Com. Somogy). [P. B.]

Gozmány, L., "Some new considerations on the generic group *Symmoca* Hbn. (Lep., Gelechiidæ)." *Acta zool. Acad. Scient. hung.*, vol. 5: pp. 41-48, 3 figs. 1959. Describes as new *Aprominta reisseri* (Silva Rouva, Mt. Ida, Crete), *A. gloriosa* (Zachlorou (Kalav), Greece), *A. xena* (Hierapetra, Crete); *Symmoca klimeschiella* (Litochoron, 3000 m., N. Greece); *ILLAHASIS* (monobasic), *I. virgo* (Assites, 500 m., Crete). Notes on some of Caradja's specimens of "*Symmoca*". [P. B.]

Gozmány, L., "The results of the zoological collecting trip to Egypt in 1957, of the Natural History Museum, Budapest. 6. Egyptian Microlepidoptera. Part I" [in English; Russian summary]. *Ann. Hist.-nat. Mus. nation. hung.*, vol. 51: pp. 363-370, 5 figs. 1959. Describes as new *BOROSIA* (Phycitidæ; monobasic), *B. ægyptiaca* (Marsa el Alam, on Red Sea); *Ommatopteryx szijjártói* (Idfu, upper Egypt), *O. ilku* (Kom Osim oasis, the Fayum); *Staudingeria ruehli* (Marsa el Alam); *Stenoptilia csanádyi* (Hurghada, on Red Sea); *ILIONARSIS* (Scythrididæ; monobasic), *I. földvárii* (Marsa el Alam). [P. B.]

Gozmány, L., "Tineid moths from Afghanistan (Lep., Tineidæ)." *Acta zool. Acad. Scient. hung.*, vol. 5: pp. 341-352, 5 figs. 1959. Describes as new *Nemapogon kabulianus* (vicinity of Kabul, 1740 m.); *Tinea distans* (Nuristan, Bashgultal, 2800 m.); *AFGHANOTINEA* (monobasic), *A. klapperichi* (Bashgultal, 1200 m.); *Catabola nuristanica* (Bashgultal, 1200 m.); *APHRODOXA* (monobasic), *A. astarte* (Nuristan, Kutiau, 1550 m.); *Episcardia mimetica* (vicinity of Kabul, 1740 m.); *SPHALLESTHASIS*, & type *S. similis* (Bashgultal, 1100 m.), *S. gracilis* (Bashgultal, 1150 m.); *LAZOCATENA* (monobasic), *L. mira* (Kamu, Bashgultal, 1500 m.). Prior publication on Afghanistan material by Petersen makes the following synonymy necessary: *C. sarobiella* (=*nuristanica*), *C. amseli* (=*E. mimetica*), *C. peterseni* (=*A. astarte*), *L. obscura* (=*mira*), *S. luteola* (=*S. similis*). Records of 2 other tineids. [P. B.]

Gozmány, L., "New and rare tineids from the palearctic region and one from Ethiopia (Lepidopt.)." *Acta zool. Acad. Scient. hung.*, vol. 6: pp. 103-115, 6 figs. 1960. Describes as new *Nemapogon hispanellus* (Madrid Prov., Spain), *N. hungaricus* (Harsbokorhegy, Budakeszi, Hungary); *Neurothaumasia africana* (L. Sedjoumi, Tunisia); *Reisserita australis* (Madrid Prov., Spain); *Tinea exquisita* (Zengg, Croatia); *Infurcitinea captans* (Wippach, Carniolia), *I. minuscula* (Chiclana, Spain); *Catabola abscondita* (Tel-Aviv); *PETERSENIA* (monobasic), *P. perplexa* (Tenfecht, 3000-4000 ft., Great Atlas, Morocco); *Myrmecozela ethiopica* (Tshertsher, Abyssinia); *Episcardia* (?) *incerta* (Alberca, Murcia, Spain). Describes previously unknown ♂ of *Nemapogon gravosellus.* New locality records for a number of spp. [P. B.]

Gregor, Frantisek, & Dalibor Povolny, "Bemerkungen zu einer Revision der an den Papilionaceæ lebenden *Lithocolletis*-Arten" [in German; Czech summary]. *Acta*

Soc. ent. Cechosloveniæ, vol. 57: pp. 84-90, 7 figs. 1960. *L. desertella* Greg. & Pov. and *L. staintonella* Stt. are two distinct spp. [J. M.]

Grey, L. Paul, "The equation of subspeciation." *Journ. Lepid. Soc.,* vol. 13: pp. 173-174. 1960.

C. MORPHOLOGY AND CYTOLOGY

Beckel, W. E., "The morphology, histology and physiology of the spiracular regulatory apparatus of *Hyalophora cecropia* (L.) (Lepidoptera)." *Proc. 10th internat. Congr. Ent.,* vol.2: pp.87-115, 42 figs. 1958. Very detailed description with numerous illustrations of the internal anatomy of a typical abdominal segment in larva, pupa, & adult, including musculature, nervous supply, & spiracular apparatus, and of histology of the latter. The spiracle is closed by a muscle inserted on a closing lever, and opened by an antagonistic elastic column which is not a muscle and has no innervation. No ganglia or nerve cell bodies were found in the vicinity of the spiracle, and no morphological explanation was found for the observed ability of the denervated spiracle to open and close rhythmically. [P.B.]

Berio, E., "Studi sull' armatura genitale dei lepidotteri III. Individuazione del X° anello abdominale [in Italian]. *Boll. Lab. Zool. gen. agrar. Portici,* vol.33: pp.330-340, 3 figs. 1956. Discusses structure of 10th abdominal segment in Lepidoptera; it is said to form a complete ring, the sternum being represented by the valves and the piece connecting them ventrally, if present. Based mainly on study of *Anua* spp. [P.B.]

Bigger, T. R., "Chromosome numbers of Lepidoptera—Part I." *Ent. Gazette,* vol.11: pp.149-151, 2 pls., 25 figs. 1960. Gives figures of chromosomes and lists haploid number for 25 spp. (Satyridæ, Nymphalidæ, Lycænidæ, Pieridæ, Hesperiidæ, Noctuidæ, Zygænidæ, Pyralidæ). [P.B.]

Bonhag, Philip F., "Ovarian structure and vitellogenesis in insects." *Annual Rev. Ent.,* vol.3: pp.137-160, 8 figs. 1958. Review article.

Bourgogne, J., "Note servant d' introduction à un travail de cytologie appliquée à la systématique des lépidoptères" [in French]. *Alexanor,* vol.1: pp.59-61. 1959. For the amateurs, some notes of popularization about the chromosomes and the formation of the gametes. [P.V.]

Buckler, H. A., "A gynandromorph of *Euproctis similis* Fues." *Ent. Rec. & Journ. Var.,* vol.67: p.237. 1955. Bilateral gynandromorph which laid fertile eggs. [P.B.]

Callahan, Philip S., "Serial morphology as a technique for determination of reproductive patterns in the Corn Earworm, *Heliothis zea* (Boddie)." *Ann. ent. Soc. Amer.,* vol.51: pp.413-428, 10 figs. 1958. Describes morphology of reproductive system and mechanics of spermatophore formation & disposition from dissections of individuals & mated pairs. Nearly ½ of wild ♀♀ do not mate. Effects of mating on reproductive organs, eggs, & fat bodies are discussed. [P.B.]

H. MIGRATION

Cookson, H., "Migration of the hesperiid butterfly, *Andronymus neander,* at the Vumba near Umtali in Southern Rhodesia." *Entomologist,* vol.91: p.99. 1958.

Daniel, Franz, "Wanderfalterbeobachtungen in der südlichen Steiermarck 1958" [in German]. *Nachrichtenbl. bayer. Ent.,* vol.7: pp.97-100. 1958. Report on migratory movements of 17 spp. [P.B.]

Dickson, G. G. C., & T. W. Schofield, "Observations on the migration of *Belenois aurota* (F.) (Lepidoptera: Pieridæ)." *Journ. ent. Soc. southern Afr.,* vol.21: pp.427-428. 1958. Notes on migration in late 1957 in Natal. [P.B.]

Foltin, Hans., "Wanderfalter-Einflug im Frühling 1958" [in German]. *Ent. Nachrichtenbl.,* Vienna, vol.5, no.8: pp.1-2. 1958. Records of migrants & other spp. in Austria. [P.B.]

French, R. A., "Migration records 1957." *Entomologist*, vol.91: pp.101-109. 1958. British immigrant Lepidoptera. [P.B.]

French, R. A., "Migration records 1958." *Entomologist*, vol.92: pp.164-176. 1959.

Griveaud, P., "Sur les déplacements de *Chrysiridia madagascariensis* (Lepidoptera Uranidæ)" [in French]. *Naturaliste malgache*, vol. 11: pp.107-109. "1959" [1960]. Note on the migrations of this malagassic uraniid. [P.V.]

Hayward, Kenneth J., "Migration of butterflies in Argentina (summer 1956-57)." *Entomologist*, vol.91: pp.163-164. 1958. Migration near Tucumàn of *Libytheana carinenta* & several pierids & nymphalids. [P.B.]

Hayward, Kenneth J., "Migration of butterflies in north-western Argentina. Spring and summer 1959-1960." *Entomologist*, vol.93: pp.237-240. 1960. Notes mainly on *Colias lesbia* & *Ascia monuste*. [P.B.]

Holgersen, Holger, "Dødningehodet i Norge høsten 1956 (Lep. Sphingidæ)" [in Norwegian]. *Årbok Stavanger Mus. 1956*: pp.145-149, 2 figs. 1957. Describes influx of *Acherontia atropos* in Norway in late summer of 1956, associated with winds from the south. One record was as far north as lat. 66° 20' N. [C.R.]

Huggins, H. C., "Immigrants (Lepidoptera) on Tresco, Isles of Scilly, 1958." *Entomologist*, vol.91: pp.251-252. 1958. Notes on 12 spp.

I. TECHNIQUE

Bean, J. L., "The use of larvævorid maggot drop in measuring trends in Spruce Budworm populations." *Ann. ent. Soc. Amer.*, vol.51: pp.500-403, 2 figs. 1958. *Choristoneura fumiferana.*

Bean, James L., "Frass size as an indicator of Spruce Budworm larval instars." Ann. ent. Soc. Amer., vol. 52: pp.605-608, 2 figs. 1959. Frass width is correlated with instar in *Choristoneura fumiferana*. Frass collected in funnels under trees can be used to determine population structure at a given time. [P.B.]

Beckel, W. E., "Sectioning large heavily sclerotized whole insects." *Nature*, vol.184: pp.1584-1585. 1959. Recommends tetrahyrofuran for fixation & clearing and sectioning directly onto Scotch Tape no.810 followed by transfer to slides. [P.B.]

Birkett-Smith, Jorgen, "Genital preparations of male Lepidoptera." *Ent. Meddelelser*, vol.29: pp.170-178, 9 figs. 1959. Describes techniques for removing ♂ genitalia without altering appearance of abdomen (by microdissesction following local relaxation) and for mounting genitalia on labels; also describes instruments used and their manufacture. [P.B.]

Blakeley, P. E., L. A. Jacobson, & R. R. Forster, "Rearing the Army Cutworm, *Chorizagrotis auxiliaris* (Grote) (Lepidoptera; Noctuidæ), in the laboratory." *Canad. Ent.*, vol.90; pp.301-302. 1958.

Bliss, C. I., "The analysis of insect counts as negative binomial distributions." *Proc. 10th internat. Congr. Ent.*, vol.2: pp.1015-1032, 2 figs. 1958.

Bourgogne, J. "Observations sur le bocal à cyanure" [in French]. *Alexanor*, vol.1: pp.29-32, 2 figs. 1959. Observations on the fabrication of cyanide jars to kill Lepidoptera. [P.V.]

Bourgogne, J., "Le bocal à tetrachlorure de carbone" [in French]. *Alexanor*, vol.1: pp.36-38. 1959. Note about a jar with carbon tetrachloride to kill some Lepidoptera, chiefly *Zygæna* and *Procris*. [P.V.]

Brady, Philip, "'Gunning' for butterflies." *Nature Mag.*, vol.52: p.360. 1959. Use of carbon tetrachloride in special spray gun for collecting. [P.B.]

Brown, Leland R., "Using the speedlight in entomology." *Journ. biol. photogr. Assoc.*, vol.22: pp.17-21. 5 figs. 1954.

Byers, George W., "Individual identification labels for pinned insect specimens." *Ent. News*, vol.69 pp.113-116. 1958. Recommends that specialists determining specimens attach species label to each. [P.B.]

Byers, George W., "A rapid method for making temporary insect labels in the field." *Journ. Lepid. Soc.*, vol.13: pp.96-98, 1 fig. 1960.

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REDISCOVERY OF *EUMÆUS ATALA* IN FLORIDA

MINUTES OF 1961 MEETINGS

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TAXONOMIC NOTES ON SOME NEARCTIC RHOPALOCERA. 2. PAPILIONOIDEA

by Cyril F. dos Passos

The present paper, like the preceding one on the Hesperioidea (dos Passos, 1960), has as its object to explain the systematic changes which will be in the forthcoming Check List of Nearctic Rhopalocera (*Memoirs lepid. soc.*, no.1).

PAPILIONIDÆ

PARNASSIINÆ

During the past half century Bang-Haas, Bryk, and Eisner have published extensively in several European periodicals on this subfamily, especially on the genus *Parnassius*. In these publications they have proposed a great number of new names for species and subspecies and a vast quantity of names which they term *nomina collectiva*. These names appear chiefly in *Parnassiana* (1930-39), *Das Tierreich* (1934-35) and "Parnassiana Nova", a serial paper currently appearing in the *Zoölogische Mededeelingen* (1954-).

These *nomina collectiva* have not been validated by the International Commission on Zoological Nomenclature, perhaps because no application has been made by those authors for that purpose, and it is believed that they have no standing presently in nomenclature. Brown (1957, p.140) republished a list of some 66 of these names together with their English equivalents which appeared originally in *Zoölogische Mededeelingen* (1955). It has been the practice of some of those authors to link two or more of these names together by plus (+) signs. In some cases these combinations take up more than one printed line and the possibilities are by no means exhausted!

Because these names have often no original description beyond their Latin or Latinized names, no types or type localities, and when multiplied do not comply otherwise with the Règles, it has been deemed best to ignore them in this paper and in the Check List. For those interested in pursuing the matter further, attention is called to a paper by McDunnough (1936) and an answer (Bryk & Eisner, 1937).

Some of the names proposed by these authors as "forms" were treated later by them as *nomina collectiva.* However, where such names were proposed originally in a valid manner under the Règles as then existing, it is deemed best to retain them in the Check List because they are available for future use. Where such names were not properly written, *i.e.*, in one word, they have been emended to comply with the Règles. In these classes fall all names having an original description, a type, and type locality. All other form names and all *nomina collectiva* have been omitted from the List. They do not meet the requirements of Zoological Nomenclature.

Parnassius eversmanni wosnesenskii Ménétriés, 1849. This insect, described from Ochotsk, [Siberia], is treated by Bryk (1934-5, p.140) and Bryk and Eisner (1932, p.93) as a valid subspecies of *eversmanni* Ménétriés, 1849 and is omitted from the List. It does not occur in North America.

Parnassius nomion Fischer, 1823-24. This species and its synonym *americanus* Bang-Haas, 1927, have been included in recent Nearctic lists but preceded by an asterisk. Eisner (1957, pp.188-192) does not give any Nearctic locality for the occurrence of this species and it has accordingly been dropped from the List, together with its synonym *americanus.*

Parnassius clodius form *maculata* Bryk & Eisner, 1937. This name is omitted because it was proposed provisionally for a hypothetical insect. Such names have no standing in nomenclature.

Parnassius baldur form *mediorubroocellata* Bryk & Eisner, 1937. This name is omitted also because it was proposed provisionally for a hypothetical insect.

PAPILIONINÆ

Following Ford (1944b) four genera of this subfamily, *Battus* Scopoli, 1777, *Papilio* Linnæus, 1758, *Graphium* Scopoli, 1777, and *Parides* Hübner, "1816" [1819] are recognized as occuring in the Nearctic region.

Battus devilliersi (Godart), "1819" [1824]. This name and its synonym *B. villiersii* (Boisduval & Le Conte), 1829, have been omitted from the List because there is no authentic record of the capture of this insect in our faunal area.

Papilio Linnæus, 1758. This genus has been restricted to species congeneric in the strict sense with *P. glaucus* the type species.

Papilio polyxenes americus Kollar, 1850. This name is omitted as a result of Brown's (1942, p.291) statement that it does not occur in the Nearctic region.

Papilio glaucus ab. *ehrmanni* McDunnough, 1938. McDunnough (1938, p.5) lists this name but the original description by Ehrmann has not been found. There is an ab. *ehrmanni* Ehrmann (1925) listed also by McDunnough (*supra*) under *Papilio polyxenes* Linnæus, 1758, so the former name must be ascribed to McDunnough and placed as an aberration of *glaucus*.

Papilio carolinianus George Edwards *in* Catesby, 1771. Holland (1931, p.321), who used (erroneously) *Papilio ajax* Linnæus, (1758) for this insect suggests that *Papilio carolinianus* should be used instead of *P. marcellus* Cramer "1779" [1777] for the spring form (*gen. vern.*). The name *Papilio ajax* has been suppressed by the International Commission on Zoological Nomenclature (Opinion 286) so the name *carolinianus* would have to be used for the insect except for the fact that Opinion 259 invalidates the work in which it was published. The next available name is *marcellus* Cramer "1779" [1777].

Graphium celadon (Lucas), 1852. This name has been omitted from the List because there is no authentic record of the capture of the insect in our faunal area.

PIERIDÆ (Opinion 500)

DISMORPHIINÆ

Enantia Hübner, "1816" [1819]. *Enantia* has been used for *Papilio melite* Johansson, 1763, instead of *Dismorphia* Hübner, 1816. (See Ford, 1941, p.74).

Enantia melite Johansson, 1763. McDunnough (1938, p.7) ascribes this name to Johansson. Ford (1941, p.75) ascribes *melite to* Linnaeus. It seems to the author that Johannson should be credited with this name. The insect is of doubtful occurrence in the Nearctic region.

PIERINÆ

Appias ilaire (Godart), 1819. This name and its synonyms *A. mysia* (Godart), 1819, described from Brazil, *A. margarita* (Hübner), "1806" [1825] and *A. molpodi* (Hübner), 1823, have been omitted from the

List because the insect does not occur in our faunal area. The author is not unmindful of the record of *ilaire* from Colorado by Brown (1942, p.82) but he advises (*in litt.*) that he only saw the insect on a flower and that most likely it was what is now called *Appias drusilla* (Cramer), "1779" [1777].

Pieris protodice Boisduval & Le Conte, 1829, and *P. occidentalis* Reakirt, "1866-7" (1866). These insects appear to be conspecific and have been combined under the older name but the latter name retained as a subspecies.

Pieris napi venosa ab. ♀ *flava* Edwards, 1881. The author is aware of the fact that Cockayne (1952) claims that this is a *nomen nudum* for lack of a description but it is believed that the words "A large percentage of female *venosa* are yellow on the upper side. . ." (pp.89, 98) together with pl.2, f.7 ♀ comply with the Règles and thus the name should be recognized as a form ♀ of *venosa.*

Pieris napi castoria ab. *flava* Edwards, 1881. Edwards mentions (pp.94, 98) a yellow male and female of *castoria* and it is apparent that he applied the name to that aberration. In any event the name is a synonym of ab. *resedæ* Boisduval, 1869.

Pieris ochsenheimer Staudinger, 1886. This name, proposed for specimens from Central Asia, has appeared in several Nearctic Lists on the basis apparently of 2 males, 1 female received by Skinner (1897, p.156) from Strecker from Mt. Wrangel, Alaska. Verity (1911, p.324) does not believe that it is distinct from *P. napi* and it has accordingly been omitted from the List.

Pieris rapæ æstivus Verity, 1913. This name appears to be a synonym and a homonym of *P. rapæ æstiva* Zeller (1847). Both were proposed for Palearctic specimens representing the fourth generation of *rapæ.* They are accordingly omitted from the List.

COLIADINÆ

Colias Fabricius, 1807 (Opinion 146). This genus has given the greatest trouble to present in a systematic manner. There appears to be considerable hybridization between "species" and few students agree where "species" and "subspecies" begin and end. The present arrangement, based somewhat on the food plants of the larvæ when known, is offered with no assurance that it will prove final. Most of the changes in the previous set-up are explained in these notes.

Colias hecla palamedes Hemming, 1934. Hemming (1934, p.98) claims that *Colias hecla* var. *pallida* Skinner, 1892, is a homonym of *Colias erate*

Esper ab. ♀ *pallida* Staudinger, 1861, and has proposed the name *Colias hecla palamedes* to replace it. It will be noted that the Staudinger name is a female aberrational name whereas the Skinner name could be either a subspecies, an aberration or a form name. While the Règles at present are silent on this subject, for five years prior to 1958 the presumption was that SKINNER had proposed *pallida* as a subspecific name. In that event, it was not necessary to replace it. Attention is called also to the fact that HEMMING gave the wrong reference for *pallida* Skinner. It is *Ent. news* 3: 49, fig.4; 1892.

The practice of upsetting form names such as *alba, pallida, flava, verida, nigra,* etc. in the genus *Colias* is of doubtful usefulness. It is better to use such names for white, yellow, green or black specimens where such forms occur in more than one species. Where such form names are proposed nothing is gained by publishing new names although such procedure may be technically correct. The situation may be different if the homonym is not a descriptive name. In that case a new name may be advisable.

Colias eurytheme Boisduval, 1852, and *C. philodice* Godart, 1819. These names have been combined by some authors such as HOVANITZ (1943, p.1) under *C. chrysotheme* Esper, 1777. Undoubtedly the relationship among all three is very close and interbreeding occurs. Nevertheless, it has been deemed best to treat them as distinct species until further work, especially breeding and the study of the preferred food plants, has been done.

Colias eurytheme keewaydin Edwards, 1869. This name has been removed from the synonymy of *C. eurytheme* Boisduval (1852) and given subspecific standing as the spring form occurring in the [southern] Rocky Mountains. The type locality is restricted to Texas.

Colias eurytheme keewaydin pallida Cockerell, 1888. This is a case where *pallida* is preoccupied by form ♀ *alba* Strecker, 1878.

Colias notatus Clark & Clark, 1941. This name appeared first in an unpublished sales list of some insects from Georgia prepared by MEGERLE in 1803. It was followed by a description sufficient to identify it as the insect subsequently named *Colias philodice* Godart, 1819. CLARK and CLARK in 1941 published this sales list and stated that *notatus* equalled *philodice.* For that reason the name is placed in the synonymy of that insect and ascribed to CLARK and CLARK. Even if *notatus* was validly published by MEGERLE, no change in long established nomenclature should be made without the approval of the Commission.

Colias nastes cocandicides Verity, "1905-1911" [1911]. This insect was named from specimens collected at 114° 30′ W. 67° 40′ N., while

C. n. subarctica McDunnough, 1928, was named from Bernard Harbor, Northwest Territory, substantially the same locality. In the circumstances these names appear to be synonymous so the oldest one will be used in the Check List.

Eurema nise (Cramer), "1779" [1776]. This controversial name has had a long and complicated history but only recent events need be mentioned in this paper. For lack of specimens MUNROE (1950, pp.180-181) suggested that the type locality Jamaica might be erroneous, but since he wrote, a series agreeing in all respects with CRAMER's figure has been received from that island and commented upon by KLOTS and HEINEMAN (1957, p.198), thus establishing the fact that CRAMER's type locality Jamaica was correct.

Two recognizable subspecies of *nise* occur in North America. The spring brood of the one occurring in Florida resembles the spring brood of the Jamaican insect. However, there are few, if any, second brood specimens from Jamaica, so that it is not known whether that brood resembles the second Florida brood or not. However, it is assumed by the author that such is the case and the Check List therefore treats *nise nise* as occurring in Florida and *n. nelphe* in Texas as a stray from Mexico.

RIODINIDÆ

Two subfamilies are recognized as occurring in the Nearctic region, Euselasiinæ and Riodininæ.

RIODININÆ

Apodemia mormo mormonia (Boisduval), 1869. This name has been given subspecific standing for the population occurring in Washington and Oregon.

Lephelisca Barnes & Lindsey, 1922. There are differences of opinion concerning the proper generic name to be used for the species of which *Erycina virginiensis* Guérin-Méneville, 1831, is typical. *Nymphidia* Boisduval & Le Conte [1833] is the earliest name but FIELD (1948, p.207) claims that it is merely a misspelling or emendation of *Nymphidium* Fabricius, 1807. MCALPINE (*in litt.*) contends that *Calephelis* Grote & Robinson, 1869, should be used, but that name is based upon a misdetermined type species and would not seem to be available until the Commission has passed on the problem. Recent authors such as KLOTS (1951, p.122) and BROWN, *et al.* (1955, p.117) use *Lephelisca* and that practice will be followed in the Check List, without, however, desiring to prejudice the question when it may come before the Commission.

LYCÆNIDÆ

THECLINÆ

Strymon Hübner, 1818 (Opinion 165). This genus needs revising. With the exception of one or two species that have been removed therefrom and placed elsewhere the species are listed substantially as by McDunnough (1938).

Strymon eurytulus (Hübner), "1816" [1819]. Comstock and Huntington (1943, p.87) consider this a Brazilian insect so the name is omitted from the List. Hübner gave no type locality.

Strymon liparops Le Conte, [27 July, 1833]. This name has been ascribed usually to Boisduval & Le Conte, but a glance at the original description (p.99) shows that those authors considered it a Le Conte name, since his name alone is printed after the specific name. When these authors claimed joint authorship the specific name was followed sometimes by "*nobis*".

Mr. Francis Harper, of Mount Holly, New Jersey, has called attention (*in litt.*) to the fact that the name John Eatton Le Conte should be written that way, and not Leconte as is usually done by lepidopterists. He has made a thorough study of this problem and will publish his data.

Strymon lycus Skinner, 1898. Comstock and Huntington (1943, p.73) have pointed out that it is difficult to tell to which Hübner name Skinner referred because Hübner does not appear to have published any name with this exact spelling. He did publish *Urbanus celebris licus* (1807, *Samm. exot. Schmett.* 1: pl.[150]) and *Bethys lydus* ("1816" [1819] *Verz. bekant. Schmett.*: 175, no.753) but these species are quite distinct from *simæthis* Drury, "1770" [1773], in the synonymy of which Comstock and Huntington place *lycus*. Klots (1951) omits this name and has been followed in the Check List.

Strymon salona Hewitson, 1868. McDunnough (1938, p.24) places this name as a synonym of *S. columella*. Comstock and Huntington (1943, p. 78) placed it as a synonym of *Thecla bubastus bubastus* (Stoll), "1782" [1784], a non-Nearctic insect, consequently it is omitted from the List.

SPALGINÆ

This subfamily name was proposed by Holland (1931, p.244) to replace Gerydinæ Fruhstorfer (1907) but has not met with general acceptance. By its nutrition from plant lice, the American genus *Feniseca* forms to a certain degree a parallel with the Indian Gerydini (Seitz

5: 743) and there appears no substantial reason for a new name until more is known about these unusual insects. Klots (1951, p.149) used Gerydinæ and is followed.

PLEBEJINÆ

Hemiargus catilina Fabricius, 1793. This name is omitted from the List in accordance with the view of Comstock (1944, p.494) that it is the subspecies of *Leptotes cassius* occurring in the Virgin Islands. See also Comstock and Huntington (1943, p.91).

Hemiargus hanno Stoll, "1791" [1790]. This name has been omitted from the List on the strength of the study by Comstock and Huntington (1943, p.104) of the species and its synonyms from which it is concluded that the insect was described from Surinam and does not occur in the Nearctic region.

Lycæides argyrognomon kodiak Edwards, "1870-1" (1870). Nabokov (*in litt.*) advises that he considers *kodiak* to be a subspecies of *Plebejus* (*Icaricia*) *icarioides* (Boisduval), 1852, but it is retained for the present in *Lycæides* because he, Nabokov ("1943" [1944], p.91), has not excluded it in the only published record found. No type has been discovered.

LIBYTHEIDÆ

LIBYTHEINÆ

Libytheana motya (Boisduval & Le Conte), "1833" [1834]. Although this name is usually ascribed to Boisduval and Le Conte it is not, in this writer's opinion, a new name but a misdetermination of *Hecærge motya* Hübner, [1823]. That insect does not occur in our faunal area and consequently the name is omitted from the List.

NYMPHALIDÆ

CHARAXINÆ

Anæa aidea morrisoni (Edwards), 1883. McDunnough (1938, p.22) gives Holland as the author of this subspecies and so did Holland (1931, p.173). There is nothing invalid about Edwards' publication of this name (1883, p.35) and he should be credited with the authorship.

APATURINÆ

Chlorippe Boisduval, 1870. Klots (1951, pp.280, 313) used this name for *Asterocampa pavon* (Latreille), "1811" [1809] but it is a homonym of

Chloripppe Doubleday (1840). It would seem that *pavon* should be included in *Limenitis. Apatura Auctorum nec* Fabricius (1807), as well as *Chlorippe* Boisduval *nec* Doubleday, are synonyms of *Asterocampa* Röber (1916).

EURYTELINÆ

ERGOLINÆ *vs.* EURYTELINÆ. ORFILA (1952, p.103) has called attention to the fact that ERGOLINI and EURYTELINI are based on the genera *Ergolis* Boisduval, 1836, and *Eurytela* Boisduval, 1833, both belonging to the same tribe as defined by MUNROE (1949, p.67). Consequently *Eurytela* having priority, he sank ERGOLINI for EURYTELINI and similar action must be taken when these names are used for subfamilies as contemplated in the Check List.

Hamadryas februa gudula Fruhstorfer, (1916). While this insect was described from the population occurring in western Mexico, the type in the British Museum (Natural History) is labeled "Texas". Consequently this name is included in the Check List.

Evonyme Hübner, "1816" [1819]. DE LA TORRE Y CALLEJAS (1952, p.68) has pointed out that this name has line priority over *Eunica* Hübner, "1816" [1819] and considers apparently that the respective type species are congeneric. He believes that *Eunica* should be retained as a *nomen conservandum.* It has seemed best to treat DE LA TORRE as the first reviser and retain *Eunica* on that theory.

LIMENITINÆ

Limenitis arthemis (Drury), 1773, and *L. astyanax* (Fabricius), 1775. These insects are considered conspecific by KLOTS (1951, p.116) but that opinion is not followed. While it is true that there is a narrow zone between their respective habitats where they interbreed, that fact does not necessarily make them one species. In any event, the problem is a subjective matter and these insects have been treated as distinct species.

Adelpha Hübner, "1816" [1819]. Following CHERMOCK (1950, p.536) *Adelpha bredowii* Geyer, 1837 has been referred to *Limenitis* (*Adelpha*) Hübner, "1816" [1819].

Anartia jatrophæ Johansson, 1763. GILLHAM (1957, p.19) has placed all Caribbean subspecies in the synonymy of *jatrophæ* but is not followed insofar as the subspecies *quantanamo* Munroe, 1942, and *luteipicta* Fruhstorfer, 1907, occurring in the Nearctic region, are concerned.

Anartia saturata Staudinger, 1884. This name listed by MCDUNNOUGH (1938, p.21) as a subspecies of *jatrophæ* is omitted on the authority of

MUNROE (1942, p.3) because it does not occur in the Nearctic region. MUNROE considers Port au Prince, Haiti, as the type locality of this insect.

Anartia jatrophæ jamaicensis Möschler, 1886. This name listed by McDUNNOUGH (1938, p.21) as a synonym of *A. j. saturata* Staudinger, 1884, is omitted from the List because, according to MUNROE (1942, p.3), it occurs only in Jamaica and not in the Nearctic region.

VANESSINÆ

Vanessa atalanta italica Stichel, (1909). This name has been used by MATURO (1953, p.154) for what he considers the North American subspecies of *atalanta*. However, it is not believed that a name proposed for the south and central Italian subspecies should be so used and he has not been followed.

Vanessa cardui carduelis (Seba), 1765. This name has been used also by MATURO (1953, pp.150, 154), who ascribes it to Cramer, "1779" [1776], for the North American race of *cardui*. The name appears to have been proposed by SEBA (1765, pp.4, 6). However that may be, it is not deemed desirable to introduce the name in the Nearctic List as a subspecies until some reasons are given for differentiating it from the nominate form.

Junonia Hübner, "1816" [1819]. HEMMING (1934, p.73) considers the type species of *Precis* Hübner, "1816" [1819], and *Junonia* to be congeneric, but DE LESSE (1952, pp.74-77), who studied the genitalia of most of the species, concluded otherwise and assigns the Nearctic species to *Junonia*. He has been followed in the Check List.

Nymphalis vau-album ([Denis & Shiffermüller]), 1775. GILLHAM (1956, p.27) has used this name for the Holarctic species and placed *V[anessa] j-album* Boisduval & Le Conte, "1833" [1834], and *Aglais j-album watsoni* Hall (1924) in the synonymy. He is not followed insofar as the subspecific synonymy is concerned, it being the author's opinion that both *j-album* and *watsoni* differ sufficiently to be recognized as valid subspecies. This is one of the many subjective matters concerning which the lumpers and splitters will never agree.

Nymphalis antiopa (Linnæus), 1758. ELIOT (1956, p.270) has pointed out that the Southern Palearctic subspecies is double brooded and suggested using the name *N. a. grandis* EHRMANN (1900) for this population. This suggestion he later (1957, p.162) withdrew on the advice of FORBES (*in litt.*) because it was claimed that this name (*grandis*) " . . . is based on characters that are aberrational, not racial". While this is not a valid objection to the use of the name, because between 1948 and 1958 aberrational names have been available as specific or subspecific names, nevertheless there is an earlier name *lintnerii* Fitch, 1858, which can be used for the southern subspecies. This name is given hereby subspecific standing. The type locality is Schoharie, New York.

Nymphalis antiopa ab. *hippolyta* (Lyman), 1898. This name was published conditionally and hence is invalid. It was next used by SKINNER (1898), who wrote it *hippolita* in the text (p.22) and *hippolyta* in the index (p.vii). It is believed best to ascribe the name to SKINNER and to use the text spelling.

Nymphalis antiopa creta (Verity), 1916. This name was used erroneously by CLARK and CLARK (1937, p.88) and CLARK and TRAINER (1941, p.39) for a subspecies of *N. antiopa* occurring in Virginia but described from Tuscany. It has not been included in the List since, as observed above, three names are available for the American subspecies.

Polygonia marsyas (Edwards), "1870-1" (1870). This insect has been given subspecific standing. The examination of a long series appears to establish that it is more than a form of *satyrus* (Edwards), 1875.

Chlosyne lacinia rufescens Cockerell, 1894. This name has been credited usually to Edwards, 1893, but Cockerell is the author. EDWARDS' paper is not very clear. It consists mostly of quotations from letters of COCKERELL wherein he gives descriptions and names to a number of forms of *Chlosyne*. However, for *rufescens* there are two descriptions and EDWARDS did not state to which one the name was applicable. The following year (1894) COCKERELL cleared up this ambiguity, so the authorship of the name must be ascribed to that author.

MELITÆINÆ

Phyciodes (*Phyciodes*) *tharos pulchella* (Boisduval), 1852. The name *pulchella* is recognized as a subspecies of *tharos* (Drury), "1770" [1773], with *pascoensis* Wright, 1905, as a synonym. BOISDUVAL described this insect from California and stated that it inhabits a large part of that State. MCDUNNOUGH (1938, p.19) lists *pascoensis* as the Western subspecies of *tharos* but *pulchella* has priority.

Brenthis œnone Scudder and *Phyciodes œnone* Scudder, 1863. These names are so listed by MCDUNNOUGH (1938, pp.16, 19). The latter is listed in the Check List under *Melitæa* (*Microtia*) *nycteis*. Both these names represent the same insect, and KLOTS advises (*in litt.*) that *œnone* is a synonym of *nycteis* and is not a *Brenthis* (*Boloria*).

Melitæa Fabricius, 1807. Following Forbes ("1944" [1945], p.140) and Klots (1951, p.94) the American species that have been placed usually in this genus have been transferred to the subgenus *Microtia* Bates, 1864. Higgins ("1958" [1959], p.161) has proposed *Texola* for some of these species but he does not indicate which species are included or excluded in his new genus beyond specifying that its type is *Eresia elada* Hewitson, 1868. This is not a Nearctic insect.

Melitæa (*Microtia*) *palla calydon* (Strecker), 1878. This name has been ascribed usually to Mead. But the 1875 mention of the name is a *nomen nudum*. It was next used by Strecker (1878, p.126) who wrote: "*Calydon* = some one of the forms of *palla*", which would appear to constitute him the author. In the Check List it is treated as the subspecies of *palla* occurring in the Rocky Mountains, the type locality being Turkey Creek Junction, Colorado.

Melitæa (*Microtia*) *dymas* (Edwards), 1871, and *M.* (*M.*) *chara* (Edwards), 1883. Higgins ("1958" [1959], p.161) in proposing *Texola* states: "It appears that Edwards' name *dymas* 1877 should replace the more familiar name *chara* Edwards, 1883", but McDunnough (1938, p.18) treats them both as subspecies and is followed.

Melitæa (*Microtia*) *mayi* Gunder, 1929. This record requires confirmation but the name is retained for the present. The insect cannot be separated from *Melitæa ambigua niphona* Butler, 1878, which occurs along the Amur River. The specimens upon which Gunder based the name may have been mislabeled. They were purchased from a dealer.

Melitæa (*Microtia*) *britomartis* Assman, 1847. This species is reported from the high mountains of Montana and Alberta by Verity (1935) but that is believed to be a misdetermination so the name is not included in the List. Possibly the insects examined by Verity were mislabeled.

Euphydryas Scudder, 1872. In this genus the classification of Gunder (1929), with a few corrections, has been followed, although it is realized that much work remains to be done with the western species.

Euphydryas chalcedona klotsi dos Passos, 1938. When this subspecies was described, Gunder (1929, p.16) had placed *hermosa* Wright as a subspecies of *anicia*. That proved later to be an error because it is a subspecies of *chalcedona* and comes from substantially the same locality as *klotsi*. Consequently, the latter name is sunk as a synonym.

Euphydryas chalcedona sierra ab. *umbrobasana* J. A. Comstock, 1925. This name has been ascribed usually to Gunder with the date 1926 but it was published the prior year by Comstock on plate 35, fig.5 of the *Butterflies of California* (1927, p.105). Hence the authorship is corrected. This plate was issued two years before the book.

ARGYNNINÆ

Boloria (*Clossiana*) *euphrosyne* (Linnæus), 1758. This species, its synonym *morrisii* Reakirt, 1866, and subspecies *B. e. andersoni* (Dyar), 1904, are of doubtful North American occurrence. *B. euphrosyne* is European. *B. morrisii* has been omitted from the List on the strength of Strecker's statement (1878, p.118) that it was described from an example of *Argynnis euphrosyne* (Linnæus), which Reakirt received from Lorquin, with "California" erroneously given as the locality. None of these names will appear in the Check List.

Boloria distincta (Gibson), 1920. This rare Arctic insect, described as a species by its author, seems better placed as a subspecies of *B. astarte* (Doubleday & Hewitson), "1846-50" [1847]. Grey advises (*in litt.*) that the genitalia are of a similar type to those of *B. astarte.*

Boloria (*Clossiana*) *titania montinus* (Scudder), 1862. This subspecific name is written "*montina*" by Klots (1951, pp.91, 112, 311), apparently under the mistaken belief that it is an adjective and thus should agree with *Boloria* in gender. But *montinus* is a noun and should be so written.

Speyeria zerene carolæ (dos Passos & Grey), 1942. Since the description of this insect Grey has received more material, and he advises (*in litt.*) that he is now convinced that we erred in referring it to *S. coronis* (Behr), 1864; hence the new combination.

DANAIDÆ

Dircenna klugii (Geyer), 1837. This name has been omitted from the List because the insect does not occur in the Nearctic region. (Klots 1951, p.276).

Ithomia anaphissa Herrich-Schäffer, 1864. This name, sometimes credited to the Nearctic fauna, has been omitted from the List because the insect does not occur in that region (Klots 1951, p.276).

Dynothea lycaste negreta Reakirt, 1864. This name has been omitted from the List because the insect does not occur in the Nearctic region. Many of Reakirt's species of Danaidæ were taken in Panama but mislabeled California.

Mechanitis californica Reakirt, 1865. This name has been omitted from the List because the insect does not occur in the Nearctic region. It is not cited by J. A. Comstock (1927), and Holland (1931, p.71) states that it is very doubtful that this insect occurs in California.

Danaus (*Danaus*) *plexippus nigrippus* Haensch, 1813. This name, representing the southern subspecies, was added to the Nearctic List by Clark and Clark (1938, p.179) but is believed to be a misdetermination of *D. p. plexippus*. Accordingly it has not been incorporated in the List.

Danaus jamaicensis Bates, 1864. This insect has been reported from Florida by Clark (1941, p.540) but the evidence appears too slight to include the name in the List. The specimen is an old one in the Barnes collection, possibly a subspecies of *D. gilippus* Cramer, "1779" [1776].

SATYRIDÆ

SATYRINÆ

Megisto Hübner, "1816" [1819]. The species listed by McDunnough (1938, p.11) under this name have been transferred to *Euptychia* Hübner, "1816" [1819].

Satyrodes Scudder, 1875. This generic name, used by McDunnough (1938, p.12) for *eurydice* Johansson (1763, p.406), has been omitted and the species transferred to *Lethe* Hübner, "1816" [1819].

Euptychia pyracmon (Butler), 1866. This name was added to the List by Nabokov ("1942" [1943], p.70) and removed by R. L. Chermock (1947, p.196). The insect is not believed to occur in the Nearctic region, so it is omitted from the List.

Cœnonympha Hübner, "1816" [1819]. Since Davenport's revision (1941) of this genus there have been several revisions in whole or in part of the Nearctic species, notably by Brown (1955), with which the author is not in complete agreement. In the Check List six species, counting *mixturata* Alphéraky, 1897 and *haydeni* (Edwards), 1872, are recognized.

Cœnonympha pamphilus (Linnæus), 1758. This name, together with its synonym *C. pamphiloides* Reakirt, 1866, on North American check lists for many years, is omitted as not occurring in the Nearctic region. The former is a European insect, and so apparently is the latter, both probably mislabeled.

Cercyonis sthenele (Boisduval), 1852. This name is retained in the List, although the insect is believed to be extinct.

Œneis Hübner, "1816" [1819]. The arrangement of the species and subspecies in this genus has been altered considerably as a result of the author's preliminary studies of the genitalia for a revision. They are arranged in the Check List in accordance with the characters of the male genitalia.

Œneis norna (Thunberg), 1791. This name is omitted from the List because the insect is not believed to occur in the faunal area.

Œneis alberta Elwes, 1893. This name is ascribed to Elwes rather than Elwes and Edwards since the latter is responsible only for the figures in their joint paper.

Œneis polixenes brucei (Ewdards), 1891. There is a name in the literature which has priority over this well known name but it has not been used for about seventy years. In the circumstances it seems best to use the well known name *brucei* until application is made to the International Commission on Zoological Nomenclature for the suppression of the older name.

Erebia epipsodea sineocellata Skinner, 1889. This name was proposed as "*sine-ocellata* nov. var." and in the next line Skinner wrote that it " . . . is a var. of *Epipsodea* Butler . . . " . The type locality is Fort Qu'-Appelle, Northwest Territory. Ehrlich (1954, p.27) described *Erebia epipsodea freemani* from Lloydminster, Alberta, a town actually on the Alberta-Saskatchewan boundary and about 350 miles northwest of Fort Qu'-Appelle but in the same general type of country. The descriptions are fairly similar. In a later paper Ehrlich (1955, p.184) placed *sineocellata* in the synonymy of *freemani* on the theory that it is an aberrational name but thereby conceding that they are synonymous. However, *sineocellata* was not proposed as an aberrational name but as a subspecific name, so it must be used for the population that Ehrlich deemed worthy of recognition.

References

Brown, F. M., 1942. *Appius* [*sic*] *ilaire ilaire* Godart in Colorado (Lepid. Pieridæ). *Ent. news* 53: 82.

..............., 1955. Studies of Nearctic *Cœnonympha tullia* (Rhopalocera, Satyridæ) *Cœnonympha tullia inornata* Edwards. *Bull. Amer. mus. nat. hist.* 105: 359-410, 2 pls., 19 figs., 21 tables.

..............., 1957. Infra-subspecific names among *Parnassius*. *Lepid. news* 10:140-142.

Brown, F. M., D. Eff & B. Rotger, 1955. Colorado butterflies. Part III Libytheidæ The Snout Butterflies Riodinidæ The Metalmarks Lycænidæ The Gossamer-wings. *Proc. Denver mus. nat. hist.* 5: 113-176, num. figs.

Bryk, F., 1934-1935. Lepidoptera Baroniidæ, Teinopalpidæ, Parnassiidæ pars 1. *Tierreich* 64: XXIII + 790 pp., 698 figs.

Bryk, F., & C. Eisner, 1932. Kritische Revision der Gattung *Parnassius* unter Benutzung des Materials der Kollektion Eisner, Dahlem. *Parnassiana* 2: 69-102, 8 figs.

..............., 1937. A reply to the critical review of the treatment of the American species of *Parnassius* in the "Tierreich" by J. McDunnough in "The Canadian Entomologist". *Parnassiana* 5: 3-7.

Chermock, R. L., 1947. A revisional study of the *Euptychia pyracmon* group. *Ent. news* 58: 193-204, 12 figs.

..............., 1950. A generic revision of the Limenitini of the world. *Amer. midl. nat.* 43: 513-569, 68 figs.

Clark, A. H., 1941. Notes on some North and Middle American danaid butterflies. *Proc. U. S. nat. mus.* 90: 531-542, 4 pls.

Clark, A. H., & L. F. Clark, 1937. Preliminary list of the butterflies of Virginia. *Proc. biol. soc. Washington* 50: 87-92.

..............., 1938. Notes on Virginia butterflies. *Proc. biol. soc. Washington* 51: 177-181.

..............., 1941. Some early butterfly records from Georgia. *Proc. ent. soc. Washington* 43: 80-85.

Clark, A. H., & F. W. Trainer, 1941. Entomology — Butterflies of Farmville, Virginia. *Journ. Washington acad. sci.* 31: 38-40.

Cockayne, E. A. [editor], 1952. [Note] *Ent. rec.* 64: 291.

Comstock, W. P., 1944. Insects of Porto Rico and the Virgin Islands. Rhopalocera or butterflies. *Scientific Survey of Porto Rico and the Virgin Islands* (N. Y. Acad. Sci.), vol.12: 421-622, 12 pls., 29 figs.

Comstock, W. P., & E. I. Huntington, 1943. Lycænidæ of the Antilles (Lepidoptera, Rhopalocera). *Ann. N.Y. acad. sci.* 45: 49-130, 1 pl., 2 figs.

Davenport, D., 1941. The butterflies of the satyrid genus *Cœnonympha*. *Bull. mus. comp. zool.* 87: 215-349, 10 pls.

Edwards, W. H., 1881. On *Pieris bryoniæ* Ochsenheimer and its derivative forms in Europe and America. *Papilio* 1: 83-99, pls. 2, 3.

Ehrlich, P. R., 1954. Two new subspecies of *Erebia epipsodea* Butler (Lepidoptera: Satyridæ). *Journ. Kansas ent. soc.* 27: 80.

..............., 1955. The distribution and subspeciation of *Erebia epipsodea* Butler (Lepidoptera: Satyridæ). *Kansas univ. sci. bull.* 37: 175-194, 3 figs.

Eisner, C., 1957. Parnassiana nova XV Kritische Revision der Gattung *Parnassius* (Part 10). *Zoöl. Meded.* 35: 177-203.

Eliot, N., 1956. The strange case of the Camberwell Beauty. *Entomologist* 89: 270-277.

.............., 1957. Nomenclature of *Nymphalis antiopa L. Entomologist* 90: 162.

Field, W. D., 1948. The correct name for the North American butterfly variously called *Nymphidia, Calephelis* or *Lephelisca* (Lepidoptera, Riodinidæ). *Proc. ent. soc. Washington* 50: 207-213.

Forbes, W. T. M., 1944. The genus *Phyciodes* (Lepidoptera, Nymphalinæ). *Ent. Americana* 24: 139-208, 7 pls.

Ford, E. B., 1941. Studies on the chemistry of pigments in the Lepidoptera, with reference to their bearing on systematics. 1. The anthoxanthins. *Proc. roy. ent. soc. London* (*A*) 16: 65-90.

..............., 1944a. Studies on the chemistry of pigments in the Lepidoptera, with reference to their bearing on systematics. 3. The red pigments of the Papilionidæ. *Proc. roy. ent. soc. London* (A) 19: 92-106.

..............., 1944b. Studies on the chemistry of pigments in the Lepidoptera, with reference to their bearing on systematics. 4. The classification of the Papilionidæ. *Trans. roy. ent. soc. London* 94: 201-223.

Gillham, N. W., 1956. *Nymphalis vau-album* (Schiffermüller & Denis), a Holarctic species (Lepidoptera: Nymphalidæ). *Psyche* 63: 27-29.

..............., 1957. Subspecies versus geographic variation in Caribbean populations of *Anartia jatrophæ* Johansson (Lepidoptera, Nymphalidæ). *Amer. mus. novitates* 1845: 22 pp., 5 figs.

Gunder, J. D., 1929. The genus *Euphydryas* Scud. of Boreal America (Lepidoptera Nymphalidæ). *Pan-Pacific ent.* 6: 1-8, 12 pls.

Hemming, A. F., 1934. Some notes on the nomenclature of Palæarctic and African Rhopalocera. *Proc. roy. ent. soc. London* (*B*) 3: 97-99.

Higgins, L. G., 1959. Four new melitæine genera (Nymphalidæ). *Lepid. news* 12: 161-164, 1 pl.

Holland, W. J., 1931. *The butterfly book* (rev. ed.). xii + 424 pp., 77 pls. mostly col., 198 figs. Doubleday, Doran & Company, Inc., Garden City, New York.

Hovanitz, W., 1943. The nomenclature of the *Colias chrysotheme* complex in North America (Lepidoptera, Pieridæ). *Amer. mus. novitates* 1240: 4 pp.

Klots, A. B., 1951. *A field guide to the butterflies of North America, east of the Great Plains.* xvi + 350 pp., 40 pls. (16 colored). Houghton Mifflin Co., Boston.

Klots, A. B., & B. Heineman, 1957. The identity of *Papilio nise* Cramer, 1775 (Lepidoptera: Pieridæ) and a neotype designation for this nominal species. *Proc. roy. ent. soc. London (B)* 26: 206-213, 1 col. pl.

Maturo, F. J. S., Jr., 1953. Range extensions of Rhopalocera in eastern North Carolina. A checklist of the species of Carteret County, N. C. *Journ. Elisha Mitchell sci. soc.* 69: 150-155.

McDunnough, J. H., 1936. A critical review of the treatment of North American *Parnassius* species by Felix Bryk in *Das Tierreich* Part 65. *Canadian ent.* 68: 216-225.

................, 1938. Check list of the Lepidoptera of Canada and the United States of America. Part 1 Macrolepidoptera. *Mem. so. Calif. acad. sci.* 1: 1-273 + 4 (corrigenda).

Munroe, E. G., 1942. The Caribbean races of *Anartia jatrophæ* Johansson (Lepidoptera: Nymphalidæ). *Amer. mus. novitates* 1179: 4 pp.

................, 1949. A new genus of Nymphalidæ and its affinities (Lepidoptera, Rhopalocera). *Journ. N. Y. ent. soc.* 57: 67-78.

................, 1950. The *dina* group of the genus *Eurema* in the W. Indies (Lepidoptera, Pieridæ). *Journ. N. Y. ent. soc.* 58: 172-191.

Nabokov, V., 1943. Some new or little known Nearctic *Neonympha* (Lepidoptera; Satyridæ). *Psyche* 49: 61-80, 4 figs.

................, 1944. The Nearctic forms of *Lycæides* Hüb. (Lycænidæ, Lepidoptera). *Psyche* 50: 87-99.

Orfila, R. N., 1952. Cambio nomenclatoriales en Nymphalidæ (Lep.). *An. soc. cient. Argentina* 154: 102-104.

Skinner, H. [editor], 1892. Plate 2 [expl. of figures]. *Ent. news* 3: 49, 12 figs.

Skinner, H., 1897. Notes on Rhopalocera, with descriptions of new species and varieties. *Canadian ent.* 29: 154-156.

................, 1898. A synonymic catalogue of the North American Rhopalocera. xvi + 99 + xiv pp. American Ent. Soc., Philadelphia.

Strecker, H., 1878. *Butterflies and moths of North America.* [4] + ii + [2] + 284 pp., 2 pls. Press of B. F. Owen, Reading, Pa.

de la Torre y Callejas, S. L., 1952. Datos taxonomicos sobre Lepidopteros, con notas sobre algunas especies Cubanas (part 2). *Mem. soc. Cubana hist. nat.* 20: 61-70.

Verity, R., 1905-1911. *Rhopalocera Palæarctica.* lxxxvi + 368 + xii pp., 86 pls. Published by author, Florence.

................, 1935. Notes on the geographical variations of *Argynnis aglaja,* L. *Entomologist* 68: 200-204.

Supplemental Note to Part 1 (Hesperioidea)

Evans (1952, p.132) places *Thorybes uvydixa* Dyar, 1915 as a synonym of *Thorybes valeriana* Plötz, 1882, or "Possibly a sub-species". An examination of the single specimen of *uvydixa* in the American Museum of Natural History and a photograph of the type kindly furnished by Mr. W. D. Field of the United States National Museum convinces me that these are distinct species. Since *uvydixa* has only been recorded from Mexico, it is omitted from the Check List.

Washington Corners, Mendham, N. J., U. S. A.

PANTHIADES M-ALBUM (LYCÆNIDÆ): REMARKS ON ITS EARLY STAGES AND ON ITS OCCURRENCE IN PENNSYLVANIA[1]

by Harry K. Clench

About the only knowledge we have of the life history of *Panthiades m-album* (Boisduval & Leconte) we owe to John Abbot and the observations he made in Georgia nearly a century and a half ago.

From these observations we have brief superficial descriptions of larva and pupa, information that the larval food is oak and perhaps *Astragalus* also, and we learn that the species overwinters as a pupa, that when not overwintering the pupal stage lasted 16 days in one reared individual. Abbot, of course, never published any of this but contented himself with the rearings he did so exceptionally well, with his exquisite illustrations and with penning copious notes which accompanied many of the paintings he sold.

Some of this information, taken from these manuscript notes, was published by Boisduval and Leconte (1833: 87, 89). Scudder, too, had access to Abbot's MS observations and he has added much more to the brief amount given by the early authors (Scudder 1889: 1825-1826).

Tietz ([1952]: 13) has given a surprizing list of host plants, which I quote verbatim: "*Astragalus* sp.; *Cratægus* sp. (thorn seed pods); *Humulus Lupulus* Linn. (hops); *Hypericum* sp.; *Quercus* sp. (oaks); *Tilia glabra* Vent.; *Vicia sativa* Linn." There is no documentation of any of these, no clue as to their source, and I hold all but the quite probable *Quercus* to be suspect until supported by confirming observation.

Recently, while attending a staff picnic at Carnegie Museum's Powdermill Nature Reserve, my wife, Odette, brought me a lycænid larva she had found near the ground in the woods. By its size alone it was immediately recognisable as something out of the ordinary, most probably a Hairstreak although the usual Hairstreaks of the area should not have been larvæ at that time (8 July). I tried to induce it to feed by placing it successively on leaves of several available trees, including oak, but it showed not the slightest interest in any of them and, when left to itself, crawled down to the ground and came to rest on a dead leaf. This leaf and a few others, together with a bit of earth, were put into a paper cup and brought home.

For two days the larva remained thus, contracted and unmoving, and on 11 July it pupated. Two weeks later to the day, on 25 July, a hand-

[1] Contribution no. 3, Powdermill Nature Reserve of Carnegie Museum.

some male *Panthiades m-album* emerged. Eclosion was accomplished sometime in the morning but the exact hour was not noted.

General Observations

Larva. No description of the larva was made at the time so these few words are solely from memory. The specimen when found was dull olive green, perhaps more brown than green, and as pupation approached it became browner still. The diagonal dorsolateral segment lines common to many lycænid larvæ were well marked. In shape, apart from the rather large size, it was typically lycænid.

Pupa. Abbot's drawings as copied (poorly) in Boisduval and Leconte (*op. cit.*, plates 26, 27) both show the pupa attached to a twig. The present specimen, however, pupated on a dead leaf originally on the ground and this may be typical. It was attached to the leaf by a girdle composed of a few strands of silk irremovably caught in a dorsal crease.

The pupa was brown, nearly unmarked save for a darker brown blotch middorsally on each of segments 1, 4, 5 of the abdomen. It measured approximately 11 mm. in length, distinctly pear-shaped with the abdomen considerably broader and higher than the thoracic and cephalic regions. A striking feature is the large dorsal separation between abdominal segments 5 and 6, marked by a polished black band, radially ribbed (under magnification) and inclined at a steep angle to the surface of the abdomen as a sort of "riser" to the step-down from the one segment to the next. It seems reasonable to suppose that this indicates mobility of the posterior abdominal segments and it may be related to the sound production described next. The pupal duration of 14 days corresponds well with the 16 days observed by Abbot.

Most surprizing of all is that the pupa is capable of making a very definite sound, consisting of a series of faint but distinct and rather high-pitched "chirps" – which it would make whenever it was disturbed. I know of no published reference to sound production in butterfly pupæ in North America but the Palearctic lycænid, *Callophrys rubi,* has been recorded (Ford 1945: 92) as making a sound described as a "slight creaking." F. M. Brown (personal communication) informs me that he has noted creaking or chirping in three very different North American species: *Hypaurotis crysalus, Chrysophanus titus,* and *Strymon melinus.*

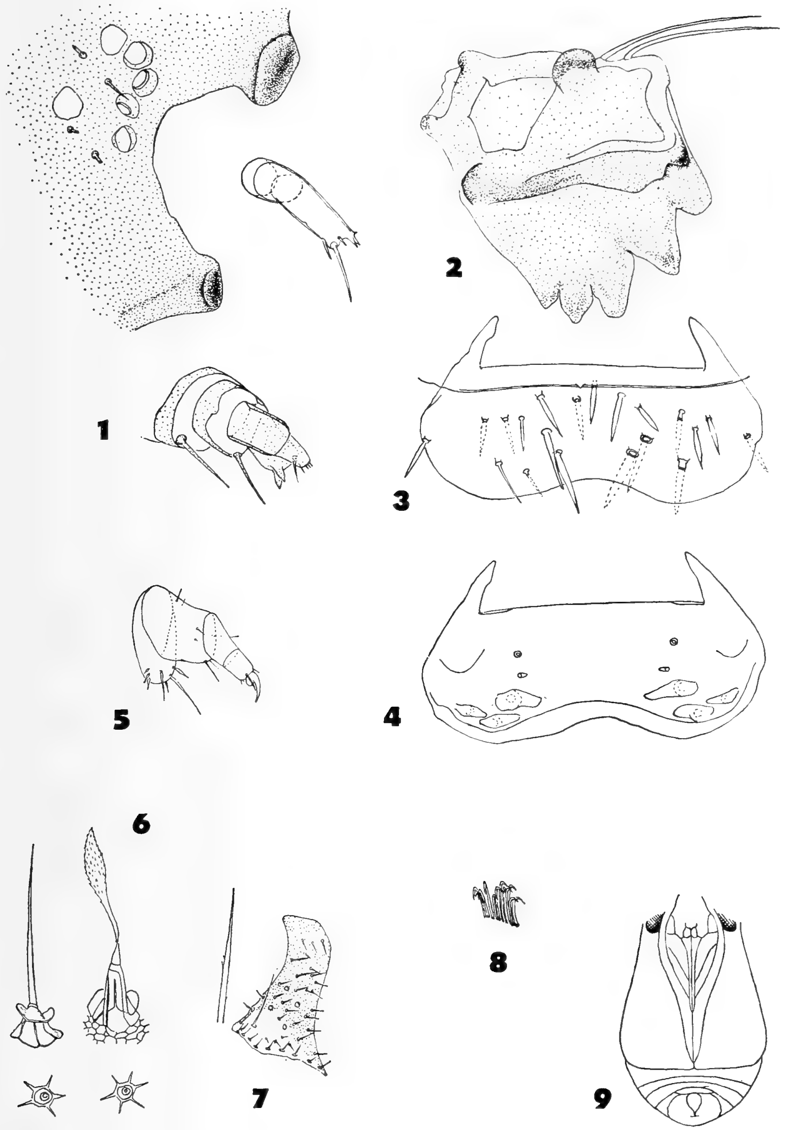
The five species now known to make sounds belong each to a different genus and represent a pretty diverse sampling of Hairstreaks, enough so that we are justified in suspecting that it may be a phenomenon common to all of them. Why, then, should it have remained so nearly unknown? With the host of keen observers in Europe and in North America one would have expected many references to it in the literature. I can only conclude that the sound, because of its faintness, has been overlooked. It is certainly to be hoped that those rearing lycænids, especially Hairstreaks, will make a point of determining whether or not sound is produced. In this connection it may help to add that I was able to elicit the sound at will by picking up the leaf with chrysalis attached and rotating it back and forth in one direction or another, though not violently of course. The sound was produced promptly and for some little time without further disturbance of the chrysalis although it must be placed close to the ear to be heard.

Note. After this paper had been submitted an important article (Hinton, 1948) on pupal sound production was found. HINTON lists (table II) a number of Lycænidæ which have been heard to stridulate as pupæ, among them the palearctic *Thecla quercus* and *Euristrymon pruni.* He also lists a Blue (the Indian *Jamides celeno*) and a Liphyrid (the East Indian *Allotinus horsfieldi*). "In the Lycænidæ," HINTON observes (*l.c.*: p.255), "both parts of the organ, which is between segments five and six, consist of rows of tubercles." This, as the description above shows, is not true of *m-album,* which has a well developed ribbed band on the posterior edge of segment five and no visible opposing tubercles. Other references to pupal sound production are in Hinton (*op. cit.*) and in Frings & Frings (1960).

LARVAL MORPHOLOGY

The chitinous structures of lycænid larvæ hitherto have received but scant attention, an omission which surely is responsible in great part for the present poor state of our knowledge of these larvæ. The advantages, however, of studying them are many and include such points as: (1) they are subject to very little distortion on mounting; (2) they normally present only limited individual variability; (3) they may be studied from cast skins as well as, if not better than, from whole specimens, thus enabling one to study and preserve larval structures and at the same time obtain the adult for firm identification.

With only *m-album* at hand there is no basis for comparison and hence no way of knowing to what extent the various structures may prove systematically useful. In consequence choice of structures for illustration has been governed partly by ready availability and favorable orientation for study, partly by unusual appearance (such as the star-socketed setæ), and partly by demonstrated usefulness in other groups (such as the ocelli, the labrum). The excellent survey by DETHIER (1941) of larval antennæ leads us to expect little if any useful variation in that structure, but until it has been compared more widely in the lycænids we may not yet reject it.



Panthiades m-album, larval structures: fig.1. — lateral view of anterior right side of head capsule, showing mandibular condyles and ocelli (also shown are right antenna, between condyles, and right maxilla, below); fig.2 — mandible (ental view); fig.3 — dorsal aspect of labrum (missing setæ or parts of setæ indicated by dotted lines); fig.4 — ventral aspect of labrum; fig.5 — left prothoracic leg; fig.6 — the two types of star-socketed setæ: lateral aspect of the sockets and setæ above, dorsal aspects of the sockets below; fig.7 — right half of prothoracic shield, with distal portion of a typical seta enlarged to the left; fig.8 — partial set of crochets from an abdominal proleg to show their irregular multiserial nature; fig.9 — ventral aspect of pupa, cephalic portion incomplete (drawn from vacated shell).

Five major types of cuticular structures, presumably sensillæ, were observed on the body segments. On the prothoracic shield (fig.7) two of them occur: (1) numerous sparsely trichose setæ, observed nowhere else; and (2) a few simple small circles, each surmounted by a small, globular, transparent "bubble", found widely elsewhere on the body as well. The next cuticular structure (3) is a simple, ordinary seta with a regular, conventional socket; these are numerous over the neck region and ventrally along the body on either side of the legs and prolegs. The last two structures (4) and (5) collectively may be termed "star-socketed" setæ (fig.6), since their primary joint characteristic is an elongated projecting socket with longitudinal buttress-like lamellæ regularly arranged around it, giving the appearance of star-like rays when viewed from above. They replace the "normal" setæ over most of the body, varying a little in the heaviness of the socket from one part of the body to another. PETERSON (1948: 157, fig. L 23 G) has illustrated what seem to be these structures (sockets only) from "an unknown . . . lycænid . . . from foliage of woodland trees." His magnification, however, was insufficient to reveal their nature. Perhaps most interesting of all is that these star-socketed setæ are found in two distinct types: (4) a five-rayed socket bearing a normal-looking (regularly tapering, slender, unarmed) seta; and (5) a six-rayed socket bearing a shorter seta with a clubbed and spiculate tip. The latter is the scarcer but still numerous.

The remaining structures illustrated are most or less self-explanatory and require no special comment.

Panthiades m-album IN PENNSYLVANIA

It is relevant to add here a few notes concerning the occurrence of this Hairstreak in Pennsylvania, for this state lies athwart the extreme northern frontier of the species range and such points as habits, broods, ecology and frequency have special significance for the species as a whole, as well as for problems of an even more general nature.

The following list gives all the Pennsylvania records of the species of which I have knowledge. I am indebted to Mr. GEORGE EHLE, Lancaster, Penna., for the records from Berks and Lancaster counties.

Allegheny Co.: Summer Hill, Pittsburgh, 1♂, viii. 1948 (A. MACHERZ; CM); Wildwood Hollow, Pittsburgh, 1♀, 13. vii. 1894 (B. KRAUTWURM; CM); Panther Hollow, Pittsburgh (W. J. HOLLAND; listed in Engel (1908: 34), but the specimen apparently lost); Gibsonia, 1 ♂, 4. viii. 1955 (J. GROM; CM); Glenshaw, 1 ♀, 7. v. 1959 (ETHAN COWLES; his coll.); Penn. Twp. (MARLOFF; in Tietz ([1952]: 13).

Beaver Co.: NE. corner of county, 2 mi. W. of Zelienople, 1 ♂, 3. viii. 1955 (CLENCH & N. D. RICHMOND; CM), dead on muddy bank of stream.

Lawrence Co.: Slippery Rock Creek, ca. 3 mi. W. of Porterville, 1 fresh ♀, 18. vii. 1953, and another fresh ♀, 6. vii. 1959 (J. BAUER, CM).

Westmoreland Co. (all Powdermill Nature Reserve, ca. 9 mi. S. of Ligonier, all but the last in the beech-birch-tulip-maple forest of the "Lodge area", all in CM): 1 fresh ♀, 14. v. 1948 (A. C. LLOYD); 1 ♀, 3. vi. 1958 (LLOYD); 1 slightly worn ♂, 4. vi. 1958 (CLENCH); 1 ♀, 7. vi. 1958 (BAUER & LLOYD); 1 rather worm ♀, 16. v. 1960 (LLOYD); 1 ♂, wooded part of "Cabins area" nr. Avinoff Lodge, *ex larva,* emerged 25. vii. 1960 (O. CLENCH), discussed in the first part of this article.

Berks Co.: Reading, 6. v. 1939 (PETERS); 9. v. 1943 (MAYER): both *teste* G. EHLE.

Lancaster Co.: Adamstown, 2. vii. 1939 and 28. viii. 1938 (both PETERS; *teste* G. EHLE).

Pennsylvania (no further data): Scudder (*l. c.*) and others. TIETZ ([1952]: 13) records it from "Rockville (April)" but there is no indication as to which of two towns of this name it might be: one in Dauphin Co., the other in Chester Co.

Flight periods. The few available records make determination of these periods both difficult and subject to uncertainty.

It is convenient to divide the records into three areas: (1) Allegheny, Beaver and Lawrence counties; (2) Westmoreland Co. (Powdermill); and (3) Berks and Lancaster counties. The first two of these groups may be studied together. In each of them there are two distinct flights and by assuming them to be of about the same length and that those at Powdermill are about a week delayed relative to those of the first area we obtain a duration of each flight of about one month, average flights dated in each areas as follows:

1. Allegheny, Beaver, Lawrence counties: (5.v – 5.vi) (4.vii – 4.viii).
2. Powdermill (Westmoreland Co.): (12.v – 12.vi) (11.vii – 11.viii).

It may be significant that the first date of the spring flight in each area corresponds closely to the average date of the last killing frost.

Records from Berks and Lancaster counties are much fewer than those for the preceding two areas and pose some other difficulties as well. The two May records fit well with the area 1 spring flight but the single record each in July and August go with the second flight of neither area, the first being too early, the second much too late. I suspect that the species in this area may have three flights, instead of two. If we take the starting date of the first flight to coincide with that of the average date of the last killing frost in spring (about 26 April), and if we assume that the duration of each flight and the interval between are the same as in western Pennsylvania, we would get the following:

3. Berks & Lancaster Cos.: (26.iv–26.v) (26.vi–26.vii) (26.viii–26.ix).

These hypothetical flight periods do contain all four dates as well as the April date of TIETZ' record, which is from the same area.

Habits and occurrence. At Powdermill and some, if not all, of the other western Pennsylvania localities *P. m-album* is preeminently a forest species, though frequenting small clearings in these forested areas. There is possibly also an association with running water for most of them have been taken within a few feet of a stream.

The species is here definitely a rarity, as the short list of records shows. At Powdermill, following the first capture by LLOYD, a concerted effort to secure additional specimens was made, by LLOYD, BAUER and CLENCH, not only during the remaining time of the 1958 spring flight period but also during the summer flight period of that year, and both periods in 1959 and 1960. The result was an additional three specimens of the 1958 spring flight, none of that year's summer flight, none in either flight of 1959 and only a single specimen, of the spring flight, in 1960, this last a surprize, for it was taken several hundred yards away from the stream-side clearing where all the other captures had been made. It is of interest, too, that no one has yet seen an *m-album* imago anywhere near the spot where the larva was found, though most of us have spent a great deal of time there, at all seasons. It would seem possible that this species may be a dweller in the upper forest canopy, which would account for some of its rarity in the eyes of earth-bound collectors.

Literature cited

Boisduval, J. A. & J. Leconte, 1833. *Histoire générale et iconographie des lépidoptères et des chenilles de l'Amérique septentrionale.* 228 pp., 78 pls. Roret, Paris.

Dethier, V. G., 1941. 1941. The antennæ of lepidopterous larvæ. *Bull. mus. comp. zool.* 87: 455-507, 9 pls., 5 figs.

Engel, H., 1908. A preliminary list of the Lepidoptera of western Pennsylvania collected in the vicinity of Pittsburgh. *Ann. Carnegie mus.* 5: 27-136.

Ford, E. B., 1945. *Butterflies.* 368 pp., 72 pls. Collins, London.

Frings, Mabel, & Hubert Frings, 1960. *Sound production and sound reception by insects: a bibliography.* 108 pp. Penna. State Univ. Press, State College.

Hinton, H. E., 1948. Sound production in lepidopterous pupæ. *Entomologist* 81: 254-269, 8 figs.

Peterson, A., 1948. *Larvæ of insects, part I.* 315 pp., 84 pls. Author, Columbus.

Scudder, S. H., 1889. *The butterflies of the eastern United States and Canada with special reference to New England,* vol.3: 1775-1958, 89 pls. Author, Cambridge, Mass.

Tietz, H. M., 1952. *The Lepidoptera of Pennsylvania. A manual.* 194 pp. Penna. State College Agric. Exper. Sta., State College.

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THE LIFE HISTORY OF *ADELOCEPHALA QUADRILINEATA* (SATURNIIDÆ)

by Richard Heitzman

During a collecting trip in June 1960 William Howe mentioned taking several fine specimens of *Adelocephala quadrilineata* Grote & Robinson. He remarked that as far as he knew the life history was unrecorded. I asked him to save the next female caught, and if eggs could be obtained I would try to rear the larvæ.

On 18 June a female was taken at black light in Ottawa, Kansas. She was placed in a large shoe box, and between June 19-22 almost 50 eggs were laid. On 26 June I received the eggs, and the following results are herewith recorded.

I thought that some species of locust would be the best bet as a food plant. Honey Locust (*Gleditsia triacanthos*) was readily accepted. A number of other trees and shrubs were offered, including Rose-Acacia (*Robinia hispida*), but all were refused. All larvæ left on any other plant than Honey Locust died within 24 hours.

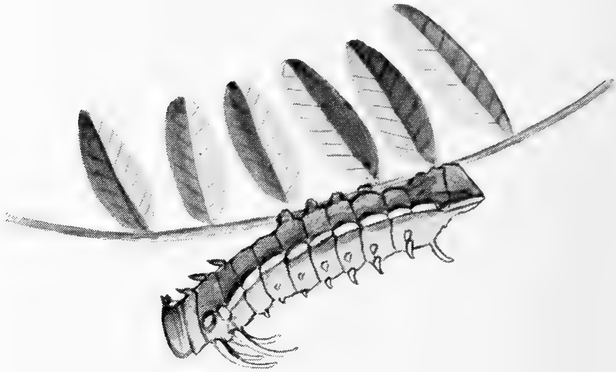
Detailed descriptions were made of the larvæ in each instar and these follow. Descriptions are taken from five larvæ taken from the group and raised separately for closer observation.

Egg: Bright green and rather flat in appearance. 1.6 mm. wide 1 mm. high. Eggs were laid singly or in clusters. In one case five eggs were laid on top of each other.

1st instar (June 27-29): The emerging larva eats from one fourth to nearly all of the eggshell. The body color is pale yellow. Small bristles cover the body. There is a brown spiny caudal horn tilted forward and four pairs of tubercles that arise subdorsally from the second and third thoracic segments. These are quite spiny and very long, at least half the length of the body; when at rest they are held together and pointed forward over the head. When touched the larva spreads all the horns wide apart and thrashes the body from side to side. After two days of feeding the body becomes a medium green in color with a narrow white substigmatal line traversing the sides of the body from the base of the outer tubercles on the third thoracic segment to the tip of the upper edge of the anal plate. The larva in this instar spins a strong silken thread as it moves around, and several of the larvæ were found hanging an inch or two below the food plant on this thread.

2nd instar (July 2-3): The body is medium green. The caudal horn is spiny, a medium brown color, tilted forward. The eight thoracic horns are still long compared to the body. They are medium brown with dark brown knobs, the entire tubercle very spiny. The white substigmatal side line is very prominent. The head is medium green with a lighter green and brown stripe vertically on each side of the head, the mandibles brown, and the thoracic legs brown.

3rd instar (July 9-11): The body is bright apple green. The caudal horn is spiny, tilted forward, and reddish brown in color. The thoracic horns are very thin and spiny, tan in color. The substigmatal side line is now light yellow in color, offset



dorsally at each abdominal segment. The thoracic segments between horns and the abdominal segments above the substigmatal lines are covered with tiny yellow warts. On the fourth and sixth abdominal segments are four flat horn-like protuberances, two on each side one below the other, pointing upward and slightly forward, and pearl colored. The head is dull green with vertical side stripes greenish white, the mandibles, thoracic legs and lower part of the prolegs light brown.

4th instar (July 17-19): The thoracic segments, anal prolegs, and abdominal segments above the substigmatal side lines are bright apple green, and the abdomen is dull grayish green. The head is dull grayish green with the vertical stripes grayish white, and the mandibles light brown. The thoracic horns now curve backward, and are green at the base and tips and reddish brown in the center. The caudal horn is reddish brown, green at the base, curving backwards. The substigmatal side lines are yellow with brown upper edges; they protrude as they cross a segment and are sharply indented at each intersegmental fold. Abdominal segments 2 through 8 each have four flat horn-like appendages, two on each side rising one above the other, the lower ones rising just above the substigmatal side lines; they are glistening pearl-colored outwardly and coral red inwardly. On some larvæ these flat protuberances are present only on the fourth and sixth segments, the other segments having only a raised yellow area with two tiny points. The first thoracic segment is ringed dorsally from spiracle to spiracle with a row of larger yellow warts. The thoracic and prolegs are gray green. The entire body is speckled with tiny yellow and white warts. As pupation time approaches the larva turns a dull reddish on the dorsal area of the body and becomes very restless. Full grown larvæ measure from 46 to 51 mm. The larvæ went into the ground from 23 to 26 July. Each larva went about one-half inch into the ground. The larvæ remain in a torpid condition for almost three days before pupation. Just before pupation the body loses almost all color contrast, being now a dull watery green. After pupation the pupæ work back to the surface.

Pupa. Dark reddish brown. 28 - 30 mm. long. Cremaster jet black, 4 mm. long, forked with two sharp points.

The moths emerged from 10 to 20 August, the first ones being males and the last ones females. All specimens are smaller than those that were collected at black light. It is therefore probable that larvæ found in nature will be slightly larger than the above description.

The drawing of the full grown larva which is included with this description was done by WILLIAM HOWE.

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EMERGENCE AND LONGEVITY OF *CATOCALA FRAXINI* (NOCTUIDÆ)

by Brian O. C. Gardiner

There is a gradually increasing amount of information becoming available on the periodicity of pupal emergence in insects. Lepidoptera appear to emerge at a set time of day which varies from species to species and may be either a short and fairly sharply defined period or an extended time of twelve hours or more. In many cases the time of emergence is governed by the preceeding conditions of light and darkness. Much of the available information has been briefly summarised by Palmen (1955). The longevity of comparatively few species of adult Lepidoptera is known. It would seem useful therefore to put on record my own observations on the emergence and longevity of *Catocala fraxini* L.

The observations were made over a period of three years, on 20 pupæ in 1955, 63 in 1956, and 58 in 1957. All these pupæ emerged between 7:00 p.m. and 8:30 p.m. Greenwich mean time. An account of the breeding conditions under which the larvæ were raised and the pupæ kept has been described in an earlier paper (Gardiner, 1956). It is perhaps best, however, to restate here that this was in an unheated wooden shed, which while getting rather warmer than the outside temperature when the sun was shining, otherwise gave natural conditions of light, temperature and humidity.

There have been two earlier observations on the emergence of *fraxini*. Howarth (1950) states that all his specimens (a total of 42) emerged ofter 10:30 p.m., while Morley (1950) had one emerge at 9:30 p.m. and 11 between 9:30 and 10:30 p.m. Neither of these authors however states which time system he is using. On the reasonable assumption that it be British summer time my results are in agreement with those of Morley and earlier than those of Howarth. It seems clear from these results that *fraxini* emerges over a short period of about an hour and a half just after the onset of dusk.

In 1956 and 1957 observations were kept on the period over which the brood emerged. In 1956 63 specimens emerged between August 7th and September 5th. In 1957 58 specimens emerged between August 2nd and 26th. The pattern of emergence for the year 1957 is shown in fig.1, which also shows the rate of death of the specimens for 1957 when

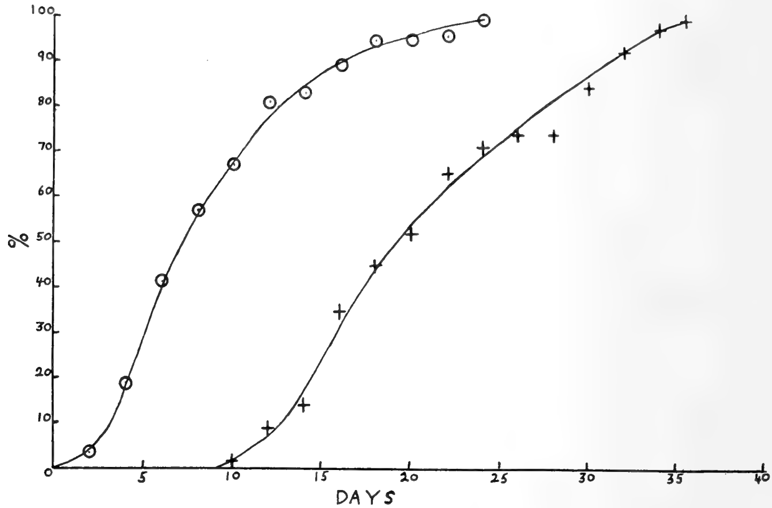

Fig.1. Graph showing the emergence (o — o) and death (+ — +) of *C. fraxini* in 1957.

all were kept. The average longevity was about 12 days. In 1956 only a total of 22 specimens were kept. Of these, 12 had an average life of 14 days. The remaining 10, however, lived on for an average of 30 days, and one female lived for a total of 55 days.

References

Gardiner, B. O. C., 1956. Some observations on breeding *Catocala fraxini* L. *Ent. rec.* 68: 202-205.

Howarth, T. G., 1950. Notes on *Catocala fraxini* L., a British residential species *Ent. gaz.* 1: 41-44.

Morley, A. M., 1950. *Catocala fraxini* L., a further note. *Ent. gaz.* 1: 99-100.

Palmén, E., 1955. Diel periodicity of pupal emergence in natural populations of some chironomids (Diptera). *Ann. zool. soc. 'Vanamo'* 17: 1-30.

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ESPECIALLY FOR FIELD COLLECTORS

(Under the supervision of FRED T. THORNE, 1360 Merritt Dr., El Cajon, Calif., U.S.A.)

THE RECENT REDISCOVERY OF *EUMÆUS ATALA* (LYCÆNIDÆ) IN SOUTHERN FLORIDA

by GEORGE W. RAWSON

Rare or supposedly extinct species of butterflies are always of particular interest to lepidopterists. Consequently, the recent discovery in Florida of a small colony of one of our unique tropical species, namely, *Eumæus atala florida* Röber, should be regarded as a special event. As YOUNG (1956) stated: "Records of its reoccurrence would be worth a published note."

Up to the time of the late twenties *atala* was regarded as quite common in the Miami area and in some of the Lower Florida Keys. In fact W. J. HOLLAND (1931: p.223) denotes the species as "swarming". Within recent years *atala* has become so rare that it is generally supposed to be extinct. KLOTS wrote (1951: pp.132-133): "the last records I know are of specimens taken about 1933 in an inland hammock near the Royal Palm State Park". More will be said about this particular area later.

Numerous causes have been attributed to the decline of *atala*, but one of the principal reasons, according to this writer's observations, seems to be the increasing scarcity of the specific food plant, that is the low-growing fern-like cycad, *Zamia* spp., commonly called "Coontie" by Floridians. According to SMALL's *Manual* (1933: pp.1-2), "The Zamias were known to the early Seminoles as Conti Hateka, which means white-root or white bread plant". Four species of this genus are listed by SMALL as occurring in the southern counties and in the Everglades of Florida. *Zamia integrifolia* seems to be the species most commonly referred to in the literature as the specific food plant for *atala* larvæ. The starchy underground stems constituted one of the principal sources of flour for the Florida aborigines and, later, the Seminoles. SMALL also stated, "The phenominal growth on the Everglade Keys now furnishes 'Florida arrowroot' to the white man".

Material changes must have occurred, because, during my five years residency in Florida, I have paid particular attention (during field trips, etc.) to the distribution of wild Coontie plants but have yet to find a native stand either in southern Florida or the Keys abundant enough to support more than a small and precarious colony of *atala*. Apparently clearing rural areas for human habitation, real estate developments, cattle ranches, etc. have diminished or destroyed the native stands of Coontie in all but private gardens, public parks, etc., where it is used for decorative purposes or as "an indigenous botanical novelty".

Within the last three or four years there have been "guarded reports" of small colonies of *atala* in wild or secluded places in southeastern Florida; but the first authentic record was obtained on 28 February 1959, by Mr. JACK DEMPWOLF's father, of Westfield, N. J., who secured a few specimens from a small colony while on a vacation trip. This locality has been kept a secret for what might be termed "Security Reasons".

The first information I received about the discovery of *atala* was from one of my former field companions, DONALD EFF of Boulder, Colorado. He, in addition to advising me of the discovery of *atala,* asked if I knew of anyone, preferably a lepidopterist living in southern Florida, who would be willing to visit the colony and capture a few female specimens. These would be used as foundation stock for the purpose of establishing an artificial or man-created colony of *atala* in a chosen area where the species would have a better chance of survival than in the place where Mr. DEMPWOLF made his interesting capture. Not knowing any person who was in a position to undertake a project of this kind and, knowing the matter to be urgent, I volunteered to carry out the suggestions mentioned by Mr. EFF in his letter to me.

Apparently DONALD EFF informed JACK DEMPWOLF of my offer to help because I received a letter from the latter appreciating my proffered cooperation and including special directions for finding the *atala* colony. JACK DEMPWOLF and his friends, knowing that the *atala* colony discovered by his father was in a precarious position due to the rapidly increasing demand for more and more land for development, decided that an attempt should be made to transfer a few captured females from the present colony to a more suitable location, where the species would have a better chance to prosper.

After my offer to assist in the establishment of the artificial colony of *atala,* I was fortunate in making arrangements with Dr. WILLIAM B. ROBERTSON, Park Biologist at the Everglades National Park, who promised to have a suitable spot located in the Park where captive females would be liberated. Curiously enough the area chosen was either near to, or perhaps the same place, where *atala* was last seen in 1933 (or 1935; see Young, 1956: p.209), namely the Royal Palm State Park (which is now part of the new Everglades National Park) east of Flamingo, Florida.

During the latter part of August 1960, while I visited the Everglades National Park, Mr. ERIC CHRISTENSEN, Park Naturalist, kindly showed me the spot chosen for the prospective *atala* colony. It consisted of a hardwood hammock not far from the National Park Service Headquarters, so situated that it would be under the protection and supervision of the Park officials and rangers.

The first attempt to capture female *atala* for breeding stock was made on 18 July 1960, in company with the late WILLIAM M. DAVIDSON, a retired government entomologist of Orlando, Florida. We visited the DEMPWOLF colony, arriving at our destination about mid-day. Very few *atala* were seen on this occasion, probably due to the fact that we were unfamiliar with the habitat. In the course of about one hour we captured twelve specimens from which four females were selected, the remainder being liberated for reasons of conservation.

The four captive females were taken to New Smyrna Beach, where I am living, and placed in a breeding cage with a supply of fresh *Zamia* fronds. Three days later (*i.e.*, July 21st) two of the females commenced to oviposit. One laid a batch of 43 ova, a second only 7. The larvæ were thrifty and the mortality rate quite low (*i.e.*, 6.2 percent). Thirty-one days after the females were confined in a breeding cage 31 pupæ had been successfully raised.

The pupæ were carefully packed and sent by mail to the Everglades National Park to Mr. CHRISTENSEN, who (because of Dr. ROBERTSON's absence at the time) promised to watch the pupæ carefully and liberate the imagoes in the spot selected near the Royal Palm Park. Mr. CHRISTENSEN reported that the imagoes emerged soon after they had been received and that they had been liberated in the chosen spot.

Unfortunately this, our first attempt, was doomed to be a failure. On the night of 11 September 1960, the tropical hurricane called "Donna" swept through the Everglades with such violence that serious damage was done to the hammock vegetation. Months after this no evidence could be found that *atala* had survived, either because of the storm or other adverse conditions.

Late in February 1961, a second visit was made to the DEMPWOLF colony. Only two specimens were seen and none taken. On 26 May 1961, a third visit was made to the spot. This time I was glad to find that the previous year's Hurricane "Donna" had not, apparently, caused any appreciable damage to either the hammock habitat or to the *atala* colony. Only two specimens were seen and none taken. On 26 May 1961, females were selected from numerous catches, all the rest being freed.

On 17 June 1961, 31 days after the thirteen female *atala* were confined to their cage, a total of 44 live pupæ had been successfully raised. These, as before, were mailed to Mr. CHRISTENSEN for liberation near the Royal Palm Park soon after the imagoes emerged from pupæ and could fly.

During the first attempt Mr. CHRISTENSEN had a special outdoor cage constructed to house the pupæ so that the emergence of imagoes could be carefully watched to see if copulation took place. However, as mating did not occur in captivity, the second lot of imagoes were taken to the Royal Palm Park area and liberated as before. Months after their liberation no evidence could be found that a colony of *atala* had been established. This time weather conditions (aside from a very dry spring and early summer) were favorable, and there were no tropical hurricanes to disrupt the programme.

While the explanation of our failure is hypothetical, it is quite evident that further attempts should not be undertaken without careful planning. In particular, potential habitats should first be thoroughly investigated to determine whether ecological conditions are suitable and that the location is safe from human interference or exploitation, or other detrimental factors. Furthermore, it is evident that a project of this kind is not likely to succeed by "remote control" or without careful planning, cooperative support, and organization.

The accomplishments of our European colleagues in saving some of their rarer Lepidoptera can be cited. For instance, the classical example of the successful artificial introduction into England of the Dutch subspecies of the English Large Copper Butterfly *Lycæna dispar* (which had become totally extinct in the Fen District in 1847 or 1848) stands out as a remarkable example of determined enthusiasm on the part of British lepidopterists and naturalists (see account in Ford, 1946).

During this work it was possible to study the early stages of *atala*. Because of this, notes were taken and drawings and photographs made of different stages of development. While the early stages and life history of *Eumæus atala* have already been described and published by Scudder (1875) and Schwarz (1888), and Dethier (1941), the first two publications are now out of print and all may be difficult to refer to. For this reason I hope the following new account of the early stages of *atala* will be of interest to those who find it difficult to refer to the earlier writers, or who are not in contact with well-stocked libraries.

The Early Stages of *Eumæus atala*

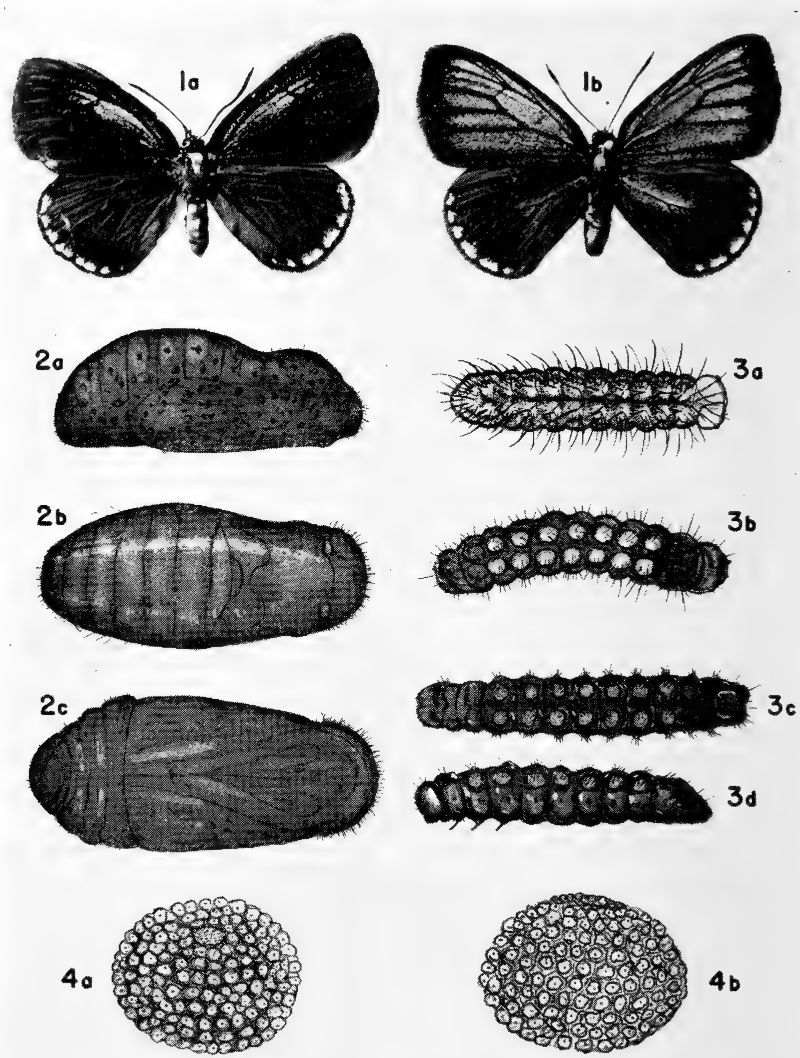
OVUM: *Eumæus atala* oviposits in clusters, generally on the upper side of *Zamia* leaflets, usually near the tip and occasionally on the stem of a frond. In color the ovum is light gray and pitted with crater-like depressions becoming gradually smaller and more compact from the base upwards toward the micropyle. The average diameter is 1.5–2 mm. The morphology is similar to an inverted bole (see figs. 4a, 4b for sketches of ovum). Ova commence to hatch 4 to 5 days after oviposition, and the young larvæ consume the micropyle together with about one-half of the egg shell. The ova are cemented or attached to their support so firmly that heavy showers, etc., do not dislodge them.

LARVA: Newly hatched larvæ are 2.5 mm. (plus or minus) in length. The body is yellowish brown during the first or second instar (figs. 3a, 3b). As the larvæ become more mature (figs. 3c, 3d), the body becomes reddish brown and finally a brilliant brick-red with two parallel rows of seven bright yellow spots which, when nearing full development, are so large that they almost cover the entire dorsal surface. The legs are black and the mandible olive brown. As in the case of other lycænid larvæ, a hood or cowl on the first thoracic segment over-hangs the head, which is usually not seen from above unless the larva is eating. The larvæ are gregarious and remain so through to pupation. Very young larvæ first consume the external cellular layer of tissue on the upper side of *Zamia* leaflets, commencing near the tip. This produces a moth-eaten appearance to the place where the leaflet has been consumed. When more mature, larvæ consume the entire leaflet. The larval stage requires about 18 days. Just before pupation the larvæ stop feeding, hunch up, and remain stationary. The number of instars was not determined.

PUPA: The shape of *atala* pupæ is similar to the general lycænid type, as may be seen by referring to the drawings (figs. 2a-c). The pupal length is 1.5 cm. (plus or minus). The color is light reddish brown, and the integument is thin enough to reveal the yellow spots on the back of the encased pupa. When nearing the time for the emergence of the imago, the pupa changes color to a dark brown and then becomes opaque. The outlines of wings, antennæ, legs, etc., are plainly discernible on the surface of the pupa.

Pupation takes place on *Zamia* leaflets and also on the stem of the frond. The pupa is very loosely attached by means of a silken girdle passing around the mid-section of the body; both ends of the girdle are attached to the *Zamia* leaflet or other support. There is no caudal attachment. In fact, the pupa turns and twists in such a way that it appears to be coming loose from its moorings. The pupal stage, depending on temperature, etc., lasts for approximately 10 days. Imagoes emerge, generally, during the early morning hours and are fully capable of flight very soon after emerging.

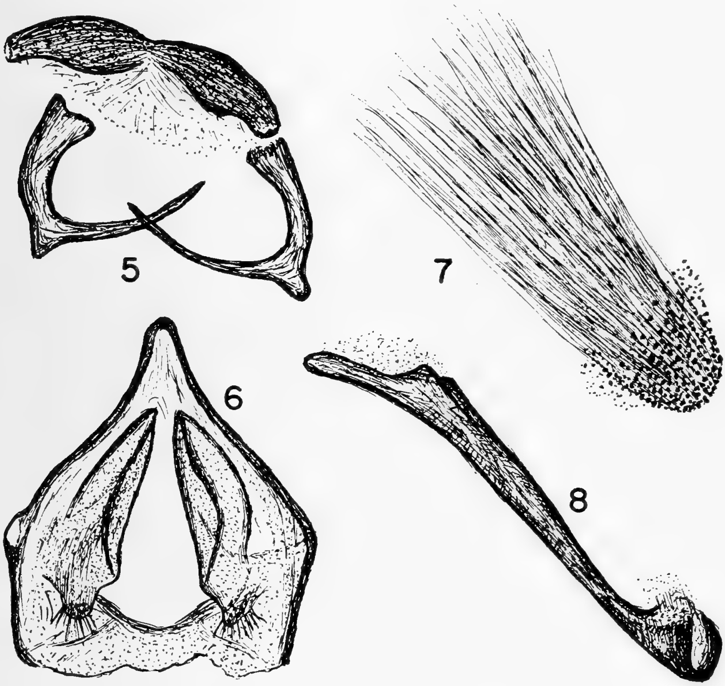
IMAGO: So little was seen of *atala* in a wild state that I have not much to add to what has already been stated by other writers. The remark made by Klots in his indispensible *Field Guide* (1951) about its flight is indeed amusingly accurate, namely "*Atala* has a deceptively slow and lazy-looking flight". It can, however, gather considerable speed if one misses his stroke with the net! After this, the insect rises and rapidly disappears over the top of trees and bushes at an accelerated



ADULT: fig. 1a — ♀, upperside; fig. 1b — ♂, upperside.
PUPA: fig. 2a — lateral view; fig. 2b — dorsal view; fig. 2c — ventral view.
LARVA: fig. 3a — first instar, dorsal view; fig. 3b — second instar, dorsal view; fig. 3c — last instar, dorsal view; fig. 3b — same, lateral view.
OVUM: fig. 4a — subdorsal view; fig. 4b — lateral view.

[Figs. 1a, 1b photographs; others drawn by author.]

speed. The number of broods per year appears to be unknown. We know, however, that broods occur during the latter part of February, the latter part of March, and again toward the end of July. When raised in confinement, about 33 days are required between oviposition and pupation. Ten or more additional days are required for the emergence of imagoes, thus making the span from egg to imago a matter of about 42 days. Captured specimens placed in the breeding cage died within a period of a week or less, so that the duration of life on the wing may be quite brief. Under subtropical conditions, it is very difficult to determine the number of broods per year, because there is much over-lapping in a number of species, some of which (even in central Florida) are on the wing from January to December.



MALE GENITALIA: fig.5 — tegumen and gnathos; fig.6 — harpe; fig.7 — one of the two lateral brush-like organs; fig.8 — ædeagus.
[Magnification here approximately × 43.]

E. atala is sexually dimorphic, the males being quite easy to differentiate from the less brilliantly colored females. This fact is quite important in selecting females for breeding and for liberating unwanted males (if one is fortunate enough to have this opportunity). The genitalic construction of male *atala* (figs. 5-8) is quite interesting; there is a brush-like organ on each side of the genitalia which apparently functions as a scent organ (see Ehrlich & Ehrlich, 1961: p.188).

In conclusion, my thanks and appreciation for the cooperation and encouragement in this unfortunately unsuccessful venture go to my late friend and field companion William Davidson. Also to Donald Eff, Jack Dempwolf, Dr. Alexander B. Klots, and Dr. Charles L. Remington of Yale University, all of whom encouraged me in tackling this project. I also wish to thank Dr. William Robertson and Mr. Eric Christensen, members of the Staff of the Everglades National Park for their cooperation in locating a place in the Park and for their appreciated assistance. I am sure that we are all very disappointed that our efforts were apparently not successful, but it can be truthfully said that failure certainly was not due to lack of cooperation or to a keen desire to accomplish our objective.

Because the present status of *atala* in Florida is in a precarious condition due to man's so-called "conquest of Nature", it is urgent that further measures should be immediately undertaken to save this interesting and unique butterfly from what appears to be inevitable extinction, while we still have material available for foundation stock. Lepidopterists must unite towards further attempts to conserve and protect this species while there is yet time.

I therefore hope that this paper will create sufficient interest so that we can, either individually or collectively, organize or formulate plans for further action.

References

Dethier, V. G., 1941. Metamorphoses of Cuban Nymphalidæ and Lycænidæ. *Psyche* 48: 70-78, pls.5-6.

Ehrlich, P. R. & A. H., 1961. *How to know the butterflies.* 262 pp., 525 figs. W. C. Brown Co., Dubuque, Iowa.

Ford, E. B., 1946. *Butterflies.* 368 pp., 72 pls. Collins, London.

Holland, W. J., 1931. *The butterfly book,* rev. ed. 424 pp., 77 pls. Doubleday, Doran Co., New York.

Klots, A. B., 1951. *A field guide to the butterflies.* 349 pp., 40 pls. Houghton Mifflin Co., Boston.

Schwarz, E. A., 1888. Notes on *Eumæus atala. Insect life* 1: 37-40.

Scudder, S. H., 1875. The structure and transformations of *Eumæus atala. Mem. Boston soc. nat. hist.* 2: 413-419.

Small, J. K., 1933. *Manual of the Southeastern flora.* xxii + 1554 pp., ill. Publ. by author, New York.

Young, F. N., 1956. Notes on collecting Lepidoptera in southern Florida. *Lepid. news* 9: 204-212.

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STUDY OF IMMATURE STAGES AND FOODPLANTS

PRESIDENTIAL ADDRESS TO THE ELEVENTH ANNUAL MEETING OF THE LEPIDOPTERISTS' SOCIETY

Dear Fellow Members:

It is my great pleasure to be able to express my gratitude for having been chosen, for the first time from Asia, as the 11th President of the Lepidopterists' Society. In assuming this honorable post, I would like to thank all the members the world over and to pay my deep respects to Dr. J. H. McDunnough and all the other predecessors of mine.

It is a great pity that I am unable, on account of my official duties at home, to attend the present meeting in Colorado, which is by no means very far from Japan at this time of advanced æronautics. I wish the kind reader of this address will convey my best wishes to all those present and also my hearty congratulations on the success of this meeting.

Now, I would like to avail myself of this opportunity to introduce to you some aspects of Japanese lepidopterists' activities in brief. We Japanese certainly have access to references written in European languages, but since our works and achievements are publicized in Japanese, it is feared that they are not so well known abroad as European and American books and papers are to us. For one thing, there is a language difficulty on both sides, and for another one may consider the financial risk involved in the publication of these in foreign languages on the part of Japanese publishers. Therefore, I hope you might be interested to know something about the recent developments made in Japan in lepidopterology, especially in the field of butterflies and, in this connection, I would like to make a proposal at the end of my address.

Only two decades ago, immature stages of about forty percent, and some of them but incompletely, were known out of a total of some 180 species of butterflies inhabiting Japan proper. Until then, early stages of even some of the commonest had been undiscovered or at least unconfirmed in the isles of the Japanese Archipelago: for instance, those of only 3 were known among 14 fritillaries; likewise, 7 among 24 hairstreaks (Theclini), one species of the 10 so-called 'alpine' butterflies, and also one of the 6 aberrant-feeding lycænids, were known.

However, an upsurge of researches into butterfly life history, which originated around 1945, culminated ten years later, when almost all Japanese butterflies could be studied throughout their life-cycle. To return to the groups just mentioned: more than a dozen fritillaries had been finished up by 1952, and the numerous Hairstreaks were grappled with by keen and ingenious lepidopterists including KEI HAYASHI, who introduced *en masse* the early stages of all but a few in a graphic supplement of the monthly insect magazine, *Shin Konchu,* 1956. Light was also thrown upon the mysterious larval life of aphytophagous lycænids one by one, beginning with the publication in 1949 of the life history of *Niphanda fusca,* the sixth and the last species, *Spindasis takanonis,* being finally conquered in 1954. In the meantime, the alpine butterflies of Central Japan were studied continuously by YUKIO TABUCHI, whose strenuous efforts of more than fourteen years crystallized in his superb photo book published in 1959 under the title of *Kozancho* or *Alpine Butterflies.* The newest of such life-history books is the *Early Stages of Japanese Butterflies in Colour, Part I.* by A. HARA and myself published in December 1960. This, together with the Part II which will soon be off the press, will provide you with information on practically all the known butterflies of Japan in every stage. These two volumes contain colored illustrations of 196 species in all, including several of southern origin found only on remote islands off the Kyushu mainland.

At the present moment, then, there remains a single species that still defies the continued painstaking searches by lepidopterists, in spite of the fact that the butterfly, though very rare, is an indigenous one known since long ago. It is one of the brilliant green Hairstreaks, *Chrysozephyrus hisamatsusanus,* and by analogy with congeneric species the larva of this butterfly has been supposed to feed on Fagaceæ, but so far there has been no positive proof of it. On account of the scarcity of the adults, the otherwise effective method of searching for eggs among twigs and branches in winter has not been successful. This method, developed in Japan recently, has been instrumental in the clarification of the life history of so many Green Hairstreaks. Details of it appeared in the *Journal of the Lepidopterists' Society,* Vol.13, No.3.

Now mention must be made of the activities of lepidopterists which made it possible practically to conquer in ten years or so all those untouched butterflies whose number had not dropped below 100 in the forties. At one time there were more than sixty hobbyists' clubs throughout the country, composed mainly of university and high-school students. Thanks to the encouragement as well as useful suggestions unsparingly extended by a few leading lepidopterists, those young students successfully attacked one species after another, publishing in their own mimeographed journals what they knew of its immature stages and foodplants. Meanwhile, the magazine *Shin Konchu* played the role of a bulletin-board for those journals and allowed some space for their introduction and excerpts every month. There is no telling how helpful this kind of exchange of information was, and it is no wonder that knowledge and techniques thus acquired and accumulated bore rich fruit in a very short period of time. In his President's address in 1958 N. D. RILEY remarked: "When you discover new facts, publish them, don't let them die with you as is the reprehensible custom of so many otherwise excellent lepidopterists." As already mentioned, the young Japanese students *had* seen eye to eye with Mr. RILEY, and excellent co-operation having been firmly established between professionals and amateurs, Dr. EUGENE MUNROE, the 1959 President, was kind enough to say that "recent progress in Japan has also been exemplary."

The application of such common knowledge on the part of young lepidopterists knows no limits. For example, new localities and even new species have been found. It is particularly significant that whenever a new species was discovered, its life history was made known one year or two later. And starting from a mere study of life history, those students have gone so far as to engage themselves in the study of distribution, phylogeny, etc. Also, recently genetic studies have been undertaken, including line-breeding and interspecific cross-breeding. These activities and their results are necessarily exerting a strong influence on moth-lovers.

Those numerous hobbyists' clubs have certainly had their vicissitudes to date, but many of them have survived, or even prospered, and some of their journals are now neatly printed. Unfortunately, the *Shin Konchu* was discontinued for commercial reasons in the summer of 1959, without concluding Vol.XII. However, the two influential societies — the Lepidopterological Society of Japan and the Japan Heterocerists' Society — are issuing their journals, *Tyo to Ga* (= Butterflies and Moths) and *Tinea*, respectively. These two organs are open to the members wishing to contribute, and many new species as well as new forms and varieties have been introduced thereby. Articles on Lepidoptera also appear in *Kontyu*, journal of the Entomological Society of Japan. Among the local bulletins is *Cœnonympha*, issued by the Hokkaido Lepidopterists' Society.

In view of the recent progress made in butterfly biology in Japan, it may be said that initial stages of study owed much more to the emphasis laid on efforts to clarify what remained unknown, than to the dissemination of what was known. Here I would like to look around the world and pick up some species whose life history it is urgently needed to clarify. Among those I am going to enumerate there may well be some which have already been studied but, as far as I know, not yet come to the knowledge of lepidopterists the world over. A good example of this may be the homopterophagous habit of a common Japanese lycænid, *Taraka hamada*, which fact escaped European scholars' notice until recently, although its biology has been well known in Japan since 1898.

Needless to say, the study of immature stages and foodplants of a butterfly accompanies the possibility of obtaining a number of finest adult specimens. Academically, it assumes a far greater importance in the fields of phylogeny and taxonomy. Let us take a look at a conclusive chart of classification as made by Dr. PAUL R. EHRLICH in his "Comparative Morphology, Phylogeny and Higher Classification of the Butterflies" (1958). Among the 19 subfamilies given in it, there are four that are classified without endorsement of life history: viz., Baroniinæ (Mexico), Pseudopontiinæ (West Africa), Calinaginæ (Asia) and Styginæ (South America). Some information has since been obtained on Calinaginæ, but the other three monotypic subfamilies have as yet to be studied in all stages of metamorphosis before there is any final conclusion on their classification. We are also looking forward to information on immature stages and foodplants of such well-known species as *Druryia antimachus* of Africa, *Teinopalpus imperialis* of India, *Clothilda* spp. of Central America, many species of Riodinidæ found in South America, Lipteninæ of Africa, Poritinæ of tropical Asia, just to name a few.

The curious Indian swallowtail, *Teinopalpus,* has been known to depend on bushes of *Daphne*-species for its larval food, but the reference on which this information is based does not commit itself to the actual dietary life of the larva. Furthermore, it more or less depends on the study of biology whether *D. antimachus* is determined to be a close relative of *Ornithoptera,* or whether *Clothilda* should be classified under the Danaidæ. Too little is known about the life history of the numerous butterflies belonging to the Riodinidæ. Lipteninæ may reasonably be considered to be lichen-feeders, but closer and more elaborate studies of them might lead to the discovery of some affinity between those and entomophagous butterflies. Of all the Poritinæ, the life history of only one species, if I remember rightly, has been known. This butterfly, *P. erycinoides* of Java, bears a trivial name suggestive of its relationship with erycinids (= Riodinidæ).

Now to end my address, I wish to make a proposal. You must already be aware, no doubt, of the content of my proposal. Yes, this influential society of international fame should now embark on researches into life history of moths and butterflies on a worldwide scale, and I believe that no other lepidopterological body in the world is so suited to take up this difficult but important task as the Lepidopterists' Society. Let us advance the *new frontiers* of lepidopterology by studying immature stages and hosts of those numerous butterflies and moths whose biologies remain unknown.

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MINUTES OF THE ELEVENTH ANNUAL MEETING OF THE LEPIDOPTERISTS' SOCIETY

The 11th annual meeting of the Lepidopterists' Society was held at the Rocky Mountain Biological Laboratory at Gothic, Gunnison County, Colorado, August 7-10, 1961. Miss Toni Lincks was responsible for registration. A number of paintings by William Howe were displayed on the walls of the meeting room.

The Laboratory provided living quarters for a number of members and families, and meals in the dining room for many more, all at cost. Some groups camped near the Laboratory, and a few couples stayed at the Elk Mountain Lodge in Crested Butte, about ten miles away. Meetings were held in a new research laboratory building, and this building was open and very actively used each night for social informalities.

The opening session on the morning of Monday, August 7, was largely devoted to a round table discussion on METHODOLOGY with L. M. Martin, S. A. Hessel, D. B. Stallings, R. O. Kendall, O. R. Taylor, and B. S. Baker participating. Discussion ranged over diverse subjects, including preservatives, light-trapping, photography and rearing techniques.

The daylight hours of Tuesday, August 8, were allocated for collecting and exploring the high mountain environs of the laboratory, and various parties travelled to Cottonwood and Cumberland Passes, Cement Creek, and Somerset. In the evening slides of Mexico and Arizona collecting were shown by P. S. Remington and L. M. Martin. The Stallings-Turner clan treated the group to a feast of "Meg" larvæ (*Agathymus* sp.), some fried and some "fixed" in bourbon, and a wide choice of beverages. Less exotic fare was provided for the more squeamish, but many larvæ were swallowed, and some apparently enjoyed.

Submitted papers were given on Wednesday morning, August 9. The following were presented:

J. W. Tilden — "A proposed terminology for the types of diapause occurring in the Lepidoptera."

D. S. Chambers — "Niche diversification in the genus *Lycæna*."

C. L. Remington and K. Saitoh — "The chromosome numbers of Saturniidæ".

R. J. Jae — "On a successful trip after the new *Callophrys macfarlandi*".

L. M. Carr — "Studies of foodplant specificity in *Papilio*."

J. D. Eff — "A little about little-known *Papilio indra minori*."

Wednesday afternoon Dr. SHIROZU's Presidential Address was read by Dr. BELLINGER; it is being published in the *Journal*. This was followed by a symposium on RECENT BIOLOGICAL RESEARCH IN LEPIDOPTERA with P. R. EHRLICH, D. B. STALLINGS and C. L. REMINGTON participating. Studies of behavior, population structure, ecology, genetics and cytogenetics were discussed.

Dr. EHRLICH, the Secretary, called the business meeting to order at 4:35 P.M. It was decided that the 1962 Annual Meeting be held in conjunction with the Pacific Slope meetings in Santa Barbara, California, late in August. The Librarian, Dr. PETER BELLINGER, described the extent and functioning of the Society library and made a plea for members to send reprints of their papers to him for the library. His address is: San Fernando Valley State College, Northridge, California. There was a discussion of the methods of determining meeting places and preliminary plans were made to hold the 1963 meeting in Texas, with arrangements to be coordinated by R. O. KENDALL. The Society's publication problems were discussed by Dr. REMINGTON, Mr. HESSEL and Dr. TILDEN. The long awaited dos Passos Checklist was described as being close to publication. Dr. EHRLICH announced that a new membership list would be published sometime in the spring or summer of 1962. After a resolution expressing the Society's appreciation for the use of the Rocky Mountain Biological Laboratory's facilities the business meeting was adjourned at 5:05 P.M.

The meeting ended on Thursday, August 10, with informal discussions and collecting.

Those present at the meeting were: BRUCE BAKER, Dr. and Mrs. P. F. BELLINGER, LINDA CARR, Mr. and Mrs. D. S. CHAMBERS, Mr. and Mrs. DON EFF and JIM, Dr. and Mrs. P. R. EHRLICH, SCOTT ELLIS, Mr. and Mrs. LUCIEN HARRIS, JR., Mr. and Mrs. S. A. HESSEL, WILLIAM HOWE, RAYMOND JAE, SAM JOHNSON, Mr. and Mrs. GEORGE KAMP, Mr. and Mrs. R. O. KENDALL, TONI LINCKS, Mr. and Mrs. SCOTTY MACDONALD, Mr. and Mrs. W. S. MCALPINE, LLOYD MARTIN, FLOYD and BRUCE PRESTON, BOB PYLE, Mr. and Mrs. RAYPHOLTZ, Dr. and Mrs. C. L. REMINGTON and son ERIC, Mr. and Mrs. P. S. REMINGTON, Dr. and Mrs. F. H. RINDGE and daughter, Dr. and Mrs. K. SAITOH, Mr. and Mrs. GLENN SCOTT and family, Mr. and Mrs. D. B. STALLINGS and son DEE, O. R. TAYLOR, Mr. and Mrs. KENNETH TIDWELL, Dr. and Mrs. J. W. TILDEN and family, Dr. and Mrs. J. C. TURNER and family, Mrs. R. S. TURNER.

Respectfully submitted,

PAUL R. EHRLICH, Secretary

(with the assistance of DONALD EFF)

MINUTES OF THE EIGHTH ANNUAL MEETING OF THE PACIFIC SLOPE SECTION OF THE LEPIDOPTERISTS' SOCIETY

One of the most successful meetings of the Pacific Slope division of the Society ever held was called to order in the Santa Barbara Museum of Natural History by LLOYD M. MARTIN. There were 36 persons present. A welcome by NELSON BAKER for Dr. V. C. VANDERHOFF, Director of the Santa Barbara Museum of Natural History, was presented and accepted by the Chairman, followed by a similar address sent by Dr. TAKASHI SHIROZU, President of the Society.

A call for announcements brought forth the following: BILL TILDEN gave a resumé of the Colorado meeting. Western members present at Colorado were PETER BELLINGER, BILL TILDEN, PAUL EHRLICH and LLOYD MARTIN. The national annual meetings are planned to be held jointly with ours next year, and the Texas group wishes the 1963 meetings.

The first paper of the meeting was then given: FRANK P. SALA, "*Saturnia albofasciata,* the enigmatic saturniid."

Luncheon, again at this meeting, was graciously provided by the host museum to which all were grateful. A group picture was taken immediately following.

The second session, RONALD H. LEUSCHNER presiding, consisted of two papers in an unofficial symposium by Dr. CHARLES H. ABBOTT, "A migration problem – *Vanessa cardui,* The Painted Lady Butterfly" and Dr. J. W. TILDEN "General characteristics of butterfly migration, with special reference to *Vanessa cardui.*" These papers engendered an amazing degree of audience discussion and participation which carried over into the next topic, an open forum moderated by FRANK SALA on "Techniques for rearing Lepidoptera."

MCFARLAND, CHARLES HOGUE, BILL TILDEN and JERRY POWELL were participating parties.

An exhibit and exchange session completed the afternoon, and was followed by the annual banquet at the Miramar Hotel at which several members showed colored slides of collecting areas, namely, LLOYD MARTIN on Colorado, JERRY POWELL on White Mountains and FRANK SALA on larvæ. 45 people were present at the banquet.

The third session was called to order by FRED T. THORNE who brought the annual business meeting to order. Items concerned in order were:

I. *Resolutions*

1. Express warmest and sincerest thanks of the group to the museum for their kind consideration.
2. Express sincere thanks to NELSON BAKER and LLOYD MARTIN for their efforts in organizing such a successful meeting.
3. Thanks to the speakers and participants.

II. *Selection of 1962 meeting site*

At the request of the participants at the National Meetings in Colorado that the National meetings be held in Santa Barbara in 1962, it was decided to merge the two groups and meet on the west coast as a single body. Also, at the request of the wider group, it may be necessary to change the customary meeting time, which is the weekend before Labor Day, to Labor Day weekend itself on Saturday and Sunday. It was voted to meet again in Santa Barbara but that, owing to the problem of housing, investigation should be made of dormitory use at U. C. S. B.

FRED THORNE was elected Program Chairman for 1962 and NELSON BAKER, Local Arrangements Chairman. The Treasurer's financial report shows a balance of \$73.11 plus \$31.00, proceeds of 1961, less a bill of \$27.45 for programs, showing a net balance of \$76.66. J. W. TILDEN suggested and was sustained that the bank balance of \$76.66 not be spent at this time. PETER BELLINGER pointed out that he maintains the Society library at San Fernando Valley State College, Northridge, California. Notice was given that the Society *Memoir* No. 1, by C. F. DOS PASSOS, would be out shortly. The meeting was adjourned.

The third session continued with the following papers: "Collecting in the Carson Range of western Nevada, with emphasis on seasonal and altitudinal problems", PETER J. HARLAN, The Nevada State Museum, Carson City Nevada; "Phylogenetic and Taxonomic Studies on the Noctuid tribe Stiriini", CHARLES HOGUE, University of California at Los Angeles; "Studies in the Literature of Lepidoptera", PADDY B. MCHENRY, Burbank, California.

The fourth session, presided over by J. W. TILDEN, consisted first of an open forum on the "Preparation and Study of Genitalia of Lepidoptera", moderated by CHARLES HOGUE. The last paper of the meetings was one by LLOYD MARTIN on "Chlorocresol, its Use in Collecting Insects." This was followed by a review of exhibits and an exchange session before adjournment.

W. HOVANITZ, Secretary *pro tempore*

RECENT LITERATURE ON LEPIDOPTERA

(Under the supervision of PETER F. BELLINGER)

B. SYSTEMATICS AND NOMENCLATURE

Griveaud, P., "Sphingidæ" [in French]. *Faune de Madagascar,* vol. 8: 161 pp., 13 pls., 235 figs. Febr. 1959. A fauna of the sphingids of Madagascar with keys. Describes as new: *Temnora catalai* (Lambomakandro); *Sphingonoepiopsis wellsi* (Tranoroa) (a synonym of *S. malgassica* B. P. Clark, 1929, not cited in the work); *Hippotion albolineata* (Didy); *Ceridia stuckenbergi* (Ampanihy), *C. nigricans* (Ankarafantsika); *Polyptychus bilineatus* (Andobo), *P. suffuscens* (Ankarafantsika). These two last spp. appear here for the first time; the "original" descriptions were published two months later in the following paper. [P. V.]

Griveaud, P., "Deux nouveaux Sphingidæ de Madagascar (Lepidoptera)" [in French]. *Naturaliste malgache,* vol. 10: pp. 75-79, 2 figs., 1 pl. "1958" [April 1959]. Description of *Polyptychus suffuscus* & *P. bilineatus,* two sphingids from Madagascar. With the delay in publication, these two species were published first in the "Faune de Madagascar" (above). [P. V.]

Griveaud, P., "Sur quelques sphingides nouveaux ou peu connus de la région malgache (Lep.)" [in French]. *Bull. Soc. ent. France,* vol.65: pp.40-47, 6 figs. 1960. Note on new or very poorly known sphingids from the Madagascar area. List of the sphingids recently collected in the Comoro Islands. Describes as new *Panogena lingens comorana* (Moheli); *Cephonodes tamsi* (Seychelles, Mahé), *C. rufescens* (NE Madagascar, Marojejy Mts.). *Sphingonoepiopsis wellsi* Griveaud is a synonym of *S. malgassica.* [P.V.]

Gross, Franz Josef, "Zur Schmetterlings-Fauna Ostasiens I. Gattung *Satyrus* Latr., Untergattung *Aulocera* But. (Lep. Satyridæ)" [in German]. *Bonner zool. Beitr.,* vol.9: pp.261-293, 6 pls., 24 figs. 1958. Describes as new S. (*A.*) *pumilus atuntsensis* (A-tun-tse, N. Yunnan), S. (*A.*) *sybillinus holiki* (N. Kansu, Liangchow, Richthofen Mts., 3000 m.), S. (*A.*) *yunnanicus* (Li-kiang, N. Yunnan, 4000 m.), *S. ellenæ* (A-tun-tse, N. Yunnan, 400-4500 m.), S. (*A.*) *swaha forsteri* (Kabul, Afghanistan, 2400 m.), S. (*A.*) *schaeferi* (Nepal, Manangbhat, Pisang, 3300 m.), S. (*A.*) *saraswati vishnu* (Sikkim, Darjeeling), S. (*A.*)*magica amida* (A-tun-tse, N. Yunnan, 4000 m.). Selects neotype for S. (*A.*) *padma verres.* Survey of the 10 spp. of this subgenus, which is limited to the mountains bordering the Tibetan plateau; many figures of adults & of genitalia; distribution maps of spp. Notes on distribution in this region of other *Satyrus* spp. [P. B.]

Gross, Franz Josef, "Bemerkungen zur Verbreitung von *Satyrus* (*Hipparchia*) *fagi* Scop., *syriacus* Stgr. und *semele* L." [in German]. *Ent. Zeitschr.,* vol.69: pp.17-23, 4 figs. 1959. Describes as new S. (*H.*) *syriacus tokatensis* (near Tokat, Asia Minor). Describes pattern characteristic distinguishing *S. fagi* & *S. syriacus.* Distribution records for these 3 spp. [P. B.]

Guérin, P., "*Lycæna helle* Schiff. dans les Monts de la Madeleine (Loire)" [in French]. *Alexanor,* vol.1: pp.87-88. 1959. Description of a new subspecies of *L. helle* Denis & Schiff. (not Schiffermüller only) from the Madeleine Range in the East of the central plateau of France: *L. h. magdalenæ.* Location of types very badly indicated; no indication of type locality (Sappery peatey) in connection with designation of holotype (which is in a private collection). [P. V.]

Hackray, J., "Note sur *Cidaria subhastata* Nolcken" [in French]. *Lambillionea,* vol.58: pp.58-59. 1958. Note on the geometrid *C. subhastata,* a different species from *C. hastata.* [P. V.]

Hannemann, H.-J., "Die Eingruppierung weiterer Depressarien nach dem Bau ihrer Kopulationsorgane, Teil 2 (Lep. Œcophoridæ)" [in German]. *Deutsche ent. Zeitschr.*, N.F., vol.5: pp.457-465, 7 figs. 1958. Describes as new *Agonopterix demissella* (Shiraz Gardens, SW Iran), *A. farsensis* (Hunaifagan, Fars, SW Iran); *Depressaria illepida* (Hunaifagan), *D. subhirtipalpis* (Tang-Ab, Firzubad, Fars, 4500 ft.), *D. parahofmanni* (S. Persia, Elburz Mts., Kendevan Pass, 2800-3000 m.). New synonymy & generic placements in *Agonopterix, Depressaria,* & *Martyrhilda.* [P. B.]

Hannemann, H. J., "Neue Depressarien aus der Sammlung S. Toll (Lep. Œcophoridæ)" [in German]. *Deutsche ent. Zeitschr.*, N.F., vol.6: pp.34-43, 15 figs. 1959. Describes as new *Agonopterix ordubadensis* (Ordubad, Russian Armenia), *A. galbella* (Yablonya 880, Manchuria), *A. tolli* (Suitun, E. Siberia), *A. inoxiella* (Greece), *A. abditella* (Kurush, Dagestan), *S. subumbellana* (Kasicoporan, Russian Armenia), *A. aperta* (Hsiaoling, Manchuria). Descriptive notes on *A. septicella,* a good sp. [P. B.]

Hannemann, H. J., "Uber die Gattungsgehörigkeit von *Alucita* [*Orneodes*] *dodecadactyla* Hübner (Lep. Alucitidæ)" [in German]. *Deutsche ent. Zeitschr.*, N.F., vol.6: pp. 170-173, 7 figs. 1959. Describes as new *PTEROPTERYX* for this sp. and perhaps A. *zonodactyla.* Figures ♂ genitalia of the 5 other European spp. of *Alucita.* [P. B.]

Heath, J., "The British Eriocraniidæ and Micropterygidæ." *Proc. Trans. South London ent. nat. Hist. Soc., 1957*: pp.115-125, 1 pl., 4 figs. 1958. Keys to genera & spp., colored figures of adults, brief descriptions, & notes on distribution & biology. [P. B.]

Heinicke, Wolfgang, "Revision der Gattung *Apamea* Ochs., 1816 (Lep., Noctuidæ). 1. Teil" [in German.]. *Deutsche ent. Zeitschr.*, N.F., vol.6: pp.100-111, 11 figs. 1959. Describes as new *MESAPAMEA* (type *Parastichtis moderata*), *M. montana* (A-tun-tse, N. Yunnan, 4500 m.), *M. evidentis* (Batang, Tibet, 2800 m.), *M. concinnata* (Asamayama, Japan); describes genitalia of type sp. & of *M. secalis.* This group is distinguished from *Apamea* (type *sordens*). [P. B.]

Heinicke, W., "Revision der Gattung *Apamea* Ochs., 1816 (Lep. Noctuidæ). 2. Teil" [in German]. *Deutsche ent. Zeitschr.*, N.F., vol.7: pp.166-176, 4 figs. 1960. Describes individual variation of *Mesapamea secalis* & summarizes distribution of species. Transfers *Celæna calcirena* to *Mesapamea.* [P. B.]

Henriot, R., "Une nouvelle race de *Parastichtis suspecta* Hb. du Sud-Est de la France (Lep. Noctuidæ, Cuculliinæ)" [in French]. *Bull. mens. Soc. linn. Lyon,* vol.29: p.273. 1960. Description of *P. s. erythema* n. ssp. (S. France, Vaucluse, Sorgnes). [P. B.]

Herbulot, C., "Nouveaux Geometridæ malgaches" [in French]. *Mem. Inst. sci. Madagascar, sér.E,* vol.5: pp.81-123, 2 pls., 37 figs. 1954. New Madagascar Geometridæ. Larentiinæ: *Piercia viettei* (Ankaratra Mt.); *Xanthorrhoe malgassa, X. vacillans; Orthonama quadrisecta; Eupithecia hydrargyrea, E. exheres, E. vesiculata, E. dissonans, E. xylopsis, E. multiplex, E. theobromina; Asthenotricha deficiens, A. parabolica, A. nesiotes; Eois incandescens.* Ennominæ: *Ectropis milloti, E. pauliani, E. chopardi, E. vadoni, E. bistortatoides, E. ulterior; Psilocera lemur, P. aspilates, P. phrynogyna, P. viettei, P. virescens; Epigynopteryx silvestris, E. tenera; Ochroplutodes hova; Drepanogynis hygrochroaria, D. ellipsis, D. acerba, D. subrosea, D. purpurescens; Nopia gracilipes; Xenimpia fletcheri; Tephrina sakalava* (Ankarafantsika); *Semiothisa leupalaria.* All but *T. sakalava* from Ankaratra Mt. [P.V.]

Herbulot, Claude, "Lépidoptères Geometridæ (Résultats de l'expedition zoologique du Professeur Dr. Håkan Lindberg aux îles du Cap Vert durant l'hiver 1953-54. No. 12)" [in French]. *Comment. biol.,* vol.16, no.10: pp.1-8, 13 figs. 1957. Describes as new *Gymnoscelis lindbergi* (Cap Verde: S. Antao); *Scopula paneli-*

usi (Cap Verde: S. Antao), *S. p. subirrorata* (Cap Verde: Brava). Records for 7 additional geometrid spp. from the Cap Verde Is. [W. H.]

Herbulot, C., "Mission du Muséum dans les îles du golfe de Guinée. Entomologie: VIII. Lepidoptera Geometridæ" [in French]. *Bull. Soc. ent. France,* vol.63: pp.100-109, 3 figs. 1958. List of the Geometridæ collected in the islands São Tomé, Principe, & Annobon by P. Viette during the trip of the "Calypso" in the gulf of Guinea. Describes as new: *Zamarada principis* (Principe); *Chloroctenis gelasmoides* (Principe); *Neocleora vietti* (São Tomé); *Somatina sanctithomæ* (São Tomé), *S. fletcheri* (Principe); *Thalassodes regressa* (São Tomé); *Chlorissa annobonica* (Annobon). [P. V.]

Herbulot, C., "Les *Psilocera* malgaches (Lep. Geometridæ)" [in French]. *Bull. Soc. ent. France,* vol.63: pp.220-229, 1 pl., 1 fig. "1958" [1959]. General study of the geometrid genus *Psilocera* in Madagascar. Describes as new *P. cuprea* (Perinet), *P. swinhoei* (Ankaratra Mts.), *P. toulgoeti* (Ranomafana), *P. tristigma* (Sandrangato), *P. griveaudi* (Ampolomita), *P. monochroma* (Perinet), *P. ferruginaria pallidizona* (Ranomafana). [P. V.]

Herbulot, C., "La position systématique d' "*Acasis*" *mariæ* Stauder (Geometridæ)" [in French]. *Alexanor,* vol.1: pp.140-141. 1960. The species *A. mariæ* described by Stauder from Calabria (S. Italy) belongs, in fact, to the genus *Solitanea* Djakonov (Geometridæ Larentiinæ). [P. V]

Herbulot, C., "Les *Asthenotricha* de Madagascar et de La Réunion (Lep. Geometridæ)" [in French]. *Lambillionea,* vol.60: pp.21-27. 1960. Describes as new *A. quadrata* (Distr. Ambatolampy: Andranotobaka, 1400 m., Madagascar), *A. furtiva* (Distr. Moramanga: Périnet, Analamazaotra Forest, 910 m., Madagascar). Gives key to adults of the 8 spp.; summarizes their distribution; notes on variation in venation, specialized scales, & pits on ♀ 7th abdominal sternite. [P. V.]

Herbulot, C., "Nouveaux *Drepanogynis* malgaches (Lep. Geometridæ)" [in French]. *Bull. Soc. ent. France,* vol.65: pp.104-109. 1960. Descriptions of new species of this geometrid genus from Madagascar: *D. amethystina* (Ankasoka), D. *alternans* (Périnet), *D. sogai* (Ambatondrazaka, Bemanavy), *D. quadrivalvis* (Périnet), *D. umbrosa* (Périnet), *D. salamandra* (Apitameloka), *D. prosecta* (Périnet), *D. clavata* (Marojejy Mt.), *D. atrovirens* (Ambatondrazaka, Bemanavy), *D. altisilvarum* (Ambatofitorahana), *D. rubriceps* (Périnet). [P. V.]

Herbulot, C., "Nouveaux *Archichlora* malgaches (Lep. Geometridæ)" [in French]. *Bull. Soc. ent. France,* vol.64: pp.175-178. "1959" [1960]. Descriptions of new geometrids of the genus *Archichlora,* from Madagascar: *A. petroselina, A. viridicrossa, A. florilimbata, A. majuscula* (all from Périnet), *A. antanosa* (Zombitsy), *A. vieui* (Ankazobe), *A. altivagans* (Andringitra Mts.), *A. pavonina* (Ranomafana), *A. tricycla* (Anosibe Road), *A. sola* (3rd Integral Natural Reserve), *A. ambrimontis* (Ambre Mt.), *A. nigricosta* (Italaviana), *A. subrufescens* (Vohilava). [P. V.]

Hering, Erich M., "Neue Heteroceren aus dem Congo-Gebiet. Zweiter Beitrag" [in German]. *Rev. Zool. Bot. afr.,* vol.42: pp.230-239, 11 figs. 1949. Describes as new: (Limacodidæ) *Ctenolita tristis* (Lubumbashi, Belgian Congo), *C. zernyi* (Mbinga, Tanganyika), *subrufa* (Elisabethville, Belgian Congo); (Metarbelidæ) *Marshalliana latevittata* (Elisabethville); (Saturniidæ) *Holocera micropteryx* (Elisabethville). Describes previously unknown ♂ of *Chrysopoloma crawshayi.* Key to spp. of *Ctenolita.* [P. B.]

Hering, E. M., "Deux nouveaux Limacodidæ du Centre de Madagascar" [in French]. *Mém. Inst. scient. Madagascar, ser.E,* vol.5: pp.63-65, 2 figs. 1954. Description of 2 new Limacodidæ from Madagascar: *PSEUDOLATOIA,* & type *P. viettei* (Ankaratra Mts.) and *Macrosemyra orthogramma* (Ankaratra Mts.). [P. V.]

Hering, Erich M., "Noch einmal *Zygæna purpuralis* (Brünnich, 1763)" [in German]. *Ent. Zeitschr.,* vol.69: p.10. 1959. Calls attention to invalidity of lectotype selection by Reiss, 1958 (*Ent. Zeitschr.,* vol.68, p.144). [P. B.]

Heslop, I. R. P., "Fourth supplement to the 'Indexed check-list of the British Lepidoptera, with the English name of each of the 2,313 species' (1947)." *Ent. Gazette,* vol.9: pp.153-155. 1958. 17 additional spp. and 5 corrections. [P. B.]

Heslop, I. R. P., "Revised indexed check-list of the British Lepidoptera. Part I." *Ent. Gazette,* vol.10: pp.177-187; vol.11: pp.55-66, 169-178. 1959-60. List of the 969 spp. of Macrolepidoptera giving revised nomenclature, common names, and some synonyms. [P. B.]

Higgins, L. G., "Four new melitæine genera (Nymphalidæ)." *Lepid. News,* vol.12: pp.161-164, 1 pl. 1959. Describes as new (types in parentheses): *TEXOLA* (*Eresia elada*); *ATLANTEA* (*Synchloe perezi*); *FULVIA* (*Melitæa fasciata*); *ANTILLEA* (*Papilio pelops*).

Hinton, H. E., "The phylogeny of the panorpoid orders." *Annual Rev. Ent.,* vol.3: pp.181-206. 1958. Review article; rearrangement of the group is based on study of larval anatomy, and only the latter justifies the separation of Micropterygidæ (Zeugloptera) from Lepidoptera. [P. B.]

Hoffmeyer, Skat, "The Transparent Burnet Moth, *Zygæna purpuralis* (Brünnich)." *Ent. Gazette,* vol.9: pp.197-200, 1 pl. 1958. Figures adults & genitalia of *Z. purpuralis* & *Z. pimpinellæ* & discusses application of the former name. [P. B.]

Hogue, Charles L., & John W. Johnson, "A new name for *Calosaturnia meridionalis* (Saturniidæ)." *Lepid. News,* vol.12: p.17. 1958. *Saturnia* (*C.*) *walterorum.*

Holik, Otto, & Leo Sheljuzhko, "Über die Zygænen-Fauna Osteuropas, Kleinasiens, Irans, Zentralasiens und Sibiriens (4. Fortsetzung und Schluss)" [in German]. *Mitt. münchn. ent. Ges.,* vol.48: pp.166-285. 1958. Concluding section deals with subgenera *Zygæna, Huebneriana,* & *BURGEFFIA* (n.n. for *Polymorpha* Burgeff), with supplementary comments on some other subgenera. Describes as new: *Z.* (*Z.*) *filipendulæ tambovana* (Kozlov, Tambov district, USSR), Z. (Z.) *f. tiefi* (Suchum vicinity, Transaucasia, USSR), *Z.* (*Z.*) *f. zangezurica* (Zangezur Mts., Armenia); *Z.* (*H.*) *loniceræ kubanensis* (Teberda Region, Ciscaucasia), Z. (*H.*) *l. abchasica* (Suchum, Transcaucasia, USSR), *Z.* (*H.*) *l. sarykamyshensis* (Sarykamysh, W. Armenia); Z. (*B.*) *dorycynii kubana* (Kuban, N. Caucasus), *Z.* (*B.*) *d. karabaghensis* (Karabagh region, Transcaucasia), Z. (*B.*) *d. ochtshiensis* (Ochtsi, near Kafan, Zangezur region); subgenus *MESEMBRYNOIDEA* (type *Z. cambysea*); also several "forms". Proposes *hadjinica* n.n. for *Z. formosa hadjinensis; talassinensis* n.n. for *Z. sogdiana talassica.* Describes geographic & individual variation in great detail. Gives index to entire work. [P. B.]

Howarth, T. G., "A description of a new race of *Acræa cerasa* Hewitson (Lepidoptera, Nymphalidæ) with some notes on related species." *Entomologist,* vol.92: pp.133-136, 1 pl. 1959. Describes as new *A. c. kigezia* (Uganda, Kayonza, Kigezi). [P. B.]

Inoue, Hiroshi, "A new species of *Lophopteryx* from Japan (Lepidoptera, Notodontidæ)." *Trans. Shikoku ent. Soc.,* vol.6: pp.9-10, 2 figs. 1958. Describes as new *L. okanoi* (Mitsumine-san, 1000 m., Saitama Pref.); sinks *L. hasegawai* to *L. hoegei.* [P. B.]

Inoue, Hiroshi, "A new subspecies of *Aglia tau* from Japan (Lepidoptera, Saturniidæ.)." *Trans. Shikoku ent. Soc.,* vol.6: pp.14-16, 8 figs. 1958. Describes as new *A. t. microtau* (Takao-san, Tokyo). [P. B.]

Inoue, Hiroshi, "Three new subspecies and one unrecorded species of the Drepanidæ from Japan (Lepidoptera)." *Trans. Shikoku ent. Soc.,* vol.6: pp.11-13, 4 figs. 1958. Describes as new *Macrocilix mysticata watsoni* (Takao-san, Tokyo); *Drepana harpagula olivacea* (Kamikochi, Nagano Pref.): *Cilix filipjevi malivora* (Hidaniigawa; from pupæ on *Malus*). Sinks *M. m. bidentata* to *M. m. mysticata. Auzata* (*Auzatella*) *micronoides* new for Japan. [P. B.]

International Commission on Zoological Nomenclature, "Addition to the Official Lists of Names in Zoology of the generic names *Caligo* Hübner, [1819], and *Charaxes* Ochsenheimer, 1816, and of the family-group names based thereon (Class Insecta, Order Lepidoptera)." *Bull. zool. Nomencl.*, vol.17: pp.140-142. 1959. Also conserves the type spp., *eurilochus* Cramer & *jasius* L.; *Caligo* Bdv., *Paphia* Fabr., *Jasia* Swainson, *Iasisus* Westwood, *jason* L., 1767, & several erroneous family-group names are placed on the Official Indexes. [P. B.]

Jäckh, Eberhard, "Beitrag zur Kenntnis der Œcophoridæ, die Gattung *Tubuliferola* Strand, 1917 (Lep.)" [in German]. *Deutsche ent. Zeitschr.*, N.F., vol.6: pp.174-184, 9 pls. 1959. Describes as new *T. synchrozella* (Mittenwald, Brunstein, 1400 m.), *T. latipenella* (Kyffhäuser Gebirge, Kattenburg). Redescribes & figures 10 other spp. of genus; gives notes on biology & on identity of some other names. [P. B.]

Janmoulle, E., "Distinction entre *Evetria buoliana* Schiff. et *E. pinicolana* Dbld. (Tortricidæ)" [in French]. *Lambillionea*, vol.58: pp.29-30, 2 figs. 1958. Distinguishes spp. on external & genitalic characters. [P. B.]

Jewett, Stanley G., Jr., "Concerning subspeciation in western North American *Euphydryas* (Nymphalidæ)." *Journ. Lepid. Soc.*, vol.13: pp.171-173. 1960.

Karnoschitsky, N., "New and rare Lepidoptera of Bulgaria's Black Sea coast" [in Bulgarian; Russian & English summaries]. *Bull. Inst. Zool. Acad. bulg. Sci.*, vol.3: pp.161-200, 8 figs. 1954. Records 68 spp. as new for the territory of Bulgaria. Describes as new: *Orrhodia rubiginea var.n. bulgarica* (env. of Stalin, formerly Varna), with 3 new "forms"; *Boarmia selenaria bureschi* (Stalin, Dalgopol, & Devnia in Bulgaria); and a new "ab." of *Hybernia declinans*. The caterpillar of *Drymonia vittata* is described also. [J. M.]

Kasy, F., "*Thiodia 'citrana* var. *major*' Rbl. bona spec.; '*citrana* var. *sardiniana*' Schaw. ssp. von *major* Rbl. (Lep., Tortr.)" [in German]. *Zeitschr. wiener Ent. Ges.*, vol.43: pp.273-275, 4 figs. 1958. Distinguishes *T. major* from *T. citrana* & selects lectotype of former; assigns *sardiniana* to *T. major* on genital structure. [P. B.]

Kernbach, Kurt, "Über einige paläarktische Sphingidenarten und -unterarten" [in German]. *Deutsche ent. Zeitschr.*, N.F., vol.5: pp.376-381, 3 figs. 1958. Discusses subspecies & geographic variation in *Sphinx ligustri, S. pinastri, Pergesa elpenor,* & *P. porcellus.* [P. B]

Kernbach, Kurt, "Die Sphingidengattung *Marumba* (Moore) (Lep. Sphingidæ)" [in German]. *Deutsche ent. Zeitschr.*, N.F., vol.7: pp.185-192, 21 figs. 1960. Describes as new *M. dryas ceylonica* (Ceylon). Discusses 21 spp. & sspp.; figures ♂ genitalia of most of these, & of *Polyptychus meander* & *P. brevis.* [P. B.]

Kiriakoff, S. G., "Notes sur les Notodontoidea (Lepidoptera) du Congo Belge" [in French]. *Lambillionea*, vol.59: pp.24-34, 8 figs. 1959. Study of new material of Thyretidæ. Describes as new: *Apisa* (*Dufraneella*) *fontainei* (Ruanda: Kisenyi); *Rhipidarctia* (*Elsita*) *subminiata* (Uele: Paulis); *Hippurarctia judith* (Uele: Paulis); *Metarctia* (*Metarhodia*) *insignis* (Ruanda: Kisenyi), *M.* (*Metarhodia*) *impura* (Uele: Paulis), *M.* (*Metarctia*) *hector* (Uele: Paulis), *M.* (*Metarctia*) *hecqi* (Kibali-Ituri: Nioka); *Bergeria ornata* (Uele: Paulis). Notes on other spp. in 8 genera. [P. B.]

Kiriakoff, S. G., "Sur quelques Notodontidæ malgaches (Lepidoptera) (deuxième contribution)" [in French]. *Rev. franç. Ent.*, vol.27: pp.173-199, 27 figs. 1960. Descriptions of new genera and species of Notodontidæ from Madagascar: *ROMALEOSTAURA*, & type R. *insularis* (E. Madagascar, Anosibe Road); *ANTSALOVA*, & type *A. musculus* (W. Madagascar, Antsalova); *ARTANASA*, & type *A. viettei* (W. Madagascar, Lambomakandro Forest); *Iridoplites malgassica* (W. Madagascar, Ampijoroa); *Desmeocræra robustior* (W. Madagascar, Antsalova), *D. mediobrunnea* (N. Madagascar, Ambre Mt.); *ITALAVIANA*, & type *I. griv-*

eaudi (E. Madagascar, Italaviana); *SCHEDOSTAUROPUS*, & type *S. elegans* (central Madagascar, Ankarata Mt.); *SPODIOSOMERA*, & type *S. oculata* (E. Madagascar, Marojejy Mt.), *S. argentea* (N. Madagascar, Ambre Mt.); *Odontoperas insufficiens* (W. Madagascar, Lambomakandro Forest), *O. ochribasis* (same locality), *O. dorsalis* (W. Madagascar, Zombitsky Forest); *ANALAMA* (type *Scalmicauda perinetensis*), *A. conspicua* (E. Madagascar, Lakato); *Eutrotonotus subvinaceus* (W. Madagascar, Lambomakandro Forest), *E. margarethæ* (N. Madagascar, Ambre Mt.), *E. ameles* (central Madagascar, Ampolomita), *E. mediofascia* (central Madagascar, La Mandraka), *E. rectilinea* (E. Madagascar, Marojejy Mt.), *E. zeta* (N. Madagascar, Ambre Mt.), *E. viettei* (E. Madagascar, Ampitameloka), *E. basistriga* (central Madagascar, Ampolomita). [P. V.]

Klots, Alexander B., & Bernard Heinemann, "The identity of *Papilio nise* Cramer, 1775 (Lepidoptera: Pieridæ) and a neotype designation for this nominal species." *Proc. Roy. ent. Soc. London (B)*, vol.26: pp.206-214, 1 pl. 1957. Identifies this sp. from extensive Jamaican material; discusses the confused application of this and other names; figures, with related spp. for comparison. [P. B.]

Klots, Alexander B., "Notes on *Strymon caryævorus* McDunnough (Lepidoptera, Lycænidæ)." *Journ. New York ent. Soc.*, vol.68: pp.190-198, 7 figs. 1960. Gives characters of adult, genitalia, & larva which distinguish *S. caryævorus* from *S. falacer;* describes last instar larva (found on *Carya glabra*); discusses distribution. [P. B.]

Komárek, O., "Correlation of morphological habitual characters of the species *Zygæna carniolica* Scop. by the populations of Czechoslovakia" [in Czech; English & Russian summaries]. *Acta Soc. ent. Čechosloveniæ*, vol.55: pp.105-120, 5 figs. 1958.

Krogerus, Harry, "Bemerkungen über einige finnische Kleinschmetterlinge" [in German]. *Notul. Ent.*, vol.37: pp.121-126, 6 figs. 1957. Deals with the Fennoscandian finds of *Tortrix nybomi, Semasia saussureana, Borkhausenia obscurella, Stomopteryx karvoneni, Aristotelia heliacella, Coleophora tractella, Incurvaria æripenella,* & *I. triangulifera.* The genitalia of *B. obscurella* ♂, *I. æripennis* ♂, ♀, *I. triangulifera* ♂ are figured. [W. H.]

Kuznetsov, V. I., "The moth *Anarsia eleagnella* V. Kuzn., sp.n. (Lepidoptera, Gelechiidæ) — a new pest of the Oliaster in the USSR" [in Russian; English summary]. *Zool. Zhurn.*, vol.36: pp.1096-1098, 4 figs. 1957. Described from Ashkhabad & other parts of S. Russia; larva on *Eleagnus sp.* [P. B.]

de Laever, E., "Trois espèces nouvelles pour la Belgique" [in French]. *Lambillionea*, vol.59: pp.54-56, 2 figs. 1959. Records *Chersotis margaritacea, Eublemma parva,* & *Apamea lucens,* new to Belgium; distinguishes latter from *A. nictitans.* figuring ♂ genitalia of both. [P. B.]

de Laever, E., "Note sur *Sterrha incisaria* Staudinger" [in French]. *Lambillionea,* vol.60: pp.18-19, 2 figs. 1960. Describes & figures ♂ genitalia, with those of *S. mareotica* for comparison. [P. B.]

Laffoon, Jean L., "Common names of insects approved by the Entomological Society of America." *Bull. ent. Soc. Amer.*, vol.6: pp.175-211. 1960. Lists insects by common & by scientific names; also lists names of families & larger groups, and proposed additions & changes. [P. B.]

de Lajonquière, Y., "Deux formes nouvelles de Lépidoptères Hétérocères" [in French]. *Bull. mens. Soc. linn. Lyon,* vol.27: pp.304-305. 1958. Description of a new suspecies of the geometrid *Bupalus piniaria*: *B. p. bernieri* (Gironde, Villenave d'Ornon) and a "form" of *Agrotis crassa* from the same locality. [P. V.]

de Lajonquière, Y., "Description d'un nouvel *Epicnaptera* de la faune européene (Lasiocampidæ)" [in French]. *Bull. mens. Soc. linn. Lyon,* vol.29: pp.233-236. 1960. Describes as new *E. kermesifolia* from Spain (Province de Jaen, Virgen de la Cabeza). [P. V.]

Lambert, Robert, "Caractères distinctifs de la sous-famille Sparganothinæ (lépidoptères-tortricidés) et distribution des genres qui la composent" [in French]. *Proc. 10th internat. Congr. Ent.*, vol.1: p.299. 1958. Abstract.

Le Charles, L., "Les *Papilio* de la faune française" [in French]. *Entomologiste*, vol.3: p.247, 1 col. pl. 1947. Note on the French spp. of *Papilio*. [P. V.]

Le Charles, L., "Nouvelles sous-espèces de zygènes françaises (Lep. Zygænidæ)" [in French]. *Bull. Soc. ent. France*, vol.65: pp.102-103. 1960. New subspecies of species of *Zygæna* of the French fauna: *Z. fausta perornata* (Seine-et-Oise, Lardy), *Z. trifolii carueli* (Marne, Fleury-la-Rivière); *Z. scabiosæ vosegiensis* n.n. for *Z. s. vogesiaca*, preoccupied; *Z. s. droiti* (Hautes-Alpes, Ceuze). [P. V.]

Legrand, H., "Nouveaux lépidoptères des îles Séchelles et Cosmoledo" [in French]. *Bull. Soc. ent. France*, vol.63: pp.142-145, 1 pl., 6 figs. 1958. New Lepidoptera from the Seychelles and Cosmoledo Is.: (Gelechiidæ) *Thiotricha fridaella* (Seychelles: Mahé); *Schizovalva blumenzweigella* (Mahé); (Cosmopterygidæ) *Stagmatophora floretella* (Mahé); (Lyonetiidæ) *Opogona daubanella* (Seychelles: Silhouette), *O. superdaubanella* (Mahé); (Geometridæ) *Scopula menaiensis* (Cosmoledo, Menai). [P. V.]

Legrand, H., "*Ephestia mistralella* Millière, bonne espèce d'Europe méridionale, et *Ephestia, moebiusi* Rebel, espèce uniquement d'Europe centrale" [in French]. *Alexanor*, vol.1: pp.57-59, 1 fig. 1959. *E. mistralella* (Lep. Phycitidæ) is a good sp. from S. Europe, and *E. moebiusi* is a sp. from central Europe. [P. V.]

Legrand, H., "Note sur la sous-espèce *nana* Ch. Oberthür de *Papilio phorbanta* Linné des îles Seychelles (Lep. Papilionidæ)" [in French]. *Bull. Soc. ent. France*, vol.64: pp.121-123. 1959. Suggests that types (2 only known) are of specimens introduced from Réunion, the habitat of the nominate race, and are of reduced size because of the unnatural conditions. [P. B.]

Legrand, H., "Une espèce très discutable: *Anerastia ephestiella* Viard, simple forme d'*A. lotella* Hübner (Pyralidæ)" [in French]. *Alexanor*, vol.1: pp.88-89. 1959. *A. ephestiella* is not a good species but a "form" of *A. lotella; uniformella* Viard was not described as a new subspecies of *E. ragonotella* but as a "n.ab." [P. B.]

Lemée, A., *Contribution à l'étude des lépidoptères du Haut-Tonkin (Nord-vietnam) et de Saïgon* [in French]. 82 pp., 1 pl. Paris: P. Lechevalier; London: Wheldon & Wesley. 1950. (With the collaboration of Mr. W. H. T. Tams for some families of Heterocera). List of about 600 spp. of Lepidoptera collected in French Indochina: Upper Tonkin (Backan and Sontay areas) and Saigon. Short descriptions of the following new spp.: (Zygænidæ) *Corma tamsi* (Backan); (Lasiocampidæ) *Metanastria leméepauli* (Backan); (Bombycidæ) *Gunda tonkinensis; Ocinara tamsi; Bombyx leméepauli* (all from Backan); (Notodontidæ) *Pydna backanensis* (Backan); *Cerasana leméemagdalenœ* (Hagiang); (Limacodidæ) *Narosa tamsi* (Backan); (Noctuidæ) *Bertula saigonensis* (Saigon); (Tortricidæ) *Cerace leméepauli* (Backan). The collection, with the author's types except that of *Ocinara tamsi* (destroyed) is now in the Paris Museum. The publication was not recorded in the *Zoological Record*. [P. V.]

de Lesse, H., "Description des caractères du groupe d'espèces d'*Erebia tyndarus* Esp. par rapport aux autres *Erebia* (Lépid. Rhopalocères)" [in French]. *Bull. mens. Soc. linn. Lyon*, vol.27: pp.202-205. 1958. Note on the characters differentiating the *E. tyndarus* group of spp. from other *Erebia* (Satyridæ). [P. V.]

de Lesse, H., "Caractères et répartition en France d'*Erebia æthiopellus* Hoffmsg. et *E. mnestra* Hb." [in French]. *Alexanor*, vol.1: pp.72-81, 7 figs. 1959. Study on the characters & the geographical distribution of these spp. in the French Alps. The author is said to have examined the problem with all documents joined actually, but it is not certain! [P. V.]

de Lesse, H., "Description d'une nouvelle sous-espèce *d'Agrodiætus hopfferi* H.S. (Lep. Lycænidæ) et de sa formule chromosomique particulière [in French].

Bull. mens. Soc. linn. Lyon, vol.28: pp.149-151. 1959. Description of a new ssp., *A. h. sennanensis* (W. Iran, Hamakasi, route Sanandadj, km.10). In five examples the chromosome number varies: n=28, n=29, or n=30. Perhaps this is a good species. [P. V.]

de Lesse, H., "Note sur deux espèces d'*Agrodiætus* (Lep. Lycænidæ) récemment separées d'après leurs formules chromosomiques" [in French]. *Lambillionea,* vol.58: pp.5-10, 9 figs. 1959. Places *A. vanensis* (n=78) as a ssp. of *A. phyllis* (n=79-82); distinguishes these from each other & from the very similar *A. posthumus* (n=10-11). [P. B.]

de Lesse, H., "Séparation spécifique d'un *Lysandra* d'Afrique du Nord à la suite de la découverte de sa formule chromosomique (Lycænidæ)" [in French]. *Alexanor,* vol.1: pp.61-64. 1959. After study of the number of chromosomes *L. punctifera* (n=24) is a good species distinct from *L. bellargus* (n=45); *L. punctifera* and *L. syriaca* may be the same species. [P. B.]

de Lesse, H., "Sur la valeur spécifique de deux sous-espèces d'*Agrodiætus* (Lep. Lycænidæ) récemment décrites" [in French]. *Bull. mens. Soc. linn. Lyon,* vol..28: pp.312-315, 5 figs., 1 table. 1959. Note on the taxonomic value of *A. dama hamadanensis* & *A. hopfferi sennanensis,* 2 sspp. described by de Lesse in 1959 in 2 different publications. These are now regarded as 2 spp. In this paper *A. sennanensis* is indicated in the explanatory note of the map & *A. h. sennanensis* in the table! [P. V.]

de Lesse, H., "*Agrodiætus iphigenia* H.S. et son espèce jumelle *A. tankeri* n.sp. séparée d'après sa formule chromosomique (Lepid. Lycænidæ)" [in French]. *Bull. Soc. ent. Mulhouse,* 1960: pp.75-78, 1 table, 1 map. These dualspecies are separated by the number of chromosomes: *iphigenia,* n=12-16, and *tankeri,* n=21 (Turkey, Kop Dagh Pass, 2400-2600 m.). The following synonymies are also indicated: *A. iphigenia* H.S. = *A. araratensis* Lesse; *A. tankeri* = *A. iphigenia* Lesse *nec* H.S. [P. V.]

de Lesse, H., "Les nombres de chromosomes dans la classification du groupe d'*Agrodiætus ripartii* Freyer (Lep. Lycænidæ)" [in French]. *Rev. franç. Ent.,* vol.27: pp.240-264, 10 figs., 5 tables, 2 pls. 1960. Study of the numbers of chromosomes in the species group of *A. ripartii* and the distribution of the species. Describes as new *A. interjectus* (Turkey: Erzincan; n=29). In his conclusion the author allows now that the number of chromosomes is a good character, sometimes variable like others, but it is not always the best. [P. V.]

de Lesse, H., "Nouvelle étude chorologique et cytologique conduisant a changer l'application du nom d'*Agrodiætus iphigenia* H.S." [in French]. *Lambillionea,* vol.59: pp.56-61, 1 map, 1 table, 1 pl. 1960. Note to indicate that *A. araratensis* Lesse, 1957, is a synonym of *A. iphigenia.* The author discusses Herrich-Schaeffer's figures and Freyer's publication to explain his synonymy, but apparently has not tried to discover whether Herrich-Schaeffer's type still exists. [P. V.]

Lichy, René, "Documentos para servir al estudio de los lepidopteros de Venezuela (4a nota). Una especie nueva del genero *Heliconius* Kluk (Rhopalocera, Nymphalidæ), *Heliconius luciana* sp.n" [in Spanish; French & English summaries]. *Rev. Fac. Agron.,* Maracay, vol.2, no.3: pp.20-44, 10 figs. 1960. Type locality: Los Tiestos rapids, 190 m., 2° 13′ N., 64° 12′ W., upper Orinoco River. The species is a Müllerian mimic of *H. antiochus,* in another section of the genus. Suggestions are given for futher study of genus. [P. B.]

Lucas, D., "Description d'une race nouvelle de zygène observée dans les Pyrénées centrales" [in French]. *Bull. mens. Soc. linn. Lyon,* vol.28: p.303. 1959. Description of *Z. carniolica descimonti* n.ssp. (Central Pyrenees, Aussone). The author uses the term "race" in the title and the contraction "n.ssp." in the text. The author's name "Hb." is interpolated between the names of the species and of the subspecies. The new subspecies is compared with "*Zygæna berolinensis*" (*Z. c.*

berolinensis is the ssp. of Berlin area) first and with the "form *berolinensis*" next. No holotype is designated and collection containing the syntypes is not indicated This is an illustration of defective papers of which the abstract, to indicate the corrections, must be almost as long as the paper itself. [P. V.]

McDunnough, J., "Concerning *Coleophora murinella* Tengström and allied species in the Canadian fauna (Lepidoptera, Coleophoridæ)." *Bull. Brooklyn ent. Soc.*, vol.50: pp.29-35, 1 pl. 1955. Describes as new *C. dissociella* (Bog, Prospect Road, Halifax Co., Nova Scotia), *C. rupestrella* (Peggy's Cove, Halifax Co.), *C. persimplexella* (Port Wallis, Halifax Co.) Records *C. ledi* & *C. murinella* from North America, & describes genitalia. [P. B.]

McDunnough, James H., "Microlepidoptera notes and new species." *Amer. Mus. Novit.*, no.1789: 16 pp., 9 figs. 1956. Describes as new *Exartema galevora* (White Point Beach, Queens Co., Nova Scotia; on *Myrica gale*); *Anchylopera galeamatana* (same locality), *A. sheppardana* (Montreal, Quebec); *Gracillaria canadensisella* (Pt. Pleasant Park, Halifax, N.S.; on *Cornus canadensis*). Notes on other spp. of *Exartema* & *Anchylopera*. [P. B.]

McDunnough, James H., "A new species of *Coleophora* belonging to the *duplicisbidens* group." *Amer. Mus. Novit.*, no.1905: 5 pp., 3 figs. 1958. Describes as new *C. acuminatoides* (Pt. Pleasant Park, Halifax, Nova Scotia; on *Aster acuminatus*).

McDunnough, James H., "Heretofore unpublished illustrations of coleophorid genitalia, with notes (Lepidoptera)." *Amer. Mus. Novit.*, no.1880: 11 pp., 15 figs. 1958. Describes as new *Coleophora sexdentatella* (Mt. Uniacke, Nova Scotia), *C. dentiferoides* (White Point Beach, Queens Co., N. S., on *Juncus militaris*). Figures genitalia of 10 other spp. of *Coleophora*. [P. B.]

McDunnough, James H., "New Microlepidoptera, with notes." *Amer. Mus. Novit.*, no.1917: 11 pp., 16 figs. 1958. Describes as new: (Phycitinæ) *Ortholepis myricella* (White Point Beach, Queens C., Nova Scotia; foodplant *Myrica gale*), *O. rhodorella* (Armdale, N. S.; bred from *Rhodora*); *Pyla gaspéensis* (Cascapedia Road, Gaspé, Quebec); (Eucosminæ) *Thiodia scotiana* (St. Paul Is., Cabot Strait, N. S.); *Anchylopera subæquana fergusoni* (Wrangle Brook Road, Lakehurst, New Jersey). Figures also *A. galeamatana* (foodplant *Myrica gale*). New *Ortholepis* spp. are distinguished from *O. jugosella* (foodplant *Carya*). [P. B.]

McDunnough, James H., "On some changes in nomenclature of Microlepidoptera, with description of a new species." *Amer. Mus. Novit.*, no.1954: 9 pp., 5 figs. 1959. Describes as new *Pseudexentera kalmiana* (White Point Beach, Queens C., Nova Scotia). Notes on identity & synonymy of *Epiblema resumptana, Pseudexentera cressoniana*, & *Gnorimoschema gallæasterella* Kellicott. [P. B.]

McElvare, Rowland R., "*Schinia macroptica* Smith, a synonym (Lepidoptera, Phalænidæ)." *Bull. Brooklyn ent. Soc.*, vol.49: pp.22-23, 1 fig. 1954. Sunk to *S. oculata*. [P. B.]

McHenry, Paddy, "*Colias palæno chippewa* Kirby or Edwards? (Lepidoptera: Pieridæ)." *Bull. Brooklyn ent. Soc.*, vol.47: pp.16-17. 1952. Name credited to Edwards, 1870. Dates of parts of Edwards' *Synopsis of North American Butterflies* are given. [P. B.]

McHenry, Paddy B., "A new name for *Papilio orion* Cramer, a preoccupied name in the Hesperiidæ." *Journ. Lepid. Soc.*, vol.13: p.66. 1960. Proposes *crameri* n.n. (*Typhedanus*).

Mackie, Richard A., "A new species of *Eumysia* from southern Idaho (Lepidoptera: Pyralidæ)." *Proc. ent. Soc. Washington*, vol.60: pp.5-8, 2 figs. 1958. Describes as new *E. idahoensis* (Malta, Cassia Co.; reared from *Atriplex confertifolia*). [P. B.]

MacNeill, C. Don, "A new species of *Hesperia* from California (Lepidoptera: Hesperiidæ)." *Wasmann Journ. Biol.*, vol.17: pp.88-94, 1 fig. 1959. Describes as new *H. miriamæ* (near Mono Pass, Inyo Co., Calif., 12,000 ft.). [P. B.]

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