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by

A. Avinoff
late Director Emeritus, Carnegie Museum

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ACKNOWLEDGMENTS

It would be almost impossible to list the many entomologists and other men of science on both sides of the Atlantic who have contributed specimens, ideas or advice in our study of the *Karanasa*. Some have been mentioned in the text; the others will have to receive our thanks anonymously.

We wish to thank those members of the Carnegie Museum staff who have assisted in the preparation of the manuscript, the Misses Eugenia McCalla, Elizabeth D. Gill and Mary Sumner who translated our almost illegible script, and Miss Caroline A. Heppenstall who checked for errors. We particularly are grateful to Dr. Richard M. Fox whose ruthless criticism kept us from wandering too far from present-day concepts of systematics.

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MEMORIAL NOTE

For nearly a half century Dr. A. Avinoff found respite from the insistent demands upon genius in amassing and studying some of the world's rarest and most puzzling butterflies. Although ably assisted during the last decade by a younger colleague, Dr. Walter R. Sweadner, specimens were still arriving, conclusions still being revised in 1949 when death terminated his entomological preoccupations.

Dr. Sweadner surmounted limitations of time and strength to re-study *Karanasa* in the light of final acquisitions, to prepare the manuscript and to see it through the press. He actually read final proofs on the very eve of a major operation, an admirable instance of scientific devotion at a time of great physical distress and mental travail. He recovered sufficiently to approve everything except the introductory material and the final color proof of Plate 11, only to succumb unexpectedly from post-operative complications on January 13, 1951.

Carnegie Museum dedicates this monograph as a memorial to these two brilliant lepidopterists, whose deaths leave unclosable gaps in our scientific ranks, unhealable wounds in our hearts.

ART. 1 THE *KARANASA* BUTTERFLIES, A STUDY IN EVOLUTION

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FOREWORD

(SWEADNER)

The authors present here a report on fifty years of study of an exceedingly compact yet variable genus of butterflies. The intricate and unorthodox relationships within this group illustrate many of the hypotheses that have been advanced during the past half century to explain the mechanics of the emergence of a species. The known hypotheses do not fully explain the observable relationships, nor can we offer a final solution. We will do our best to present as clear and as detailed a picture as possible with the hope that it will serve as a basic study from which more important findings may stem.

The senior author collected and studied the butterflies of this group during the years preceding the first world war. The war and accompanying Russian revolution interrupted the study and placed beyond reach most of the material. In America, during the late twenties, the senior author resumed the accumulation of specimens and data, and during the early thirties made studies of all of the collections outside of Russia. The junior author entered the picture at this time as a graduate student working on a similar, but much simpler problem. He served largely as a foil in the development of the senior author's grasp of the problem. During the later thirties the two separated, and in this period the senior author worked out the basic groups. In 1941, the junior author joined the staff of the Carnegie Museum and there followed a period of intensive activity, dealing principally with anatomical studies and species relationships. When the senior author retired in 1945 the joint study was continued by correspondence and at the time of his death in 1949, most of the major points had been worked out. There remained only the incorporation of some new material from Afghanistan and the preparation of the definitive manuscript. Certain phases of the problem have been written and revised several times by the senior author. As many as possible of these passages — mostly written in the first person and dating as far back as 1939 — are incorporated intact and so labeled in the final version. This may make the structure of the essay deviate a little from the generally accepted form. We hope that the reader will bear with us on this point.

INTRODUCTORY REMARKS

(Avinoff)

While my early entomological preoccupations were centered on Palearctic Rhopalocera, I was particularly attracted by the lepidopterological fauna of central Asia. Among all central Asiatic butterflies probably none offered such an absorbing challenge as the group of *Karanasa huebneri,* being one of the most difficult and involved among the butterflies of that region.

The *Karanasa huebneri* group deserves the attention of entomologists for many reasons. There is a highly diversified assortment of forms in terms of local variations and individual mutations. It illustrates a phenomenon of a peculiar systematic significance, because of the simultaneous distribution of related forms which remain as independent biological entities at a given place, but apparently show a series of transitional steps in other places of the general area. This fact alone, in view of strict uniformity of taxonomic terminology, should preclude the conventional use of the term 'subspecies' which designates a unique representation of a species, excluding the presence of other comparatively stable forms of the same species in the same place.

One might surmise that we are witnessing in this case a species-in-the-making, breaking up into a number of branches, with the different evolutionary tendencies clearly indicated. Some of the forms are gradually gaining independence, while intermediate forms are still preserved. In most cases such transitory forms are found elsewhere than in the habitat where other more extreme and divergent forms have reached a sufficient degree of differentiation. This phenomenon is at variance with the presumable process of the formation of species which is accompanied, as far as one can judge, by the extinction of intermediate forms and by the widening of the systematic gaps. In the case of *K. huebneri,* we are observing a simultaneous coexistence of many of such formative steps. These successive units are scattered in some cases in different sections of the general area occupied by the group and partly overlap each other in their distribution. The region of the Pamirs seems to be particularly favorable for such a phenomenon, since geologically the mountain ranges are of recent origin. It has been generally accepted that this mountainous system has been lifted up over eight thousand feet sometime before and during the Pliocene Period. One might presume that in the course of these geo-

logical processes the biological conditions favored the differentiation of local forms and brought about an intricate system of inter-penetrating of the intermediate links of this chain of related forms.

One could not find a more striking illustration of such a relationship and distribution among the palearctic Lepidoptera than the *Karanasa.* A certain approach, however, to a similar correlation is found in the case of *Parnassius simo* Gray and *P. boedromius* Püngeler. Although the forms of the *P. simo* group constitute a perfect transition to *P. boedromius,* usually looked upon as a race of *simo,* nevertheless in certain parts of Tian-Shan one can find in the same place the typical *boedromius* and a form of *simo,* namely *P. gylippus* Fruhst., which because of the extreme development of the red ocelli, is the form most remote from *boedromius,* with its plain black maculation. The features of the more complex case illustrated by *S. huebneri* are thus duplicated in principle, as the forms most unlike in the group are found together, while intergrading members of the chain constitute local races elsewhere. *P. simo gylippus* and *P. boedromius,* in the place of their joint habitat, exist as independent species; but in order to find their systematic connections we have to go to Pamir, Chitral, and Tibet. The case of *P. boedromius* and *P. simo* was treated at some length in my monographic revision of the group in Oberthur, Et. Lep. Comp., XIX, 2, 45 (1922). If these forms, both of Parnassius and Karanasa, were to be found in one single geographical region it would be easy to construe them as individual variations of the same exceedingly unstable species. If, on the other hand, each of these forms was the sole representative of the group in each definite locality, they should be looked upon as geographical races of the same species. The actual facts, however, are different and of a somewhat more complicated order. If, for the sake of a diagrammatic simplicity of the exposition, we give numerical designations to this row of forms, we observe that several members of the group are frequently found in one single point of their distribution — for instance, Nos. 1, 5, and 10, but not the intervening numbers. In some localities where we might encounter only two representatives of the group, they are often the most remote members of the series. If we study the biological conditions in the actual habitat of these co-existing forms we would note that they deport themselves as independent species. They do not cross among each other and no regular intergrading forms are observed. A well-

marked, systematic gap between these is plainly observable. Their biological independence seems to be perfectly well established.

Such a phenomenon presents definite difficulties for analysis from a taxonomic point of view. The perfect intergradation uniting many members of this group of Satyrids into uninterrupted series impedes, on formal grounds, the breaking of these particular sets into independent species in the customary sense. On the other hand, the fact that different members of the group occur simultaneously and behave toward each other biologically as if they were separate species, does not warrant their classification as races of one species as long as we have to uphold the accepted principle that a species can be represented in a given locality only by one geographical form. In view of such an involved situation it would be advisable to use another taxonomic terminology for similar cases, and in my former writings over a quarter of a century ago I even proposed, tentatively, the term vice-species, for the purpose of recording such phenomena in order to preserve the prevailing usage of the terms *species* and *subspecies*. While I would hesitate at present to advocate such a formal introduction of a new term, in view of the difficulty of ascertaining all the diacritical conditions, I have since then witnessed an accumulation of more facts to support my reasons for its adoption, in the case of certain divisions of the group in question. Nevertheless I choose to maintain the more conservative stand of not burdening taxonomy with a new term.

For another reason the group of *huebneri* requires a thorough survey. The nomenclature and identification of these forms have been considerably confused, whether they be considered species, subspecies, or "varieties" in some special sense. I have never yet seen a collection containing a representation of this group of Satyrids which did not show a number of mis-identifications. To some entomologists the task of disentangling this group seemed almost hopeless. Here is a typical view of a pessimist, expressed by Elwes, in this respect. In the corner of one of the drawers in the British Museum containing the series of their group he placed a written statement as follows: "I have been quite unable to follow out the varietal differences found by Staudinger for the forms of this species found in the Pamir region. A study of Groum's remarks in Romanoff's Memoir, 4th volume, p. 463-482, convinces me that he who has seen more of these forms than any one

else was quite unable to find any constant characteristics by which to separate them."

Since my preoccupation with this intriguing group has lasted for such a long time, in the course of which I came in contact with many lepidopterists (now no longer living), I might be forgiven for injecting into this paper entirely personal recollections. My interest in the *Satyrus huebneri* group originated before I went on my first expedition after butterflies into central Asia in 1908. In my preparatory training for this enterprise I had to peruse, naturally, the fourth volume of Romanoff's "Memoirs" and was fortunate to have had many discussions with the learned author of this volume, Grum-Grshimailo, and with the Grand Duke Nicholas Mikhailovitch, who sponsored that magnificent publication. In this record of the fauna of the Pamirs, the Satyrids of the *huebneri* group are treated with considerable care. While I traveled, in part, along the itinerary of Grum-Grshimailo, and in other localities of the Pamirs which he did not visit, I made a special point of collecting as much material in the *huebneri* cycle as I could. This gave me an opportunity to observe the habits of these butterflies in their natural haunts. The result of this investigation was printed in the publications of the Russian Entomological Society[1] Four years later when I traveled to north Indian Ladak and Karakoram I had another occasion for collecting and studying these butterflies. Altogether, my former collection contained, before the beginning of the first world war, over 2,000 specimens of this group, mostly assembled in the course of over forty expeditions to central Asia that I organized. While I lost possession of this collection, which became the property of the Russian National Academy of Science, nevertheless I brought to America with me a small box containing some of the most precious examples of my favorite group, including some types. Later I was favored by an opportunity of studying some of the material from my former collection, and obtained certain series in exchange through the courtesy of the Museum of the Russian Academy of Science. In this country, although I was deprived of the bulk of my unique material, I continued to assemble all the material that I could gather. I also have seen probably all of the most important collections of this Satyrid in the Old World. Unfortunately in this country there are

[1] Avinoff, A. N. Contributions to the Fauna of Butterflies from Eastern Pamir. Horae Societis Entomologicae Rossicae V. 39, P. 225-246.

very few specimens of this group in any of the public institutions. Surely by far the most significant collection, outside of materials preserved in Russia, is the collection in the British Museum, which I have studied and photographed in kodachromes. I have received, through the courtesy of the most obliging entomological staff of that great Museum, not only photographs but also some duplicate specimens for my collection. Furthermore, I purchased from dealers abroad every available specimen I could obtain, including some actual specimens from my old collection, which came into the hands of entomological firms. I received them with my original labels still accompanying these familiar specimens! In this fashion I rounded up close to a full representation of this group. The only missing part was the material described and studied by General Tytler. After he passed away I was able to acquire his whole collection of this group, through the intermediacy of my late British friend, Mr. George Talbot. In that way all the types and paratypes collected by General Tytler came into my hands, completing practically all the lacunae of this group in my possession. Thus I am able to give a presentation of all the known forms, in color, without exception, and all the different variations of the same forms in the supplementary black and white plates. My collection, which was donated a few years ago to the Carnegie Museum, contains every one of the known and herein described forms of this group, with one possible exception, a form[1] which I am describing now from a unique specimen in the British Museum. However, I still doubt the validity of that race.

It is hoped that the analysis of this involved group which is offered on the subsequent pages and the accompanying illustrations, will bring the known data on *Karanasa* into as comprehensive a system as I was able to construe for this protean clan, and will correct the mistakes of former publications. I trust that this paper will enable the student to identify every form of the group and will encourage, further, a more complete and more substantial entomological study in the future. Perchance it might serve as a preliminary contribution to a puzzling systematic problem, depending on involved biological phenomena, which are manifested by this whole cycle of species and forms. Similar examples of fluctuation, simultaneous occurrences, and distributional paradoxes are duplicated not only among cited examples

[1] *Karanasa regeli eburnea* nov.: P. 105.

of Lepidoptera, but probably also through a wide range of other living forms. This study may help to give some clues which could better be solved on other grounds. Besides, it indicates that an extensive field for future explorations remains open in the region of the "Roof of the World."

With all the studies conducted up to date in Central Asia, the entomological surface has barely been scratched in some portions of that vast territory; and our present conclusions will doubtless have to be revised by subsequent investigators. They might substantiate the necessity I encountered in recognizing and giving many racial names. On the other hand some of those designations may be merged into greater units, or will have to be thrown overboard altogether into the hospitable waters of the sea of synonymy, where due oblivion comes to things that should better be forgotten or which never should have been mentioned to begin with. But for the time being one has to use some nomenclatorial handle to be able to manipulate all this multifarious complexity, and such is my excuse for leaning more towards 'splitters' than 'lumpers.'

STATUS AND DELIMITATION OF THE GENUS

The first question which arises in connection with this whole group is the choice of generic term to be used. In all the recent catalogues and surveys, such as the publication of Strand and Seitz's "Grossschmetterlinge der Erde," this group is treated under the caption of *Satyrus.*

There has been no general agreement on the content of this genus or of its subdivisions or offshoots. The International Commission on Zoological Nomenclature, under a suspension of the rules (Opinion 142) has designated *Papilio actaea* Esper (1780) as the type of *Satyrus* Latreille (1810), "and that genus, so defined, is hereby added to the Official List of Generic Names in Zoology." While the status of the generic name is now fixed, the task of straightening out the heterogeneous assortment of forms that have in the past been included under that name still remains. A little of the history of the controversy regarding this group may help us here.

Francis Hemming, in his searching study of generic names of Holarctic butterflies, expressed himself in favor of taking *galathea* Fabricius as a genotype of *Satyrus.* This view, shared by his two colleagues on the lepidoptera subcommittee of the committee on generic nomenclature of the Royal Entomological Society of London, is based on the fact that Latreille, who established the genus of *Satyrus* in 1810, places *galathea* at the head of the list of species belonging to this taxonomic division. In that fashion a homogeneous group of white Satyrids, familiary known as *Melanargia,* or *Arge,* acquired a new name, incidentally the basic generic name of the Satyrid family. According to the views of Mr. Hemming, the group of *hermione* L., which should be called *fagi* Scopoli, since it appeared under this name a year prior to the Systema Naturae, 1764, is assigned to the genus *Hipparchia,* established by Fabricius; *antonoe* — to the Huebnerian genus *Eumenis,* and *phaedra* Moore (correctly *dryas* Scop.) to the genus *Minois,* while *proserpina* is referable to *Aulocera* Butler. (AVINOFF MSS.)

I have had much discussion on the matter of the generic designation of the Satyrid group with fellow entomologists and would like to give *in extenso* an instructive and thorough summary by Dr. Charles D. Michener, recently of the American Museum of Natural History, and

now of the faculty of the University of Kansas. The letter written in 1943 before the ruling of the International Commission, follows:

"The genus *Satyrus* was described by Latreille (1810) who included six species, *teucer, phidippus, sophorae, piera, galathaea* and *maera*. According to the international rules, the type species must be selected from this list. The first three species belong to *Caligo, Amathusia,* and *Brassolis* respectively, genera not now included in the Satyridae. The fourth is a *Haetera*. The remaining two are the only Palearctic satyrids in the list. The only valid genotype designation is that of Scudder (1875), who considered *galathaea* as the type. Hemming's extensive discussion of Retzius' work is quite acceptable, the more so because the suggestions of Crotch and Higgins (recognition of *maera* or *megera* as type) which Hemming refuted would make *Pararge* a synonym of Satyrus. Under the rules, then, and avoiding nomina conservanda, the only course is to recognize *galathaea* as the type of *Satyrus*. An additional advantage of this course is that *Satyrus* would replace the familiar name *Melanargia* which unfortunately is a synonym of the unfamiliar *Agapetes* and cannot, therefore, be retained. Such a course would leave such names as *Hipparchia, Eumenis, Minois,* and *Karanasa* available for the assemblage usually known as *Satyrus*. *Hipparchia,* as the oldest of these names, would be used for the entire group if it were regarded as a single genus.

"The course outlined above has the disadvantage of shifting the name *Satyrus* from the group with which it is usually associated to the group usually, but improperly, called *Melanargia*. In order to save *Satyrus* in its usual sense, it would be necessary to place the name on the nomina conservanda list with a type (such as *actaea,* selected by Butler, 1868) chosen from the pale species usually included in *Satyrus*. This course would still leave *Satyrus* (1810) as a synonym of *Hipparchia* (1807). —(Stephens (1829) considered *Satyrus* a synonym of *Hipparchia.)* The commission would therefore have to rule at the same time that *Hipparchia* be set aside in favor of the *Satyrus*. Otherwise the family name would have to be changed to *Hipparchiidae,* in connection with the change of the generic name, and *Satyrus* would be lost all together!

"In view of this complication, and because of the actions of Scudder (1875) and especially Hemming (1934) which I believe will be more and more regarded as an important milestone in the history of lepidopteran nomenclature, I think that I would probably accept the change in meaning of Satyrus (i.e., follow Scudder and Hemming). I suspect that under the circumstances it would be very difficult to obtain a ruling on *Satyrus* from the new American commission, especially since it is an Old World group and since a recommendation to the opposite effect is before the International Commission (Hemming, p. 40). I believe that in the past the International Commission has sometimes refused to place such names on the nomina conservanda list.

"If you do submit the matter for a decision, it should, of course, be pointed out that since the time of Westwood (1851) Satyrus has been applied

to a large group of more or less pale butterflies except by Scudder (1875) and Hemming (1934), and that to change the name now to the black forms would cause more confusion than uniformity."

As has been recorded above, The International Commission made the special exception. Incidentally, the fine point of eliminating the competition with the term *Hipparchia,* as pointed out by Dr. Michener, was not raised.

Among the various genera set up to take some of the motley assemblage of insects assigned in the past to *Satyrus,* is *Karanasa,* established by Frederick Moore. (Lepidoptera Indica Vol. 2 1893-96, page 38).

"Genus Karanasa-Satyrus (part.) auctorum. Hipparchia (part.) auctorum. Imago.— Male. Wings somewhat elongated and narrow. Forewing subtriangular; costa very slightly arched, apex obtusely-pointed, exterior margin slightly oblique, convex, posterior angle very convex; costal vein swollen at the base, median very slightly swollen; cell extending beyond half the wing; discocellulars outwardly recurved, concave before the middle, upper radial from a slight angle very close to subcostal, lower radial from above the middle; median veinlets widely separated; crossed by an ill-defined broad inwardly-oblique discal glandular patch, which is clothed with a few short oval and some longer narrower sharply dentate-tipped scales, interspersed with several longer slender androconia, which have lengthened-bulbous base and short hair-like tasselled-tip.

Hindwing ovate; exterior margin very convex, slightly denticulated; cell extending to half the length; discocellular very oblique; middle median emitted at some distance before end of cell. *Body* rather stout; thorax and head very hairy; palpi clothed with lengthened fine hairs to the tip; antennae with a rather stout short club, the tip being obtuse. Eyes naked."

"Type. — *K. huebneri*"

The main characters of the genus are the shape of the discocellular, the relative position of the upper radial and subcostal, and the emergence of the lower radial. Another useful character is the position of the gnathos of the male genitalia which are directed exactly posteriorly, parallel to the uncus.

The reference to the glandular patch does not prove valid in regard to some Indian forms and to the majority of forms outside of the confines of India, which became known after Moore's writings. I should like to point out that Moore was in error with regard to the antennae which, even in the type species, have an attenuated and gradually swelling club drawn out into a thin point.

In this genus, whose type was designated as *huebneri* Felder, are included *pimpla* Felder and *digna* Marshall, the former specifically

related to *actea* Esper. *Huebneri, digna* and *pimpla* do not seem to be sufficientally homogeneous to be combined *en bloc* with *actaea.*

(AVINOFF MSS.)

The genus *Satyrus auctorum* has been also called in a wider sense by the older name of *Hipparchia* with an inclusion of certain species belonging to the genus *Aphantopus.* Furthermore a restricted application of *Aulocera* has been also used by authors while that latter designation is suggested for a subgeneric term with *Minois, Karanasa,* and *Brintesia.* The last name was suggested by Fruhstorfer to take the place of the Huebnerian name of *Oreas* which has been preoccupied in the class Mammalia. These four subgenera (now called genera) of *Minois, Brintesia, Karanasa* and *Aulocera* in contradistinction to other subdivisions of *Satyrus* auct. or *Hipparchia,* have only one costal vein inflated. With that characteristic in common they diverge in the configuration of the discocellular, the shape of the discal cell of the hind wings, and the character of the club of the antennae. *Karanasa* has a more angular discocellular and a shorter precostal of the hind wings, and, as compared with *Aulocera,* has a similar precostal of the hind wings but a different discal cell and a different shape of the discocellular. (AVINOFF MSS.)

Karanasa is thus related to the Brintesia group (*Circe* cycle) and the *Aulocera* division (including the Indian species *padma* and relatives). The subgenus *Eumenis* is an entirely different and somewhat heterogeneous subdivision of the collective genus and includes such species as *fage, alcyone,* etc. With *Minois,* of which *dryas* is the most typical representative, *Karanasa* has in common not only the single inflated vein but also the general characteristics of the structure of the antennae. Altogether one might say that the characters of the subgeneric divisions of the genus *Satyrus* auct. or *Hipparchia* auct. are of a help in grouping, but are not conclusive in a definite natural arrangement since they obviously bring into immediate association several forms not particularly closely related among themselves in every respect. On the ground of all foregoing considerations it is proper to recognize the designation of *Karanasa* in a generic or subgeneric sense. It is not without certain advantages for a clear comprehension of position of this group within the alignment of the collective and rather heterogeneous assemblage of species known as *Satyrus* auct. or *Hipparchia* auct. (AVINOFF MSS.)

The state of considerable nomenclatorial confusion dictates as

advisable the policy which was already indicated, namely a recognition of a genus *Karanasa* for the broader complex of *huebneri* relations with a very questionable inclusion of *digna* and a preferable exclusion of *pimpla* and its numerous palearctic relatives. The exclusion of *pimpla* is furthermore substantiated by the selection of *actaea* — an obviously related insect — as the genotype for Satyrus. (AVINOFF MSS.)

Under such circumstances the safest policy seems to be to extend recognition to the name *Karanasa* proposed by Frederick Moore with *huebneri* as the genotype and to limit it to only the closely knit group centering about it. I use the term of *Karanasa* only as a convenient device to segregate a natural group although the validity of *Karanasa* as a genus in its own right is obviously debatable. To my mind it is an equivalent to brackets enclosing a compact group of related forms and all through this article I use this term in the generic sense with an understanding that the term subgenus would be equally or even more satisfactory. (AVINOFF MSS.)

Whether *Karanasa* should be looked upon as a genus of good standing or a subgeneric division of a larger complex loosely designated as Satyrus in a broader sense, I would not consider a matter of serious importance. The concept of genus as a systematic entity is a matter of recognizing a certain degree of affiliation for which no precise, uniform and formal measure could possibly be applied. It is a way of interpreting biological kinship and a term of accepted commodity of designation provided by the binomial principle. No more sacrosanct or esoteric meaning could be read into the term of genus, and I am just as willing to call *Karanasa* a good genus or a valid subgenus of Satyrus at large in the same sense the vast body of *Papilio* can remain united under this generic name or broken up into the many natural groups, based chiefly on the structure and life habits of the caterpillars, or even into the multitudinous genera which hold together only the apparent immediate relations. Thus in my acceptance of the term *Karanasa* to hold together this group being presented, I am in no way inclined to enter into an argument about its limit and validity any more than I would fight for or against using the generalized name of *Papilio* in preference to its subgeneric equivalents. In fact, I would like to avail myself of this opportunity to record my aversion to this most disconcerting current movement of shifting, changing and restricting generic names. (AVINOFF MSS.)

REVIEW OF PREVIOUS WORK (AVINOFF MSS)

The writings on the *huebneri* group are scattered in a diversity of publications and some of them appear in editions of unusual rarity, remaining inaccessible to many entomologists who would desire to consult the original sources. The more important of these will be quoted at length, *verbatim,* or translated into English in cases where Latin or some other foreign language was used. Original descriptions will appear in their proper places in the "Description of forms of the lowest category." Others will be used where they fit best into the discussion.

The introductory statements of Grum-Grshimailo, the first monographer of the group, are so important that it is deemed advisable to give here a translation of the complete French text from Volume IV of "The Memoirs" published by the Grand Duke Nicholas Michaelovich (N. Romanov). It may be considered as a discursive preamble to the discussion on the best systematic arrangement of the group and of the taxonomic values of the different forms. This pioneer in monographing the group writes as follows. (Translated from French)

"The *Satyrus huebneri,* of which I have received ten specimens from Kashmir, opens up a series of forms of innumerable transitions, all of which occupy the Pamir without extension beyond its confines indicated by the venerable zoologist N. Severtsow, except in two places and in two forms in the northeast *(S. regeli)* and in the southeast *(S. huebneri).*

"We count altogether ten forms. Should they be considered as definite species or varieties? This is a complicated question, the solution of which is entirely individual and personal. There is in general a consensus of opinion that a species and a variety cannot live together side by side. Besides, this conviction based principally upon the study of European fauna, could not hold ground when we have encountered such 'ancient sources,' as for instance the Pamirs. We have had already the occasion to state how simply can be explained the innumerable proportion of the typical form to the variety in the same locality of mountains. We have also seen more than once that in regions so isolated in general as the vast spread of the mountains in the interior of Asia, especially in the Pamir, with its endless variation of climates and condition of habitat there is nothing that favors the development of a very distinct fauna, but there exist on the contrary a number of conditions conducive to the development of one type encouraging in it the tendency to be modified in the most varied directions and contributing considerably to its breaking up into specialized forms. It is

known that it is only long duration (great antiquity) which consolidates the type, provides a finished aspect and develops sometimes in astonishing constancy. On the contrary a type limited in its distribution but not having penetrated from other regions (as for instance many alpine forms in Europe) and circumscribed in the area where it has developed, is always distinguished by its instability and has aptitudes to infinite modifications. It is always exceedingly difficult not to be lost amidst such variations; and such an analysis has little chance to satisfy all the tastes and still be in conformity with truth.

"We will endeavor to elucidate this question as far as possible. We have mentioned already that there are ten forms constituting the group of *huebneri;* I presume, however, that there are more; for instance, *Wilkinsi* of Kisilart is not the *Wilkinsi* of Alai, and the *Josephi* of Farab is not the *Josephi* of the southern part of the mountains of Ghissar.

"According to the habitation these ten forms can be divided into two categories; the first composed of the species Josephi, Leechi, Boloricus, and Huebneri (?) living on the high mountainous plateaus notably arid and covered with various kinds of Oxytropis, Astragalus and Echinospermum; the second, the most numerous and comprising the forms Regeli, Abramovi, Wilkinsi, Intermedius, Pamirus and Dissoluta, lives in the steppes varying in regard to the vegetation and to the type of soil, and also of another geo-botanical character. These steppes, covered with Stipa, are inhabited by Abramovi and possibly Regeli[1]; in those of the alpine zone with Festuca are found Dissoluta, Wilkinsi, Intermedius,[2] and Regeli.

"Finally in conditions almost identical with those of the first category, which means on tablelands covered with Astragalus and at the same time with a quantity of plants typical for steppes in this subalpine zone, usually along ancient dry 'sais' (beds of mountain streams), fly the last of the six Satyrids of the second category, namely Pamirus.

"In regard to coloration these forms fall into two principal categories. To the first belong three species with a coloration more or less brown-black, namely Boloricus, Regeli, and Abramovi; to the second, forms of an ochreous coloration of various tints and shades: this group includes the balance of all the other species.

"From the shape of the wings this group shows two series of forms though they can not be very sharply divided.

"One form somewhat elongated, or to be more precise, with a sharp basal angle of the wings produced by the costal and interior margin, is exemplified by Pamirus and Intermedius. Another with a blunter angle is characterized by Josephi, Dissoluta (though not constantly) and Abramovi.

[1] I did not have the occasion to take Regeli near the Tschatyr-Koul, the two species flying together, but it must be ascertained whether they are found in the same conditions.

[2] Wilkinsi and Intermedius are fond of going down on the "sais," but exclusively in order to fly over the water.

"The other five forms must be considered as being intermediate following the amplitude of the basal angle (Boloricus and Regeli) as being either very unstable and furnishing among various representatives examples of divergence into two extreme directions (Wilkinsi and Leechi), or as being the forms which depend on the sex to be classed in the two extreme categories (Huebneri).

"We are far from having mentioned all the differentiations of this type. We could divide it into different groups according to the development of the bands on the upper sides of the wings, the coloration of the hind wings, etc., but we fear we should be lost among these details and furnish as a result a mess of facts proving, it is true, the different degrees of kinship among these forms, but nothing more important.

"What strikes us in the first place in this type are the two different hues of the predominant color. Since we possess in both cases series of forms spread all over the Pamirs we conclude that these two branches originally existed from very ancient times. The prototype of this whole group certainly could not have been divided immediately into two forms of such a diversity of coloration exemplified at present by Intermedius or Abramovi. There occurred a gradual adaptation to these two tendencies. The coloration of this prototype has doubtless been intermediate between these two extremes. It is somewhat similar to the one which distinguishes Leechi and Boloricus. These two forms were found, as it is known, on the isolated mountain ranges of Kounjout, where they fly together. They are not distinguishable from the underside, but show a number of characters on the upper side separating these two species, though these points of difference are not sufficiently accentuated to disguise the close relationship. So it happens that there the two principal groups of the type of Huebneri are reapproached in a closer way than in the case of other forms. The Hindou-Kouch occupies the center of this enormous area inhabited at present by representatives of this group. Toward the north and the south they are represented only in their extreme forms including into such a Huebneri on the one side and Josephi, Pamirus and Abramovi on the other.

"So it seems to me that I succeeded in indicating with sufficient probability, first, the hypothetic center of distribution of this group, which could be located somewhere to the north of Hindou-Kouch, for instance in the great Pamir, which showed already at the epoch of the first geological uplifts of the Pamir of suitable conditions for the development of a sub-alpine and alpine fauna; the regions of distribution of Leechi and Boloricus are divided from the Grand Pamir only by the high vale of Aksu, about 13,000 feet, the two forms apparently penetrating into Hindou-Kouch already separated as they do not show any intermediate links. Second, to indicate approximately the most ancient representatives of this group being the closest relatives of the original form, one of the branches of which, Boloricus, can be justly considered as the ancestral form, has no representative to the south of Hindou-Kouch.

"It is evident that in the general chaos of migrations produced by the geological lifting of the Pamir, by the desiccation of the Han-Hai and the basin of Turkestan, and later by the approach of the glacial epoch this branch of the group has been pushed directly northward. This group reached to the geological processes which affected the Sarikol and Kashgar, the part of Mous-tag in Trans-Alai, and penetrated into the mountains, which at that time were surrounding the immense Tschatyr-Koul, where ultimately it broke up into two branches. Abramovi spread to the west and Regeli to the east and northeast. Regeli forms at present in every respect the intermediate link between Boloricus and Abramovi. These three forms nevertheless are so well differentiated that one can consider them as different species.

"The second branch also originated in the Grand Pamir endowed with all the elements of instability and, placed during this migration under other conditions, did not fail to be scattered in the most varied directions. Any one who sees my collection of Satyrus leechi will be convinced that this peculiar species cannot be otherwise characterized than by being called the collective type, because of the fact that in it are united in varying degrees all the peculiarities of such species as Josephi, Wilkinsi, Huebneri, and Intermedius.

"Thus Satyrus leechi confirms better than any secondary argument the correctness of the opinion which I have hitherto outlined.

"The separation has occurred primarily somewhere in the districts adjacent to Hindou-Kouch. Huebneri was the first to differentiate and was followed by dissoluta. Huebneri reached from the Hindou-Kouch; dissoluta and leechi first appeared as entirely separate entities on the northern slopes of those mountains and subsequently were involved in a rapid migration by identical agencies and have followed two paths. Satyrus leechi chose the oriental direction; the north in the mountains of the oriental Trans-Alai and later in all the oriental section of the Alai including Tschatyr-Koul, modifying itself gradually into wilkinsi. Dissoluta followed the western road leaving everywhere along its way the traces of its sojourn and reaching almost without any modifications the Alai Mountains; and only upon crossing into the western Ghissar chain its extreme link has broken up into a series of varieties, Josephi from Liagar Mourda being apparently the extreme link of the chain. In these two cases a complete change of ecological conditions took place, a fact which remains not sufficiently comprehensible and which may have been the cause of modifications in the coloration of the upper and lower sides of the wings. Dissoluta and Leechi are restricted in Hindou-Kouch into different ecological surroundings. Their tendencies mutually change in the north. Josephi flies over shrubbery of Astragalus and Oxytropis, and Wilkinsi is found in the steppes covered with Festuca. There exist all the transitional forms between Leechi and Wilkinsi as well as between Dissoluta and Josephi. I do not find it possible, however, and do not consider it advisable to reunite them, even if it were only for the reason that similar transitions are found between leechi and dissoluta on

one side, as between wilkinsi and dissoluta on the other. There are no means, nevertheless, to unite the forms such as wilkinsi-leechi and dissoluta-josephi, especially as the ones and the others are representatives of different races derived from the second branch of the type of Huebneri.

"It has been mentioned already that the Wilkinsi of Trans-Alai mountains, which some day might deserve a special denomination, as well as Leechi, and is distinguishable from the bulk of other Satyrids of this group by their undecided habitus, ought to be more precise by their faculty of holding the middle ground between extreme forms owing to the variability of the shape of their wings, sometimes narrow and sometimes just as broad as those of Josephi. This peculiarity has allowed a form with broad wings as Dissoluta to be separated from the type of Leechi, and favored with modification of Wilkinsi in its movements to the west to be modified into a form which I call intermedius, and which presents all the characteristics of the true species.

"The Satyrus pamirus is entirely isolated.

"We do not doubt in the least, however, that a further study of forms from Chouguan and Rochan will trace all the transitions between this extreme form and the Satyrus leechi."

While Grum-Grshimailo was the earliest writer on *Karanasa* as a whole, he expressed many worthwhile and sound ideas on forms known in his time, and in some respects the erudition of his prognosis should be considered quite remarkable. He may have exaggerated the significance of the color divisions and may have stressed unduly the particular part of southern Pamir as a center of distribution of palearctic and nearctic lepidoptera. His point of view in this regard was quite firmly set; in support of this opinion he argued the case of close blood relationship of the American Colias of the *alexandra* group with that extraordinary species from Hindu Kush which he called *marco-polo* with his keen sense of the dramatic in nomenclature. Unfortunately *marco-polo* is in no way related to these American forms and is but a paradoxical offshoot of the *wiscotti* group prevailing in the Pamirs at large and in the Tian Shan mountain system. Nevertheless, the ideas of Grum on the primordial character of *bolorica* and the primitive traits of *leechi* are quite correct and surely have a bearing on evolution of forms, which may not have undergone such orderly migration as he surmises. It would be more justifiable to speak of wider distributions, partial survival, extinction and isolation than actual migration, notwithstanding the fact that the lepidopterous genus *Parnassius* and the mammalian genus *Ovis* behave as if they were inseparable traveling companions. (AVINOFF MSS.)

One should also take exception to the somewhat confused conceptions of Grum on *josephi,* which he seems to make a portmanteau holding both the branded *iskander* and the regular *josephi* which is deprived of androconia. But he sensed well the divergence of types contained in these nomenclatural brackets. (AVINOFF MSS.)

The only other attempts at analysis of the forms of the *huebneri* cycle were by M. Gaede in Embrik Strand's *Lepidopterorum Catalogus* published in 1931 and in Seitz' *Gross-schmetterlinge der Erde.* In volume I of the latter, the writer was Adelbert Seitz; in volume I supplement, M. Gaede; and in volume IX, H. Fruhstorfer. Both contain some mistakes that should be corrected and, since these sources are apt to be largely used by lepidopterists, comments on these two works are in order. (AVINOFF MSS.)

Gaede, in *Lepidopterorum Catalogus,* proposes a strange arrangement of the representatives of this group. While he divides most of the cycle into two species, *huebneri* and *regeli,* he preserves *alpherakyi* as a species. This insect unquestionably does not deserve any more special consideration than many of the units which are tabulated under the other two species that Gaede recognizes. This group is placed correctly under *Karanasa* to which, though, a subgeneric validity is assigned. Strangely enough, in *Aulocera,* another subgenus of the collective unit of *Satyrus,* is placed *pungeleri* (O.B.-H.) as a species, with *erschoffi* (Avin.) as an aberration and *minutianus* (Fruhst.) as a variety. Both of the latter are nothing but forms of *abramovi,* which is placed in *Karanasa.* Still more strange is the double appearance in the list of *minutianus,* once in its correct spelling as mentioned above in the guise of a variety of *pungeleri* (O.B.-H.), which it is not; and again as *minuianus* (Fruhst.), misspelled with the omission of the "t" and with other bibliographical references. Since Gaede himself was responsible for that reference to *minuianus,* he should have noticed the mistake of splitting the identity of this insect between two different "subgenera" of *Satyrus.* Also it is not clear why *Satyrus fidia* (Linn.) should be selected to take a place in the subgenus *Karanasa,* instead of alongside its other close relatives of the *statilinus-sylvicola* group. *Actaea* (Esper) and its form *pimpla* (Feld), with *digna* (Marshall) lie outside the relatively homogeneous *huebneri* cycle and are better placed in other "subgenera" of *Satyrus."*

(AVINOFF MSS.)

In the *Gross-schmetterlinge der Erde* there are also a number of errors. Seitz, in volume I has figured a *josephi* (Staudinger) as *cadesia* (Moore) in row D, plate 43. *Cadesia* (Moore), as figured in *Lepodoptera Indica,* is an entirely different insect, which is predominantly orange-russet with only one apical eyespot on the frontwings, and a few dark median patches as the remnants of the dark basal portion. *Josephi* (Stgr.) and *wilkinsi* (Ersch.) are placed as synonyms of *cadesia* (*Moore)* whereas all three are entirely different insects. *Decolorata* (Stgr.) is marked as being found in Bukhara and Tian Shan. The known localities are around Karasagin in Bukhara. The label Samarkand is of questionable authenticity; nowhere in the vicinity of Samarkand could one find a satyrid of this alpine group. The extreme eastern distribution of the *josephi* group is indicated in transitional form from northwest Alai. It is not found in the Tian Shan. *Wilkinsi* (Gr.-Gr.) is not a synonym of *dissoluta* (Stgr.). *Intermedia* (Gr.-Gr.) is not from Altai, but from Alai. This must be a typographical error, which brings into the range of this group the name of the Siberian mountains where no *huebneri* representatives are found. In regard to *abramovi* (Ersch.) the reference should be more precise. This form is never found in the actual Pamirs and does not extend farther south than the northern slopes of the Trans-Alai. The habitat of *hoffmanni* (Christ.), indicated as Turkestan is certainly too wide and indefinite, since all of the localities of the distribution of the *huebneri* cycle north of the Hindu Kush lie within the province of Turkestan. The exact locality for *hoffmanni* was not sufficiently indicated by its describer Christoff. The habitat of *regeli* (Alph.) as Kuldja is too restricted. It is not found in the immediate vicinity of that city, but is spread over a considerable portion of the Tian Shan from Yuldus to Khan-tengri. On the other hand, *korlana* (Stgr.) has an indication of too wide a spread when located in Tian Shan. It is found only in the eastern part of this mountain chain, to the north of Korla. *Pamira* (Stgr.) is listed as having the habitat of Fergana, which covers a large province, including the Pamirs, Trans-Alai and other mountains. In actuality, *pamira* (Stgr.) is found only in the western part of the Alai Valley and the adjacent parts of the Pamirs to the south of that locality. (AVINOFF MSS.)

Fruhstorfer, in volume IX of the *Gross-schmetterlinge der Erde* described *minutianus* as a subspecies of *regeli* (Alph.). He states that

this butterfly is related to *korlana* (Stgr.) from which it differs by having a darker band across the middle of the forewings, ocelli almost double in size, and a prominent ocellus on the hindwings. He mentions that this butterfly is found frequently on Alai. Not having seen the type, it is difficult to make a satisfactory identification of this form. The description is very incomplete, and in fact could apply perfectly to the well known form *abramovi* (Ersch.) whose mesial dark band is very prominent, the eyespots exceptionally large and the hindwings frequently bear ocelli in (cell Cu_1-Cu_2). Besides, having visited the Alai Valley and having received numerous specimens from that region, I have no evidence that any satyrid of the *regeli* (Alph.) group is to be found there, whereas *abramovi* (Ersch.) quite frequently occurs in the eastern end of the valley. It seems as if Fruhstorfer is redescribing *abramovi* (Ersch.), which somehow escaped his attention. But this scarcely seems possible, since *abramovi* (Ersch.) and its synonym *regulus* (Stgr.) are among the best known representatives of the whole group. Strangely, however, both the description and the locality fit *abramovi* (Ersch.) quite well. (AVINOFF MSS.)

Gaede, in the supplement to volume I of the "Macrolepidoptera der Erde," places *minutianus* (Fruhst.) as a relative of *pungeleri* (O.B.-H.) and not *regeli* (Alph.), for which no special reasons are given. According to the description, *minutianus* (Fruhst.) cannot belong to *pungeleri* (O.B.-H.) which is characterized by traits diverging in the opposite direction, such as the reduction of the ocelli. Gaede also placed my own *erschovi* under *pungeleri* (O.B.-H.), which is entirely erroneous since it belongs to the *regeli-tancrei* group. In the above, Gaede is consistent with his groupings in the "Lepidopterorum Catologus." The female of *cadesia* is indicated as identical with *modesta* (Moore), which is wrong, since the males of the two forms are entirely different; *modesta* (Moore) having a uniform dark base and two ocelli, while *cadesia* (Moore) has a russet base and one apical ocellus. *Talastauana* (O.B-H.) is erroneously compared with *intermedia* (Gr-Gr.) as to the pattern of the underside of the hindwings. In reality, it has all the characteristics of the underside of a dark *dissoluta* (Stgr.). *Intermedia* (Gr-Gr.) has an exceptionally light underside with a reduction of the light marbled portion so very prominent in *dissoluta* (Stgr.) and *talastauana* (O.B.-H.). (AVINOFF MSS.)

MATERIAL AVAILABLE FOR STUDY

The genus *Karanasa* is well represented in but few collections, the most important early collection having been that assembled by Grum-Grshimailo. His extensive explorations of Pamir and adjacent regions enabled him to obtain a magnificent documentation of the species and races known in his time. In the beginning of the Twentieth Century his collection was sold to Elwes and subsequently became part of the collection in the British Museum. Thus the material of Central Asia, within the Russian confines, was added to the extensive series from the Indian territory. The British Museum became in this way an extremely valuable repository of specimens of this intricate group, supplying an elaborate array of data on geographical variation. The Rothschild collection has but a very restricted set of examples from the group and unfortunately did not preserve the type specimen of *Karanasa huebneri,* although the Tring Museum came into possession of the collection of Felder who described this species. (AVINOFF MSS.)

The collection of the Russian Academy of Science also ranks very high, especially in the series showing the distribution of forms in Russian and Chinese Turkestan. The original material of Alpherakyi, Erschoff and that of Grum-Grshimailo contained in the immense collection of the late Grand Duke Nicholas Mikhailovitch (N. M. Romanoff) deposited there are of prime importance because of the presence of many types and typical series. This collection, however, does not cover thoroughly the fauna of northern Indian and Pakistan. The senior author's old collection, nationalized by the Soviets, was kept separate until the early 1930s. It contained some two thousand specimens of this group, covering practically all the forms contained in the main collections of the Academy, with the addition of some newly discovered species and forms from some of the localities investigated by the senior author and his collectors. This collection, however, is also not rich in North Indian forms. (AVINOFF MSS.)

Another collection in which is represented quite completely the forms known in earlier times is that of O. Staudinger, now in the Berlin Museum. There are a few somewhat scattered series in the Munich Academy of Science, including some material obtained by later German explorations of Pamir. In France the group is not richly

represented. There is a surprising dearth of material in the National Museum of Natural History in Paris and the now scattered collection of Oberthur had but a slight assortment, which could scarcely do justice to such a diversified group. Other European museums have an extremely inadequate assortment of *Karanasa*. (AVINOFF MSS).

Most museums in North America unfortunately possess a very restricted representation of this group, confined to some of the best known forms. The American Museum in New York has not a single specimen; The National Museum has a few odd specimens from Turkestan and northern India.

The senior author accumulated, in this country, a collection of slightly more than seven hundred specimens but including all of the known forms and specimens from practically all of the places where karanasa butterflies have been taken. Thus we are able to show colored figures of each of the forms with the exception of three that were acquired since the making of the plates. An especially welcome addition to this collection was the complete set of the *huebneri* specimens assembled by Major General Sir Harry Tytler, who resided and collected for many years in the north of India. This series contains the types and cotypes of the forms that he described, together with series of duplicates from topotypical localities. The second Avinoff collection, not the largest, but the most complete, is now in the Carnegie Museum at Pittsburgh.

THE HOMELAND OF THE *KARANASA* BUTTERFLIES

General Geography

The *karanasa* butterflies are found in very restricted habitats in the high desert mountains centering about the Pamir region of west central Asia. The Pamirs, which form the western bastion of the Tibetan plateau, may be considered as a knot tying together the ends of mountain chains that extend east-southeast into Tibet (the Karakoram ranges) and India (The Punjab Himalayas), west-southwest into Afghanistan (the Hindu Kush system), west towards the Caspian Sea (the Alai-Tag), and northeast into Russian and Chinese Turkestan (the Tian Shan mountains). The Tian Shan forms a secondary knot where it joins the Alexander mountains in Russian Turkestan.

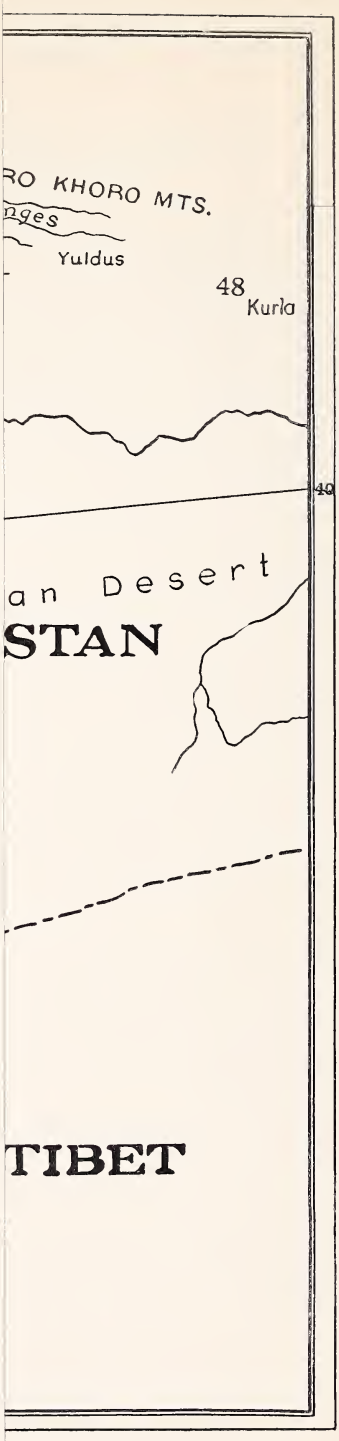
Not all of these high regions support *Karanasa*. The butterflies do not extend into Tibet proper and are missing from the wet southern slopes of the Himalayas. The western limit in Afghanistan is unknown. They are found in Bukhara and extend in the mountains from near Samarkand to Aulie-Ata. One form is found as far northeast as Dzungaria on the outside of the knot formed by the junction of the Tian Shan and Alexander mountain systems. The easternmost outpost is Korla in the Tian Shan. They appear to be missing from the eastern slopes of the Pamirs although found in similar positions farther north along the Tian Shan. Distribution within the area marked out by these outposts is not continuous but insular.

The long chains of the Himalayan mountains that mark the boundary between high Tibet and low India, swing northwest towards the southeast corner of the Pamirs, but do not quite reach there. Their westernmost ridges, called the Punjab Himalayas, end in Kashmir and serve to screen the moisture laden winds from the lands to the north. They are separated from the more lofty Karakoram ranges, which parallel them to the north and which do reach the Pamirs, by the mighty gorge of the Indus River.

DeFilippi[1], in his account of the expedition of Prince Luigi Amedeo of Savoy to Karakoram and the Western Himalaya, gives a vivid description of this land. "The Karakoram, like the Himalaya, of which

[1] Karakoram and Western Himalaya, 1909, De Fillippi, London, 1912.

FIG. 5 Type localities of *Karanasa* subspecies.


RO KHORO MTS.
nges
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48
Kurla
40
an Desert
STAN
TIBET

it is the western portion, consists of a series of chains parallel to each other, and approximately parallel to the course of the geological zones and tectonic features, ill-known as yet, of the whole system. The rivers flow in open valleys between the chains and narrow, deep cut channels frequently reduced to impassable gorges, by which the rivers pass from one valley to the next, sever the chains in pieces." He also writes, "The whole land is one vast labyrinth of high, barren, desolate mountain chains, of cliffs split and shattered in every direction, usually precipitous; overhanging valleys full of rocks and stones, pebbles and sand; detrius of all shapes and sizes hurled down in avalanches and mingled with vast accumulations of alluvial deposits. The disintegration is so continual and on so vast a scale that the general aspect of the valleys must perforce change at many points every few years."

The Hindu Kush range is the backbone of a series of mountains extending west-southwest from the southern edge of the Pamirs. It is virtually continuous with the Karakoram and with it forms an arc concave towards the south. Some of the short secondary ranges in Afghanistan, such as the Safed Kuh on the Kashmir-Afghanistan border just south of the famous Kyber Pass, the Paghmans and Koh-I-Baba to the west, and the Chodja-Mahomet to the north, harbor interesting Karanasa. Many of these ranges are dissected by short steep valleys called nallahs, running at right angles to the main ridge, which tend to obscure the continuity of the main ridge. The Hindu Kush are not quite as high nor quite as rugged as the Karakoram.

The Pamirs form a rough square about a hundred and fifty miles on a side, bounded on the south by the Karakoram-Hindu Kush system, on the east by the relatively low Chinese Turkestan, on the north by the Trans-Alai, the Alai-Tag Mountains and the valley of the Syr Daria, and on the west by the valley of the Amu Daria. The Pamir area consists of a high plateau folded in a northwest-southeast direction continuous with the Tibetan plateau, but faulted in north-south and east-west directions so that the principal ridges run east-west. The peaks do not reach the heights of the Karakoram, but the general level is higher, averaging about 13,000 feet. The region derives its name[1] from that of its high desert badlands—freezing cold at night and

[1] A pamir is defined as a high valley reaching up in long slopes to the foot of mountains.

burning hot by day. These badlands are without water and support only rare patches of sparse grass and wild flowers. Marco Polo called one of these pamirs a plain and twelve days were required for him to traverse it. They are not plains, but flat bottomed valleys with long, undulating, monotonous slopes covered with boulders and gravel. From them the ranges of snow peaks, laced with great, relatively horizontal glaciers, rise an additional eight to ten thousand feet. Rickmers[1] writes that the region is one of violent climatic contrasts where "glaciers dig their cold snouts into grey rocks blistering with heat." In 1929, Anna Louise Strong[2], after crossing Kizel-Art pass from the north, wrote "Here was no sweeping view of the higher snow peaks, but a long descent to a gray depression of sand and gravel blighted by sun and wind." The numerous travelers, from the time of the Chinese pilgrim, Hsuan-tsang, to the present Russians, stress in their reports the stony gray monotony.

The mountains to the north of the Pamirs are built on a less grand scale. The Alai-Tag Mountains parallel the northern ramparts and extend westwards between the valleys of the Amu Daria and the Syr Daria in a series of decreasing ridges to the region of the city of Samarkand. Eastward, they join with the east rim of the Pamirs to form the Tian Shan mountain system. This latter range, extending in a northeasterly direction, serves to separate the great depression of Chinese Turkestan from the higher, more rugged Russian Turkestan. On the north side of the Syr Daria valley, the Alexander mountains and associated ridges run parallel to the Alai-Tag, and where they meet the Tian Shan, form a complex of mountains. These northern ranges do not have extensive "high deserts," as do the Pamirs and southern ranges, but their central ridges provide similar conditions of much more restricted area.

General Ecology

The entire mountainous district under consideration is isolated by *deserts;* the rivers flowing from it have their origins in melting snow and all but the Indus empty into desert lakes and salt swamps. Along the lower valleys there are rich agricultural areas which are dependent

[1] From "Geographical Record" The Geographical Review V. 21, 1931, PP. 159-160.

[2] "The Road to the Grey Pamir." Boston 1931, Little Brown & Co.

on irrigation; and in the northern parts there is also seasonal pasturage. Otherwise, the district is barren. As in most high desert mountains, there is a double timberline, the timber being reduced to bushes in the south. The upper line, which is the usual alpine limit of trees, extends to 13,000 feet in the Kashmir ranges, to 12.500 feet in the Hindu Kush, and fails to reach as high as the lowest of the Pamirs. The lower limit, which is determined by the distance that melting snow supplies water, extends down to about 9,500 feet in Kashmir and to 10,500 feet in the Hindu Kush. There is some "stream side vegetation" along the watercourses, but this does not support Karanasa. Over a great part of the area the vegetation belt is more theoretical than evident, almost all of the surface being bare, either live rock or talus slopes. Ground cover of any kind is the exception rather than the rule. Sparse grass and wild flowers may reach to 16,000 feet, and the older talus slopes harbor sedums and other alpine plants. There are rare mountain meadows, usually at a slope of thirty degrees or more. There are scattered junipers at the lower levels which may give way to similarly dispersed pines at the upper. Artemesia extends the lower limit 500-1000 feet.

De Filippi describes the Karakoram (Baltistan) as follows:[1] "The whole of this vast region is quite bare and without vegetation. Few and far between are the groups of trees and bushes, the little grassy hollows hidden away in the high valleys. . . . They are all too diminutive to appear as more than dots in the illimitable desert of rock, gravel and sand. . . . The dryness of the climate is such that in the whole of the transhimalayan region there are barely six inches of rainfall in the year."

De Filippi goes on to mention *Juniperus excelsa* as the principal woody growth, twisted, stunted, contorted; patches of shrubby *Lonicera* six to eight feet high at 13,200 feet as the highest woody growth. Grass may be found to 14,000 feet, *Saxafraga* and *Potentilla* to 18,000 feet. Sedge extends to 16,500 feet. In one spot, dwarf willows were recorded at 15,000 feet. Wildflowers, mostly of the type we regard as rock-garden plants, were recorded from restricted areas. A partial list of the more familiar genera include:

[1] "Karakoram and Western Himalaya," 1909. De Fillipi, London 1912.

Silene	*Delphinium*	*Potentilla*	*Gentian*
Lychnus	*Aconitum*	*Astragalus*	*Veronica*
Cerastium	*Papaver*	*Geranium*	*Lonicera*
Ranunculus	*Sedum*	*Epilobium*	*Aster*
Clematis	*Saxifraga*	*Primula*	*Artemesia*

Dr. John Clark of the Carnegie Museum, on his recent return from the Hunza and Chitral districts just to the west of Baltistan, has orally confirmed de Filippi's descriptions, and mentions particularly a large-leafed fleshy plant on old talus slopes. Ernest F. Fox, an American geologist who explored some of the western ranges of the Hindu Kush in 1937-1938, wrote an account of his work from which, although it deals principally with geology and the human inhabitants, a similar ecological setup may be deduced.

The Pamirs are equally, if not more barren, but the mountains to the north have ecologies that approach those normally to be found in the mountains of western North America, with forests, pastures and mountain meadows.

The southern ranges of the "Punjab" Himalaya, including the Vale of Kashmir, have moderate forests on their northern slopes. This region, which does not support Karanasa, is sharply separated ecologically from the lands behind the mountains. We again quote de Filippi.[1] "They feel this contrast more keenly who cross the Zoji La[2] in Summer gazing to the very top of the pass upon the green forests and lush pastures of the Sind Valley, and then looking down on the other side upon the stony desert of Baltistan. There is probably no other range of mountains upon the face of the earth whose two slopes reveal features so absolutely opposed to one another."

There is a similar transition at the crest of the Trans-Alai range at the northern edge of the Pamirs, and a less abrupt one on the eastern side. There and on the western side, tongues of pastureland extend up the mountains from the rich valleys below. These irrigated valleys, the Amu Daria (Oxus) to the west, the Syr Daria (Jaxartes) to the north and the Jarkand Daria (Tarim) in Chinese Turkestan to the east, correspond to the Vale of Kashmir, and like it, are bounded outwardly by low sandy deserts.

[1] "Karakoram and Western Himalaya," 1909. De Filippi, London 1912.

[2] In Kashmir and Western Tibet "La" means a pass.

SPECIFIC ECOLOGY AND HABITS

Grum-Grshimailo has given an account of the habits of these Satyrids. Since a complete translation is given in an earlier part of this paper[1], we merely recapitulate that he divides the habitats into four classes: The dry mountainous plateaus covered with plants like *Oxytropus, Astragalus* and *Echinospermum;* grassy steppes covered with *Stipa;* the alpine zone with *Festuca* (another grass); and finally a somewhat intermediate alpine zone with a mixed vegetation of *Astragalus* and typical steppe plants. It is not implied that the larvae feed on these plants. His observations hold true only to a limited degree. His descriptions produce the impressions of openness whereas the reverse is the case. "Passes" is more accurate than "plateaus," and the vegetation is definitely sparse. It is only *pamira* that is at home in the open steppe-like regions of the Alai Valley. *Abramovi,* variety *regula,* in the eastern part of that territory will also frequent lower elevations and an open, slightly sloping terrain. The others seem to prefer higher and more rugged territory. (AVINOFF MSS)

In regard to the flight of these insects, one might say that they are not inclined to traverse considerable distances on the wing and usually settle on the ground within a relatively short distance from the point at which they are disturbed. They fly low with irregular jerks and shifts of direction typical of many satyrids. They settle on the open ground with wings tightly closed and usually take a position at a low angle to the surface, which may be because of the prevailing winds in these open mountainous regions. While sitting in this way on the soil they are excellently protected by their marbled underside which blends to a deceiving point with the pebbles and miscellaneous debris on the ground. They can remain entirely undetected even at close scrutiny. Altogether their first flight and habits are extremely similar to those of the American *Neominois.* While I watched *Neominois* in the elevated plains of Wyoming, I was struck by a remarkable likeness to the ways of the familiar satyrids of Central Asia, which I have observed so many times in different parts of the Pamir and Ladak. I should mention, too, that the general natural setting of the region adjacent to the Bad Lands of Wyoming has a definite analogy to the habitat of Pamir.

(AVINOFF MSS.)

[1] Pages 15-19.

Karanasa pamira has a slightly different flight. It is a more robust butterfly, stronger on the wing, and apt to fly longer distances from the point of disturbance than *dissoluta* and *wilkinsi*. It is, perhaps, even more alert and would notice an intruder more quickly than *dissoluta* or *leechi*. The latter butterfly, the smallest in the russet group and the one reaching the highest elevations, has a tendency to fly particularly low, scarcely rising a foot or two above the ground. It is difficult to catch because of the strong winds that blow over the passes where this butterfly is native. It is only on quite warm days that I have seen these satyrids fluttering around and chasing each other among the cliffs of the dry "sais," beds of temporary mountain streams, which are among the best hunting grounds for Karanasa. In their regular habitats they are quite numerous and a representative collection may be taken during a short interval without much trouble. Without any special exertion my companions and I have collected five hundred specimens during a summer season in the Alai and Pamir. Perhaps the fact that their habit is to fly short distances and to stay within restricted zones is responsible for an extreme localization of racial forms even in a region which does not have visible obstacles to their distribution. Such is the Alai Valley. Here one can observe a definite difference in the assortment of these satyrids in the extreme eastern and western points of a vale separated only by a distance of about a hundred miles.

(AVINOFF MSS.)

In many instances where two or more forms are reported from a single locality, they do not necessarily fly together. Even within the group of *dissoluta, wilkinsi* and *intermedius* one may observe a certain segregation; *intermedius* appearing in higher zones than *dissoluta,* while *wilkinsi* seems to prefer less rugged territory.

(AVINOFF MSS.)

The larval stages of none of these butterffies are known.

On the whole, the Karanasa are to be found at and above timberline in dry mountains or on high dry steppes, being taken at 15,000 to 17,000 feet on the western border of Tibet, 12,000 to 13,000 feet in Kashmir, 8000 to 13,000 feet in the Hindu Kush, and at elevations as low as 4,500 feet at Kandyk-Tau at the extreme northern portion of their range. Most forms have been taken in the vicinity of passes over the mountains.

Perhaps these fragmentary descriptions will convey an impression of the ruggedness and the scarcity, tenuousness and discontinuity of vegetative cover in the home of the Karanasa. Here we have an isolating mechanism of great efficiency, an important factor in the development of the genus.

GENERAL DESCRIPTION

Form, Color and Pattern

The wings of *Karanasa* are longer in proportion to their width than those of the rest of the *Satyrus* complex. The general background color varies from almost white through straw to orange russet and reddish orange, with the bulk of the forms crowded near the ends of this range. The markings are various shades of deep brown to almost black that may in some cases restrict the ground color to a narrow band on the discal area. The whole group divides conveniently in two, one having a whitish ground color with fuscous markings and the other having russet ground color with richer markings. Following the nomenclature introduced by B. N. Schwanwitch (1926), we find the basal bands always missing on the upper side. The system of lines ($m_2g_2ddg_1m_1$) which make up the median band in the schema, is

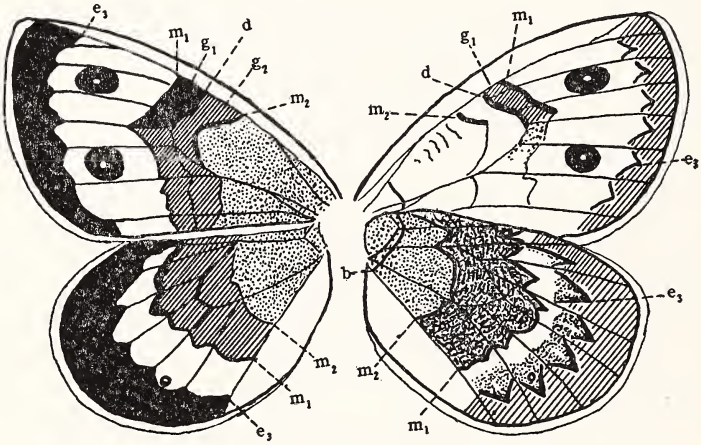


FIG. 1. Basic Wing Pattern in the genus *Karanasa* — upper and under sides.

represented to varying degrees. They may be almost all missing, only d_1 — the line outside of the discocellulars being present as in some specimens of *Karanasa cadesia* — or the complete band may be present. On the forewings these lines and bands in order of their prominence and frequency are d, m_1 (the outer boundary of the band), g_1 (the space between d and m_1), g_2 and m_2 (the inner space and inner

boundary respectively). g_2 is always paler than g_1 and m_2 is never more than a trace. In many forms there is almost a continuous dark shade from m_1 to the base obliterating the other lines and the basal ground color. m_1 is often extended outwards into a point along vein 4. (M_3 of Comstock-Needham.)

The row of ocelli, except in freak specimens, is restricted to one spot in cell Cu_1-Cu_2 and one in cell M_1-M_2. The ocelli may or may not have pupils — almost never more than one — and the umbra shade is missing. The ground color in this area usually becomes paler at the anterior end and along the outside of m_1.

The terminal markings are composed of a solid dark band bounded inwardly by e_3. This may sometimes be broken along the veins by light streaks. The e_3 line is scalloped with the points of the scallops extending inward along the veins.

The hind wing overside repeats the fore wing with the d lines omitted. m_1 is indented at the veins, deeply so between veins M_3 and M_2. The median band usually extends to the base uniformly from m_1. The veins are often light.

The ocelli are rarely represented and then only by traces of the one in cell Cu_1-Cu_2 exceptions being *Karanasa ruckbeili* and *K. regula* in which the ocellus is large, pupilled and overlaps the terminal band. The terminal band is similar to, but more prominent than, that on the fore wing.

On the underside, the hind wing and that portion of the front wing exposed while resting is cryptically marked in shades of grey and white and sometimes brownish, the ground color tending to be replaced by speckled grey scaling. The markings, however, with the following exceptions repeat those of the upper side. First the m and d lines are more accentuated than the g shades, particularly on the fore wing; and the primitive marbling lines of the cell and costal area of the fore wing are more pronounced. Secondly, on the hind wings, the m and e_3 lines are more pronounced and the basal lines sometimes appear. The e_3 line is most developed, the scalloping very pronounced so that the line becomes discontinuous on the veins. The terminal band tends to be bleached and the outer part of the discal ground color filled with grey or brown scales, so that the e_3 line seems to be a part of the latter rather than the former. The row of ocelli, usually missing on the upper surface, is represented by white points. Very rarely, a single

reduced ocellus lies under the larger one on the upper side. The greyish ground color suffusion, which may be Schwanwitch's umbra, gives way to white at the m_1 line. The median band is darkest at m_1 and gradually suffused with lighter scales towards m_2. The basal areas are also suffused with salt-and-pepper markings with the basal line sometimes discernible. The veins are usually light.

GENERAL DESCRIPTION

THE MALE GENITAL ARMATURE

The genital armatures of the Karanasa are individually quite variable, as variable as the color and patterns, but not necessarily correlated with them. They are invaluable in some species distinctions, but because of the great minor variability and the short series generally available, are not critical in separating populations.

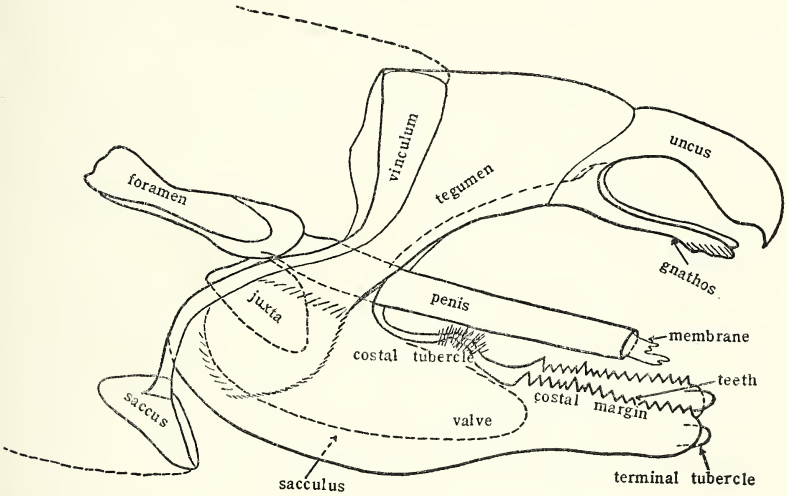


FIG. 2. Composite side view of the male genitalia of the genus *Karanasa*.

The structures are comparatively simple, perhaps the simplest of the Satyrus complex. The *vinculum* is narrow, usually expanding somewhat in the dorsal portions and is reflexed flat on the *tegumen*. The *saccus* is short, being in the form of a blunted slightly skewed conical pocket whose greatest depth is approximately equal to the diameter of its opening. The *tegumen* is stout, about one-third the length of the *valve* and displaced posteriorly so that it lies above the center of the *valve*. The sides narrow down so that the length of the dorsal hinge of the *valve* is about one-fourth the length of the top of the *tegumen*. Just below the dorsal hinge of the *valve*, the *tegumen* becomes membranous and the membrane is continuous with that of the basal quarter of the

valve. The *uncus* and *gnathi* are jointed to the *tegumen* by a slightly indented, more or less obliterated suture. The *uncus* is more or less of an elongated helmet shape with a slightly downward pointing tip; it averages about two-thirds of the *tegumen*. The stoutness or slenderness of this organ varies significantly. The *gnathi* (sing. *gnathos*) *are* slender, elongate and free, having about the same length as the *uncus,* but not reaching to its tip because of their slightly more anterior attachment to the *tegumen*. They show the most significant variations. They are cylindrical at the base and curve slightly inwards with a small outward turn at the tips (vaguely lyre-shaped when viewed from above). The membrane extending between the edges of the *uncus* and *tegumen* is quite delicate.

The *juxta* is a moderately chitinized sling below the *penis*; if flattened out, it would be in the form of a half disc with the curved edge directed posteriorly. The external portion of the *penis* is straight, slender and two-thirds the length of the valve; the membrane is slightly developed, and the foramen is very heavily chitinized and narrowly scoop-shaped.

The *valve* is leg-of-mutton shaped, flat on top along the costal edge and without abrupt changes in curvature below. It varies from three to five times as long as its greatest width and has a thinly chitinized area between the dorsal and anterio-ventral hinges. The upper or costal margin is closely toothed along the distal half with an irregular double row of short conical projections. A highly variable tubercle topped with long bristles is found half way between the dorsal hinge and the beginning of the teeth. A tubercle is placed on the tip of the valve towards the inside. It is vestigial in most forms. The *sacculus* exists only as a narrow chitinized inward continuation of the lower edge of the *valve*.

In our studies we have found that the shape of the *gnathos* and the toothing of the valve are of the greatest use in intra-generic distinctions. The shape and position of the *gnathos,* the relative length and slenderness of the sides of the *tegumen* and the shape and ornamentation of the *valve* provide the best inter-generic characters.

Within the *huebneri* cycle of *Karanasa* the butterflies may be divided into four classes on the basis of the gnathos: first slender, cylindrical, with a little taper to blunt tips; second thornlike with broad bases and gradual taper to sharp points; third stout, cylindrical

with the tips flattened or feathered on dorso-lateral sides; and fourth similar, but shorter, with the feathering extending to the base and the tips blunt, giving them the appearance of the blade of a maple seed. On the basis of the spines of the *valve,* they may be divided into two groups, coarse and fine points. The latter division may, with difficulty, be split into four on the basis of the shape of the distal half of the valve.

Comparison With Related Forms

Satyrus digna Marshall, *S. actaea* Esper., *S. pimpla* Felder, and *S. fidia* Linn. have at one time or another been included in the subgenus Karanasa. *Satyrus geyeri* Herrich-Schaffer has many pattern similarities and *Neominois ridingsii* Edwards is the nearest New World approach to the *huebneri* cycle. Slides were made of these forms as a check on their exclusion from the genus *Karanasa* as we conceive it. Using the relatively stable genitalia of the *huebneri* group as a norm, these forms exhibit the following deviations:

Satyrus pimpla Felder

Tegumen	Similar
Uncus	Slender and pointed
Gnathos	Similar (*bolorica* type)
Valve	Very short, very broad and blunt. What would correspond to the tooth-bearing distal half of *huebneri* is missing. Costal hump well developed.
Teeth	None
Penis	Shorter, stouter, with numerous spines at tip.
Saccus	Similar

Satyrus actaea Esper

Almost identical with *S. pimpla* as would be expected. The blunt valve has the costal margin drawn into a square point rather than evenly rounded.

Satyrus digna Marshall

Tegumen	Smaller with long slender sides
Uncus	Short, clawlike in typical form; longer in new subspecies from Afghanistan
Gnathos	Short, curved, tapering with bases widely separate from base of *uncus*

Valve	Very long and slender with distal half curved up and inward; *sacculus* well developed.
Teeth	Four or five large conical points near tip.
Penis	Similar
Saccus	Similar

Satyrus fidia Linnaeus

Tegumen	Well developed but lightly chitinized, sides broad and heavy. Has a median finger-like process about the diameter of the *uncus* and about half as long that extends backward closely applied over the top of the *uncus.*
Uncus	Slender, straight to a blunt point and with a very broad heavy base.
Gnathos	Longer than *uncus,* base at base of *uncus.* They extend downward at an angle of about 80 degrees to the *uncus,* are wide and flattened at the base and taper evenly to sharp points. The last fifth turns up so as to parallel the *uncus.*
Valve	Long, broadly joined to *tegumen* and *vinculum;* has a strong, conical hump in the middle of the costa, roughened on top, rising above costa a distance equal to the depth of *valve.* Valve beyond hump is strongly constricted to less than half the depth of the basal half.
Teeth	Row of stout teeth (6 or 7) on inner edge of costa extending half way from base of hump to tip of valve.
Penis	Long, slender, curved; foramen broadly spatulate.
Saccus	Elongate with long point extending backwards from lower lip.

Satyrus geyeri Herrich-Schaffer

Tegumen	Large and well developed with long narrow side pieces.
Uncus	Long, slender, bent downwards at about the middle.
Gnathos	Bases widely separated from *uncus;* thorn-like with tips bent sharply upwards (90 degrees).
Valve	Long and narrow, curved up slightly at tip; has costal hump.
Teeth	None
Penis	Short, two-thirds the length of *valve.*
Saccus	Elongate

Neominois ridingsii Edwards

Tegumen	Large and well developed, side pieces as in *huebneri.*
Uncus	Long, slender, evenly curved.
Gnathos	Long, and slender, larger in proportion than in *huebneri;* bases widely separated from *uncus.*
Valve	Quite short, almost triangular, costal border has lobe on median side with roughened area; rough on tip; no costal hump.
Teeth	Reduced to roughened area.
Penis	Very long, nearly twice the length of the *valve.*
Saccus	Similar

Perhaps the overall deviations can be best shown in a chart on which we will rate each structure as "S" similar or deviating by not more than species-level amount, "D" greater differences, perhaps of generic amount and "W" wide and striking differences that are without question of generic distinctness.

	actaea	*pimpla*	*digna*	*fidia*	*geyeri*	*ridingsii*
Tegumen	S	S	S	W	D	D
Uncus	D	D	D	W	W	W
Gnathos position	S	S	D	W	D	D
Valve size & shape	W	W	W	W	W	W
Teeth, etc.	W	W	W	W	W	W
Penis	W	W	S	W	S	S
Saccus	S	S	S	W	D	S

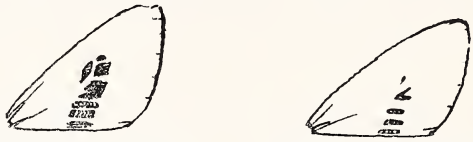
Summary	digna	2W-2D-4 S
	actaea-pimpla	3W-1D-4 S
	fidia	8W
	geyeri	3W-4D-1 S
	ridingsii	3W-2D-3 S

The genitalia uphold to a remarkable degree the senior author's previous evaluation of these species with respect to *Karanasa.* The armature of *Satyrus fidia,* in particular, is strikingly different. Even Satyrus *digna,* which comes the closest, has a very different valve, the difference being on a par with generic differences in other families such as the Ithomidae.

GENERAL DESCRIPTION

THE ANDROCONIA

The highly specialized scent scales called androconia that are peculiar to male lepidoptera are of considerable value to the taxonomist in studying the family Satyridae. *Karanasa* presents no exception. In this genus, if androconia are present, they are to be found in an area roughly coincident with the posterior position of the median band of the forewing. (Fig. 3.) Usually androconia occur in more or less prescribed areas of rough scaling known as "brands." In *Karanasa* the



Androconia on iskander *Androconia on astorica*

FIG. 3 Position of the brands, or androconial patches.

brand is vaguely outlined, if at all, and consists of more or less dense patches of elongate scales that are two to three times as long as the other wing scales. The long scales are not confined to the brands, but may sometimes be found elsewhere, such as along the costal margin. The androconia are in among the long scales on the brands only and are not rare when present, with the possible exception of *Karanasa roborovskyi*. Those forms that do not have androconia are not always distinguishable to the unaided eye from the ones that do. In fact, the form *Karanasa haslundi* from the Koh-I-Baba range in Afghanistan has one of the best marked "brands" in the genus, but no androconia.

The basic scale form is that of a club with the thick end attached and the other end terminating in a brush-like tassel of fine tubes on a thin neck. The average length is 0.23 mm., the thickest part being about a quarter to a third of the distance from the base, the thin neck being about 0.03 mm. long and 0.005 mm. thick. The tassel itself is seldom longer than 0.05 mm. The scales from any individual specimen vary very little and those from specimens of a population vary only slightly more, but there are often quite considerable differences between the androconia of discrete groups.

Deviation from the typical scale is principally in the direction of shortening and thickening of the neck. The deviations do not produce natural groups but taken as a whole, exhibit a more or less continuous gradation. In order to make use of the differences between the

androconia of the different populations of *Karanasa,* we will divide this continuous variation into six classes or types. The basic type described above we will call type B. There occur butterflies with longer androconia, up to 0.3 mm. long, with slightly more bulbous bases and longer thin necks. These we will put into type A. A group of populations have the scent scales as in type B but with thicker necks varying in width from one-fourth to one-third of the maximum width of the scale; these are type C. Still thicker necks on shorter scales, necks up to half the maximum width, fall into class D. A short blunt scale with no neck and the tassel attached directly we will call type E, and finally short scales of almost uniform width whose tassels seem to flare out from the end of the scale like the bristles of a shaving brush constitute type F.

While the variations in shape of the androconia provide supplementary evidence in segregating some groups, they do not present characters sufficiently diacritical to stand alone and their most significant contribution to the taxonomy of *Karanasa* lies in their presence or absence.

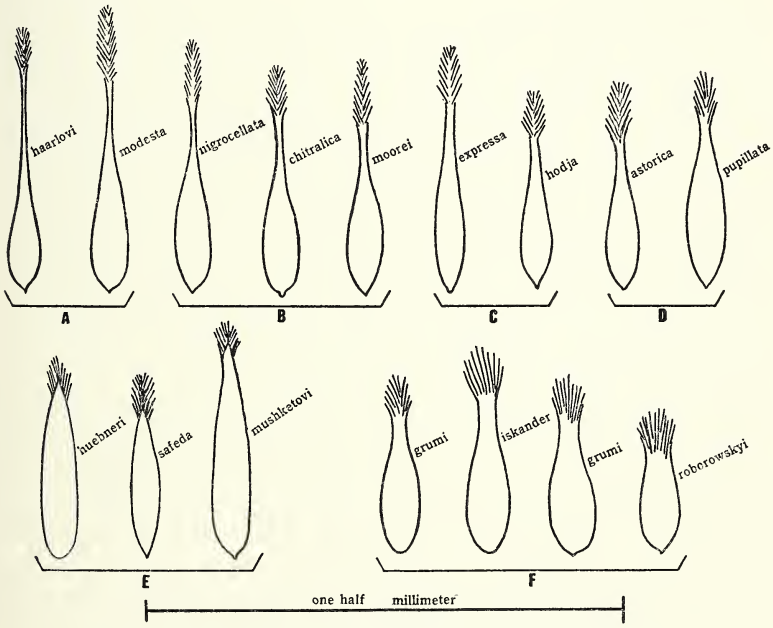


FIG. 4 Types of androconia found in the genus *Karanasa.*

TAXONOMY

PLAN FOR NOMENCLATURE

In the introductory remarks we attempted to show that an incredibly complex group of butterflies is to be found in the barren rocky lands centering around the Pamir Mountains at the western end of the Himalayan Range. Their homeland is so high, so hostile, so inaccessible, so lacking in the things that draw the interests of man that, with the exception of a few moderately well known kinds, the number of specimens available for study is small. The infinite variety, nurtured by the isolating factors of high barren mountains and deep eroded valleys, has resulted in the impression that no two specimens are alike, that a chaotic condition exists, a bewildering array, like the colors of pansies or *Schizanthus* among cultivated flowers. That, frankly, was the reaction of the junior author to his introduction to the Karanasa butterflies. The reader can appreciate this through a glance at the color plates, where single examples of each kind are shown crowded together for purposes of economy. However, in the few localities from which moderately long series are available — some Pamir localities in the collection made by the senior author and since nationalized by the U.S.S.R., the Chitral region collected by General Tytler and the series from western Afghanistan — the specimens vary from each other no more than do related species from the Garden of the Gods in Colorado, from Red Canyon, Arizona, or from Darjeeling, India. In other words, we do not have an infinitely varying population, but a great number of populations, each reasonably uniform within itself and each differing from its neighbor not fortuitously, but almost according to plan. By sampling some of these populations, it is our object to expose this plan, to speculate on its causes and to try to wring from it some bits of information concerning the nature of Nature.

The taxonomic and nomenclatoral problem is muddled by the considerable amount of misdetermination of the butterflies by the various workers in the field of Palearctic Lepidoptera. Similar appearing, but distinctly different specimens have been included under one name; new kinds have been described as subspecies of unrelated species; and some names have been shifted from a butterfly in one area to a similar appearing butterfly in another area. This shift, covered usually by rather indefinite labels, is attributable to dealers who filled out orders

from a second series when the first had been sold out. A fourth source of error is the practice of labeling the specimen with only the name of the province (Turkestan) or a mountain range merely guessed at (Alexander Mts.) or, one of the commonest, the name of the nearest city (Samarkand), though the conditions necessary for the existence of *Karanasa* and the establishment of a city are mutually exclusive. The confusion is so great that one can never be certain which butterfly is being discussed in any particular writing.

We have come to recognize seventy-seven populations — there are probably more. The local population may be restricted to a single peak, pass or valley, or may spread over many such geographical units provided that there is no effective internal barrier to the movement of the butterflies. These populations, though distinct from each other, could not possibly be considered as separate species especially since they all belong in what most authorities recognize as only a subgenus. They will serve as the units in our taxonomic scheme, subspecies in the most restricted sense.

In view of the tremendous confusion now existing in the nomenclature, it is quite remarkable that, in the original descriptions of the butterflies of this genus, the same population was named twice in only one instance (*regula* Stgr. 1887=*minutianus* Fruh. 1911), and the same name was used twice in only one instance (*leechi* Gr-Gr. 1890 ≠ *leechi* Moore 1893) and only two were named as aberrations (*fumigata* Avin., *erschovi* Avin.). Although many of the thirty-three names have been applied indiscriminately, each originally was assigned to a definite population and we so restrict its use in this paper. To facilitate discussion of the remaining populations we propose an additional forty-four names. All previous synonymizing or grouping into formal arrangements will be ignored. Since the relations between species and subspecies are not developed until later, we use the subspecific name without reference to the genus or the author; thus *Karanasa huebneri* var. *balti* Tytler becomes merely *balti*.

In the following section each of the subspecies is described. The original description and all pertinent later comment is reproduced (translated into English if it appeared in another language), and all controversies as to the application of the name used are settled to the best of our knowledge and ability.

DESCRIPTION OF FORMS OF THE FIRST CATEGORY

THE SUBSPECIES

1. **Karanasa voigti** O. Bang-Haas *(Karanasa voigti voigti)*
   Plate 3, fig. 16 ♀ type (Paghman Mountains, Afghanistan)
   Plate 9, fig. 29 ♀ same
   Plate 12, fig. 7 ♀ same, underside.

Karanasa voigti was described in Horae Lepidopterologicae, volume I, page 50, in 1927 by Otto Bang-Haas.

(from German)
"*Satyrus huebneri voigti* O. B-H. subsp. nov. Habitat: Afghanistan
"The Paghman Mountains, 3000 meters in the west of Kabul, July. Size: one female 44 mm.
"Unfortunately I have only one specimen. It differs from the typical *huebneri* from Ladahk by the lighter coloration of the exterior band of the frontwings which is, like in *decolorata* Staudinger, filled out with white at the apex."

The type is now in the Avinoff collection at the Carnegie Museum. The wings are relatively shorter and more pointed than those of the Ladahk *Karanasa* and the general tone of the markings is much darker. In August of 1948, Neils Haarlov of the Third Danish Expedition to Central Asia took a long series of *Karanasa* in the Koh-I-Baba, the next range west of the Paghmans in the Hindu Kush mountain system. On the basis of the male genitalia, this series is divided into three species, one belonging to the *huebneri* group, one to the *bolorica* (*decolorata*) group and one to the *pamira* group. The *voigti* female fits most closely with that of the form belonging to the *bolorica* complex and we provisionally place it in that relationship, pending the finding of a *voigti* male. We had originally considered *voigti* as belonging in the *huebneri* complex, but the Koh-I-Baba representative of that complex follows a trend in a different direction.

2. **Karanasa nigrocellata** nov. *(Karanasa voigti nigrocellata)*
   Plate 12, fig. 9 ♂ holotype (Puistagoli, Koh-I-Baba, Afghanistan); fig. 8 ♀ allotype (Surtu, Koh-I-Baba, Afghanistan); fig. 1 male genitalia.

A pair of *Karanasa* most closely related to the *grumi-decolorata-*

iskander group from Bukhara were taken in the Koh-I-Baba Mountains in north central Afghanistan. They are characterized by large black ocelli, so we will call them *Karanasa nigrocellata.*

Male. Upperside. Similar to *Karanasa grumi* but with deeper and more warm-toned brown. The median band is sharply angled on vein M_3. The base is lightened only in the distal anterior quarter of the cell which is pale russet and shows traces of the discocellular and inner median (m_2) lines. The outer border is broader than that of *grumi* and deeply toothed into the discal band along veins Cu_1 and M_3. The discal band is white tinged outwardly with russet from the anal border to vein M_3. The anterior ocelli are very large and very black extending across three marginal cells. The pupils are conspicuous. The posterior ocelli, also pupilled, are half the size of the anterior. The hindwing is dark, warm-toned brown with the marginal band very wide and deeply toothed. The veins of the basal area are narrowly russet. The discal crossband is narrow, having the most anterior part cut off as a pale triangle. It is white, washed with russet with the russet predominating from the outside inwards.

Underside. The forewing is as in *grumi* except for the greater development of the ocelli which match those on the upperside, and a decrease in the width of the marginal band in comparison with the upperside thus making the discal crossband wider. The reticulations in the cell are well developed. On the hindwing the zigzag lines are less deeply indented than in *grumi.*

The androconial patches are very wide, the androconia medium broad with medium length necks and well developed brush. They fit into class B and measure .256 x .033 mm. (Text fig. 4)

The genital structures are well outside of the range of variation of *grumi.* The uncus is short and without any hook or downward extension of the side pieces. The gnathos is slender, slightly tapering and evenly curved upward. The valves have flat costal surfaces densely toothed; the terminal tubercle is well developed. The shortness of the uncus and curvature of the gnathos depart from *grumi,* while the development of the tubercle is a *grumi* character.

Female. Forewing upperside. The female closely resembles the male except that the base is lighter and the dark brown androconial area is replaced with brownish russet and the ocelli are even more developed. The second ocellus is three-quarters the size of the first, spreading well

below vein Cu_2 and above vein Cu_1. The median band is represented by a transverse line (m_2) in the cell, a diagonal bar at the end of the cell and a faint trace along m_1 which broadens a little on the tornus. On the hindwing the dark outer edge of the median band is rendered conspicuous by the lighter brown shading on the base. The discal band is as on the male except that the most anterior cell is not separated. The underside is as on the male.

Holotype 38 mm. Puistagoli, Koh-I-Baba, Afghanistan.

Allotype 47 mm. Surta. Koh-I-Baba, Afghanistan.

This form, which is the most southern representative of the *grumi* cline, is also the most reddish and has the largest ocelli of the russet division. In pattern it resembles *grumi,* but in overall color tone, it approaches *haarlovi* with which it flies, but with which it is only distantly related. Except for the size of the ocelli the female comes close to *voigti.*

3. **Karanasa bolorica** Grum-Grshimailo *(Karanasa bolorica bolorica)*
   Plate 1, fig. 10 ♂ type; fig. 11 ♀ allotype reproduced from Rom. Mem. Lep. Pl. XIV.
   Plate 2, fig. 1 ♂ (Beik); fig. 2 ♀ (Beik); fig. 3 ♂ (Misgah); fig. 4 ♂ (Misgah).
   Plate 7, fig. 21 ♀ (Hindu Kush).
   Plate 10, fig. 35 ♂ (Misgah Hunza).
   Plate 11, fig. 39 ♀ (Hindu Kush).
   Plate 14, male genitalia.
   Plate 16, male genitalia.

Original description in Horae Societ. Entom. Rossicae. Vol. 22, page 307, 1888.

Translation: "The wing of the male above fuscous-olivaceous, paler towards the base; the transverse band of the front wings is broad, on the hind wings — narrow, of a whitish-yellowish color, more frequently of an ochreous tint, with dentate outline. This band is marked with two fuscous-black ocelli — the upper with a white pupil, the lower blind. The underside is like in *Sat. huebneri* Felder. ♂ ♀ 20-21 mm.

"The female differs from the male by the upper side being much paler, frequently with a yellowish coloration toward the base, the band being wider."

Grum-Grshimailo elaborates as follows in the fourth volume of the Romanoff "Memoirs" quoted earlier.

"*Satyrus boloricus. Boloricus* on the upper side is characterized by coloration of a paler hue than *regeli.* The brown color is of light olive brown tending in the females toward a golden-gray, the base of the wing being lighter. Nevertheless there are specimens of females where the ground-color is almost indistinguishable from the color of the band. In these cases the basal part is darker. The band of a pale straw color with a more or less marked admixture of ochre is always larger on the forewings and considerably narrower and more indentate on the hind wings. Inwardly this band is suffused with dark scales in the males. In the females it is clearly outlined. There are two dark spots on the front wings, the one near the apex is always larger, and has a white center. The lower one, always smaller, is sometimes reduced to a scarcely perceptible point; the fringes are not marked in any particular way. The under side of the hind wing preserving altogether the general pattern typical for the group, is distinguishable from *regeli* by an ochreous coloration sometimes so intense that it would be impossible to distinguish from *leechi* especially on account of the fact that the pattern and color of the underside of the hind wings reminds one more of *leechi* than of *regeli.*

"*Boloricus* inhabits the northern slopes of the mountains of Kounjout on an altitude averaging 14,000 feet. It flies in the beginning of July. . . ."

The general resemblance to *leechi,* with which it flies, is even more striking when we consider that certain specimens of the latter from Alitchur in southern Pamir have a light band. There are no intermediate forms, however, and the females are different. The anatomy of the male genitalia also places them in different groups.

The greatest point of variation is in the lower ocellus. This ocellus is missing from about a fourth of the specimens and varies from a trace to almost full development in the others. On two specimens the upper ocellus expands over into the adjacent interspaces. The intensity of the dark base also varies, being lightened especially in the females, one of which has it entirely lightened except for the dividing line at the inner edge of the band. Two males from Hunza also have lightened bases.

The underside (Pl. 7, fig. 21) is characterized by an even and broad outward outline in black of the median band of the hindwings and very broad black arcuated ante-marginal "arrow points." These properties produce a special habitus of the underside which may be observed in comparing the material figured on plate 7.

The male genitalia: The uncus is moderately deep and drawn out into a sharp point. The gnathos is thorn shaped, very heavy with a broad base as wide as that of the uncus, tips slightly turned up and

with a sharp point. The tips of the valve are slender, the teeth on them moderately coarse.

The androconia are of type B and measure .215 x .032 mm.

Karanasa bolorica ranges on both sides of the Hindu Kush range from Beik Pass at the extreme east, west to Misgah Hunza in Northwest India and Alitchur in southern Pamir. Most of the specimens are in the Elwes collection at the British Museum, in the Tytler collection at the Carnegie Museum and in the former collection of the senior author in U.S.S.R. The total is less than fifty. The specimens from Hunza are slightly larger, but otherwise, all are quite uniform.

4. **Karanasa chitralica** Tytler. *(Karanasa bolorica chitralica)*
   Plate 2, fig. 5 ♂ (Ghizer, Gilgit); fig. 6 ♂ Type, (Chitral) BM; fig. 7 Allotype (Chitral) BM
   Plate 6, fig. 27 ♂ underside Paratype (Shandur Pass, 11,000 ft.)
   Plate 10, fig. 36 ♂ Paratype (Shandur Pass, 11,000 ft.)
   Plate 11, fig. 38 ♀ Cotype (Chitral)

Original description in Journal Bombay Nat. Hist. Soc. vol. XXXI, pp. 254-256 by Major-General H. C. Tytler.

"*Karanasa regeli chitralica,* subsp. nov.

"There were several specimens of a form of *Karanasa* from Chitral above the type and label of *K. moorei* Evans in the British Museum which are not that species as they do not agree with the type but appear to be a race of the *regeli;* they are rather larger than *K. regeli boloricus* but are otherwise the same. I propose the above name for the Chitral form.

"Expanse ♂ 42 mm.; ♀ 49 mm.

"The types are in the British Museum and a ♂ paratype in my collection."[1]

These brief notes require additional descriptions: The ground color is of a darker fuscous tone, and the light band is slightly more yellowish than in the true *bolorica.* The band on the hindwing is broader, less remote outwardly, and does not show a tendency for breaking up into isolated patches as compared with the typical form. The ocelli, especially in the female are slightly larger. The allotype from the British Museum (Plate 2, fig. 7) shows well this considerable development of both ocelli provided with well defined pupils.

The series of seven males and seven females of *chitralica* in the

[1] Now in Carnegie Museum

British Museum gives a good idea of the divergence as compared with true *bolorica*. The largest and brightest *bolorica* compares fairly closely with the smallest *chitralica* male, but the rest show clearly that it is another race with an intense dark basal portion and antemarginal band, the light band being also somewhat brighter. The females show a decidedly darker base. Light forms, which frequently occur among *bolorica,* are not found among the larger and darker *chitralica*. About half of the specimens have two ocelli on the front wings.

The male genitalia are almost identical with those of *bolorica*.

The androconia are type B and measure .219 x .031 mm. (text figure 4)

The form is found only in Chitral, south of the Hindu Kush main ridge and immediately to the west of the range of *bolorica*.

5. **Karanasa hodja** nov. *(Karanasa bolorica hodja)*
Plate 2, figs. 8, 9, 10, male paratypes (Chodja Mahomet, northeastern Afghanistan 3800-4000 m.)
Plate 10, fig. 33 ♂ type (Chodja Mahomet)
Plate 14, male genitalia

Described from five males collected for Kotzsch in the Chodja Mahomet Mountains, a northern side chain of the Hindu Kush, north-northeast from Kabul.

Male. Forewings narrow as in *bolorica;* outer border almost straight between veins Cu_1 and M_1. The brand covers the median band from vein M_2 to the anal border. Transverse discal band is moderately narrow, white, suffused with orange scales from the outer edge inward in much the same manner as in the forms of *grumi,* but here the orange staining is wider and may cross two thirds or more of the band. The veins crossing the band are dark brown, vein M_3 being heavily marked breaking the band in two as sometimes occurs in *bolorica*. On the hindwing, the band is narrow, almost evenly curved along its inner margin and deeply indented along the veins on the outer, the indentation of vein M_1 almost dividing the band. The basal area is brown lightened by a pale suffusion and with a lighter spot at the end of the cell on the forewing. The median band is dark brown, makes a right angle with the costa and is only slightly angled at vein M_3. The marginal band is the same shade and very broad on both wings. The veins are concolorous. The anterior ocelli are medium to

large, lightly pupilled; the pupil of the type is reduced to a single scale, two others have, and two others lack small pupils. The posterior ocellus is reduced and may be entirely missing, but when present may have a vestigial pupil.

The underside is marked as in *grumi* but darker brown, the markings heavier and more contrasting. The band edges on the forewings are well developed and the marblings of the cell less. The ground color of the forewing is dull ochreous, lightened on the discal band. The white veins of the hindwing are prominent.

The androconia are extremely numerous, moderately broad, with a little thicker neck than *bolorica*. They are type C measuring .196 x .030 mm. (Text figure 4)

The genitalia are distinctly of the *bolorica* type, the uncus being short, slender, heavily chitinized and pointed; the gnathos is large, thick, heavily chitinized, strongly tapering with slightly turned up tips. The teeth on the valve are medium sized and extend clear to the tip where they roll over the end like the teeth on a dogfish shark's jaw. There is a sudden constriction of the valve just after the beginning of the teeth giving the costa of that region a concave shape, but that may be individual variation.

The female is unknown at this writing.

Individual variation is great with respect to the ocelli and the extent of the orange staining on the band. The most evident diagnostic character is the division of the band at vein M_3.

In external appearance this form fits so nicely into the geographic pattern of variation for *grumi* that the senior author was keenly disappointed when genitalic analysis ruled out that relationship. Even so, some of the specimens from Pshiharv intergrade even in this character and that series has been shunted back and forth between the two species during our deliberations. They finally came to rest with *grumi* but still present problems that will be discussed later.

7. **Karanasa grumi** nov. *(Karanasa decolorata grumi)*

Plate 5, fig. 21 ♂ extreme form (Pshiharv).
Plate 10, fig. 31 ♂ paratype (Vis-harvi Pass, Darvas); fig. 32 ♂ type. (Vis-harvi Pass, Darwas — mislabeled Alai — Tancré coll.).
Plate 14, male genitalia.
Plate 16, male genitalia.

Male: The light band on the dark brown background of both wings is of an ivory color with a very slight tint of russet at the exterior edge. It is relatively narrow, has a rather straight edge inwardly toward the androconia, and is distinctly broken by vein M_3. The upper ocellus is pupilled while the lower, slightly smaller one may have or lose the white center. The dark brown basal part of both wings has a distinct ochreous tinge as compared with the darker mesial band. The lightness of the veins through the dark portion of the hindwing may vary in intensity.

On the underside of the forewing the ground color is of a russet tinge and is well defined from the lighter whitish band. The transverse striae of the cell are well marked. On the hindwings the zigzag (e_3) line is well developed about midway between the median band and the external border; the white veins are very clearly defined.

The forewings are pointed, but less so than those of *bolorica*. The outer margin is slightly convex.

The brands (androconial patches) are well developed and the androconia are numerous. They are broad and blunt, of type F, Pshiharv forms measuring .172 x .042 mm., while Vis-harvi forms are .182 x .033 mm. (Text fig. 4)

The genitalia have the edges of the uncus drawn down about the middle, somewhat like the side pieces on a helmet, which make it about twice as deep in the center as at either end. The gnathos is slender, cylindrical and pointed. The valve is finely toothed almost to the end, a tubercle on the tip protruding slightly beyond like a "chin."

At the time of writing, no authentic female has come before us.

Karanasa grumi is described from eight specimens, four collected at Vis-harvi in Darwas, eastern Bukhara by A. Goldbeck, plus two Carnegie Museum specimens from the Tancré collection with black-bordered labels marked "July, Alai Region" and identified erroneously as *regeli* var. Since these could not have come from the Alai region, it first seemed that they would have to be disregarded with their place of origin a mystery, but there were found in the British Museum two entirely similar specimens, also from the Tancré collection, which bear the label "Vis-Harvi-Darvaz, Bokhara." The lighter male from the Tancré collection in the Carnegie Museum is taken as the type. The other seven specimens including the two in the British Museum are paratypes.

There is a tendency among the paratypes for a very slight invasion of the outer edge of the band by russet shades, not uniformly, but having the appearance of having run into the band from the external border when the insect got wet. The most pronounced of these is the paratype shown on plate 10, figure 31.

Three specimens from Pshiharv, a pass one range farther south than Vis-harvi, also in the Darwas Region, should be ascribed to *grumi.* Although none of them has as light a band as the type, two approximate the extreme shown by the paratype (Plate 10, fig. 31) as far as the russet tinge is concerned. A third specimen deviates even farther in that direction by having the russet tinge over the major exterior portion of the band.

Relationships are indicated with *bolorica* through *hodja* and to *iskander* and *decolorata.*

6. **Karanasa mushketovi** nov. *(Karanasa decolorata mushketovi)*
Plate 11, fig. 40 ♂ type (Muzkulak — W. Rickmers Pamir Exp.)
Plate 14, male genitalia.

Male. This form is related to *grumi* and resembles it closely except as follows: The outer margin of the forewing is slightly more convex. The orange shading that appears in the most extreme *grumi* extends entirely across the band on the forewing from vein M_3 to the anal margin; on the hindwing it also extends across, but is slightly lightened just before the inner margin of the band. On the underside the ground color is very pale, leaving the chocolate colored lines in very strong contrast.

The androconia are few and of type E, similar to *huebneri,* broad and long, with no neck. The measure .245 x .035 mm. (Text figure 4)

The male genitalia have the uncus moderately short and with the sides drawn down as in *grumi.* The gnathos is stout, heavily chitinized and tapers to a sharp point. It is on the borderline between the cylindrical and thornlike types. The tooth-bearing part of the valve is curved slightly upward and the teeth are fine. The chinlike tubercle on the end of the valve is slightly developed.

The female is unknown.

Type 1 ♂ Muzkulak, south central Pamir W. Rickmers Pamir Exp.
Expanse 39 mm.

This single specimen represents the extreme of differentiation from the typical *grumi.* When more ample material is available from southern and central Pamir it is probable that one will be able to distinguish actual local populations, but at present we must be satisfied to designate the extremes of geographical variation. Some of the Pshiharv specimens would fit best under *grumi,* others under *mushketovi* but for the present we will confine the latter name to topotypical material.

8. **Karanasa roborovskyi** nov. *(Karanasa decolorata roborovskyi)*
Plate 6, fig. 25 ♀ allotype underside (Koshalayak Glacier, Pamir); fig. 26 ♂ holotype underside (Koshalayak Glacier).
Plate 10, fig. 30 ♂ holotype (Koshalayak).
Plate 11, fig. 34 ♀ allotype (Koshalayak).
Plate 15, male genitalia.

Near the Koshalayak Glacier in western Pamir, Jakobson, one of the senior author's collectors, took three specimens that appear to be intermediate between two fundamentally different species, *josephi* and *regula,* but are related to neither. We will call them *Karanasa roborovskyi.*

Male. Size and wing shape as in *josephi.* Marginal band and discal band are shaped as in *josephi* but the discal band is oyster-white with a barely detectable edging of ochreous along the outer margin instead of solid rusty orange. The ocelli also differ by being without pupils. The outer edge of the median band is at an acute angle to the costa, extends into a long point along vein M_3 and has an outward tooth between veins A_2 and Cu_2 as in *josephi.* The inner border of the median band and the basal areas are just as in *regula,* distinctly outlined and with the basal areas white dusted with brown. On the underside the ocelli are pupilled and the discal band largely white, the general form of the markings being nearer to *josephi* than *regula.*

Female. The wings are more elongated than either *josephi* or *regula* being similar in shape to those of the Indian *huebneri.* As in the male, the markings from the center of the median band outwardly closely resemble those of *josephi* and inwardly resemble those of *regula.* The allotype has considerable ochreous suffusion of the outer part of the transverse band, but a second female approximates the male in this respect. The ocelli are faintly pupilled and the posterior one

appears to be elongated transversely because the portions that extend into the adjacent interspaces are diffuse.

The androconia are very few and are the smallest in the Karanasa. They measure .158 x .035 mm. and are extreme examples of type F. (Text figure 4)

The genitalia of the male have the uncus of medium length and slightly drawn down at the sides; the gnathos is almost cylindrical, slightly tapering to a blunt point and slightly swollen at the base. The teeth of the valve are small and the terminal tubercle is small but recognizable. The outer third of the valve is straight. This is almost identical with that of *josephi* and differs from *regula* in the length of the uncus and the shape of the gnathos.

This form, by reason of the male genitalia and outer wing markings, appears to be most closely related to *josephi,* but on the other hand, lack of the russet coloring is contrary to the trend of the *josephi-dissoluta* group which, in the form *darwasica* immediately to the southwest, emphasizes the russet at the expense of the brown. Actually it approaches the branded *grumi* of the same territory. The general appearance, particularly of the male, suggests a hybrid infusion from *regula,* but this seems unlikely because the range of that butterfly does not reach so far southwest and Jakobson took none of them.

9. **Karanasa decolorata** Staudinger *(Karanasa decolorata decolorata)*
Plate 3, fig. 13 ♂ (Kara Sagin), fig. 14 ♀ (Samarkand).
Plate 9, fig. 31 ♂ (Kara Sagin).

Original description in "Catalogue of Lepidoptera of the Palearctic Fauna" by Staudinger and Rebel, Berlin, 1901.

Translation: "Bands pale yellow, inwardly with a whitish admixture (nonsaturated yellow) similar to var. *leechi,* but larger, and the basal part in the male dark." [As localities are mentioned] "oriental Thianschan, near Chamyl; oriental south-eastern Buchara (aberration)."

Supplementary description: The males have broad androconia of type F, .196 x .042 mm. The forewings are somewhat pointed. The bands are evenly edged inwardly, the inner edge of that on the forewing being straight from vein M_3, where the band is slightly constricted, to the hind margin. While the base is darker than that of *leechi,* it is not solid dark, but lightened considerably behind the median band.

The veins are conspicuously lightened even, to a limited degree, over the terminal band. The anterior ocellus is pupilled and the posterior one more or less reduced.

The underside is brown toned, the bands being suffused with light scales. Thus the terminal band is pale, darkening toward the outer edge on the hindwing. The zigzag line (e_3) forming the outer border of the discal band is dark but not sharply separated from the rest of the band which gradually lightens to almost white at its inner border. The outer border of the mesial band (m_1) again is heavy brown as is the inner border (m_2), the space between being peppered brown and white. The basal area is heavily striated with brown. On the frontwing, all of these markings are more or less washed out except along the costa.

Female. Like the false *josephi* (*iskander*) from the region of Samarkand but with a lighter coloration of the russet bands which show a stronger pale ochreous coloration in the upper part of the bands in both wings.

It is with a certain degree of hesitation than one might ascribe this light female to the typical males of *decolorata* which are found both in Kara Sagin, their regular habitat, and also from some portions of the mountains near Samarkand as the label attached to some typical *decolorata* states their origin. The female which is described was acquired from the Staudinger-Bang-Haas firm and bears the label of Samarkand. Its exact origin is unknown and it is only surmised that it should be associated with the light form bearing the name of *decolorata*. It would be entirely legitimate to expect a female with such characteristics on the basis of the traits of the male, but the differentiation of the regions inhabited by the typical *iskander* and *decolorata* in the mountains of the Samarkand regions remains unsettled. It is one of the points which require further and more thorough investigation.

(AVINOFF MSS.)

There are many anomalies connected with Staudinger's description. In the first place there is no locality known by the name of Chamyl. Apparently Staudinger meant Chamy. Furthermore, one must deduce that a local race from eastern Tian Shan would be identical with a form occasionally occurring as an aberration in eastern Bukhara at a distance of nine hundred miles between the two localities. This in itself seems to be an impossible phenomenon within the highly

specialized regional differentiation of the forms of the *huebneri* group. The region of Tian Shan is indicated in the first place, so one should take it for the origin of the type. The only form of that general group found in the eastern Tian Shan Mountains is *korlana* which fits in a loose and rather imperfect way into the very brief description of *decolorata,* as may be observed by consulting Pl. 10, fig. 29. This hypothesis, however, seems to be improbable since *korlana* was subsequently described by Staudinger himself, who would have recognized the identity of these two butterflies. Another form of that general cycle found in Tian Shan is *latifasciata,* which is highly variable, and one can always easily pick a specimen which will comply perfectly with the loose description of Staudinger. For instance, fig. 5, Pl. 8 would answer all the prescribed specifications of an honest-to-goodness *decolorata,* while it is nothing else but a regular *latifasciata* tending toward *regeli.* This butterfly is not found, however, in the eastern Tian Shan, but in the central region of that range near Khan-tengri. Such a consideration of *latifasciata,* a race which was described by Grum-Grshimailo three years after the form *decolorata* was established, should be ruled out. If it were not for the locality, one might accept *decolorata* as the priority name for the insect recognized subsequently by Grum-Grshimailo as worthy of a special designation. Under the circumstances, naturally the validity of *latifasciata* remains unchallenged, but the significance of *decolorata* becomes even more dubious. Overlooking Tian Shan as the typical locality of *decolorata,* one should pass to the consideration of the alternative of identifying this form with some representative of this group from southeastern Bukhara. Such a form exists, namely the light variation of the butterfly which was erroneously called *josephi* by all the authors including Grum-Grshimailo. In this paper the correct application of *josephi* has been restored to the unbranded race which Staudinger had before him while he was making the description. This other, branded race with a patch of androconia which are, by the way, not mentioned in the description of *decolorata,* has been distributed by the firm of Staudinger for years under the name of *decolorata.* I remember having had a lengthy discussion with Mr. Bang-Haas, grandson of Staudinger, on the correct application of the designation of *decolorata.* He pointed out that the light form of the so-called *"josephi"* or *cadesia* (another erroneous association with the totally unrelated Indian butterfly) is

identical with the type of *decolorata* which we could not consult in Dresden since the collection of Staudinger, including all the types, had been transferred to the Berlin Museum. If one takes this stand for granted, one can readily admit that the imperfect description of Staudinger is applicable to this butterfly from eastern Bukhara, particularly from Kara-Sagin, shown in fig. 31 on the colored plate 9. It is also true that this butterfly resembles in a general way an excessively large specimen of *leechi,* as Staudinger mentions in his description, although the base is not altogether dark, as the description reads. The author may have had in view the greater intensity of the darkness of the bases as compared with the regular *leechi* represented in figs. 12 and 13 on plate 1. This attribution does not settle, however, the reference of Staudinger that it is occasionally found as an aberration in Bukhara. In the first place the natural question arises — of what is it an aberration? What should be the basic species which undergoes an incidental mutation of a lighter band? This matter is left entirely in the dark by the description of Staudinger. One may make a conjecture that it is a lighter form of some related butterfly found in Bukhara, and this might very plausibly be a mute reference to the false *josephi* which is actually found within the territory of Bukhara in a much brighter form. Following this course of reasoning which is fortified by the identification by Bang-Haas of *decolorata* as a light form of the branded group, one may accept it as a name which would perpetuate the customary notion among Lepidopterists and collectors of applying this term to a pale example of the branded, spurious *"josephi."* But in this case, all references to Tian Shan become entirely enigmatic as no forms with androconia are found in the Tian Shan region, and surely no case would be on record where a highly specialized sport of this kind would be located so far from the original forms of the race. (AVINOFF MSS.)

It is necessary to discuss one more consideration in connection with the identity of *decolorata.* The brief description of Staudinger applies very closely to the form herein described as *grumi* from Vis-harvi. The band here is predominantly whitish, and specimens are found with uniform ivory-white bands. It seems that this application should be excluded on good grounds because Staudinger never obtained that particular butterfly from the borderland of western Pamir. Besides it would be plausible to compare offhand my *grumi* with *regeli* than

with *leechi*. That was precisely the very error committed by Tancré. On Pl. 10, fig. 32 is illustrated the specimen of *grumi* which bears his misleading label of *regeli* var. Thus it becomes legitimate to accept the popular identification of *decolorata* with a light form of the branded butterfly wrongly known as *josephi*. With this course of reasoning it becomes necessary to establish a legitimate name to this species of the false *josephi*. The name given by Staudinger is herewith saved for its original use, consequently *decolorata* becomes next in line to designate the branded forms of Bukhara and the mountains near Samarkand. The nomotypical conception for the basic species has to be, naturally, shifted from the brightly banded form usually called *josephi* to the pale race of oriental Bukhara. *Decolorata* in that fashion divests its subordinate position of variety and aberration to assume belatedly the dignity of a species. (AVINOFF MSS.)

10. **Karanasa maureri** nov. *(Karanasa decolorata maureri)*
Plate 9, fig. 28 ♂ type (Bukhara).
Plate 14 male genitalia.

Male. The wings are narrowed at the tips and the outer margin is straight between veins Cu_1 and M_1. On the forewing the median band is much reduced from the radius to vein M_3, and from there to the anal margin is represented only by the androconial patches; at the end of the cell it is overlaid with orange scales. The basal area, the discal band and the veins between the androconial patches are the same dull orange, the anterior end of the band being lightened to a creamy white opposite the end of the cell and above vein M_1. A similar condition obtains on the hindwing except that the anterior outer edge of the median band is more developed and the rest of the band and the basal area is dusted with brownish scales. The marginal band on both wings is vinaceous brown with its inner border (e_3) accentuated and moderately scalloped. The veins are orange.

The underside is bright and sharply contrasting. The pattern is that of *iskander* with the outer edge of the terminal band darkened and the inner third of the discal band light. The veins are quite light. The markings on the forewing are washed out behind the middle of the cell except the terminal band.

The androconia are very plentiful, medium width with slight necks, falling into classification E. They measure .210 x .039 mm.

The genitalia differ from those of *iskander* only in the lack of development of the tubercle on the tip of the valve, a character that varies in *iskander*. Expanse 39 mm.

Karanasa maureri is described from a single specimen collected in an unknown locality in Bukhara by Maurer and sent out under the name of *cadesia* which is one of the names that have been mistakenly applied to the branded forms from that region. Anatomically, it belongs with the *decolorata-iskander* forms but fits into neither so we must, as in the case of *mushketovi,* give it a name tag until more material makes accurate race or aberration determination possible.

11. **Karanasa iskander** nov. *(Karanasa decolorata iskander)*
Plate 3, fig. 11 ♂ (Samarkand); fig. 12 ♂ (Hasret Sultan); fig. 15 ♂ underside (Hasret Sultan, 2200 m.).
Plate 9, fig. 32 ♂ holotype (Hasret Sultan, 2200 m).
Plate 11, fig. 25 ♀ allotype (Dukdon).
Plate 14, male genitalia.
Plate 16, male genitalia.

The name *iskander* is proposed to apply to that butterfly from Bukhara and the mountains south of Samarkand that has been known for the past six decades as *josephi,* the latter name being restricted to the form originally described by Staudinger.

Male. Forewing moderately pointed, the external margin nearly straight between veins Cu_2 and M_2. Brand heavy, broad, continuous from vein M_2 to hind margin; crosses tip of cell. Median band dark brown, changing to a more satiny shade where covered by the brand, makes an acute angle with costa, breaks sharply on vein M_3, and parallels outer margin to posterior margin. Basal area usually only slightly lighter; may be touched with orange in cell, especially at apex. Discal band on forewing is clear orange to veins M_3 or M_2 above which it is much lightened, becoming almost white at apex next to median band. On the hindwing it is solid orange, occasionally lightened inwardly. Marginal band is uniform dark brown with a russet sheen, moderately broad on the forewing, very broad on the hindwing. It invades the orange discal band in points along the veins, particularly veins M_3, M_2 and M_1 of the forewing and all veins of the hindwing. The anterior ocelli are medium size, always with pupils; the posterior ones vary in size and may or may not have pupils. Veins on the hindwings are slightly lightened.

The underside is similar to *grumi* and differs from *decolorata* by being brighter and less "grainy."

The androconia are of type F, some have a slight constriction at the neck and tend towards type D. They average .221 x .040 mm. (Text figure 4)

The male genitalia are similar to those of *grumi,* but the gnathos has a more expanded base and the teeth on the valve are heavier.

Female. Similar to the male except that that part of the median band normally covered with androconia in that sex is obsolescent, being represented only by a faint dusting of brown scales over the orange of the disc. On the hindwing, the outer border of the median band is deep brown, but fades into a light greyish-brown at the base. The basal area of the forewing is the same greyish-brown, shading to orange-brown along the discal band. The underside is lighter, less contrasting.

The general appearance of *iskander* is close to *grumi* and *decolorata* being as bright as the former, but with an overall russet sheen, and differing from the latter only in brightness. In fact, the principal difference appears to be that usually found between specimens from dry and slightly moist ecologies, with *decolorata* resembling the dry form.

Satyrus (Karanasa) josephi was described by Staudinger in 1882 from specimens caught on the northern slopes of the Alai mountains in Fergana. A surviving member of the type series and all the other specimens caught in the Alai region lack androconia. In 1886,[1] Staudinger, in an article on Central Asiatic Lepidoptera, wrote: (translation)

"From Haberhauer I received this species in numbers from Alai and *from the mountainous regions on the south from Samarkand* (italics mine) where this butterfly flies in the end of July. These specimens seem to me to fit very well with *huebneri* on grounds of the figure and description as a local race and I name it *josephi* . . ."

Grum-Grshimailo, writing in the fourth volume of the "Memoirs" reports *josephi* from the western Alai and from the northern outskirts of Pamir at Farab. He had no specimens from northern Alai. He writes: (translation)

[1] Ent. Stett. Zeit. vol. 47, p. 245.

"The *Josephi* from the Farab furnishes in every respect a transition to the form of the Alai, which we must envisage as the type.

"Plate VX portrays the *Josephi* of Ghissar, which deserves probably particular denomination. Nevertheless, without possessing specimens from the northern slopes of the Alai mountains I cannot make up my mind to separate it as a special form. . . . "

These excerpts from the literature indicate the confusion out of which the more easily obtained, branded form from Saravshan and Bukhara replaced the similar, but unbranded, form from the Alai in the general concept of the butterfly *josephi.*

12. **Karanasa maidana** nov. *(Karanasa decolorata maidana)*
Plate 9, fig. 30 ♂ type (Maidan Pass, Zaravshan Mts., July)

Male. Differs from *iskander* in smaller size, brighter russet and narrower discal bands on both wings. The androconia are short, with short necks as in *iskander;* Size, .211 x .032 mm., type F.

Expanse ♂ 38 mm.

Locality. Archi-Maidan, Zaravshan Mountains near Samarkand.

This is the most northern representative of the *iskander-decolorata* group and perhaps the westernmost representative of the entire genus.

13. **Karanasa hissariensis** nov. *(Karanasa josephi hissariensis)*
Plate 8, fig. 8 ♂ holotype (Hissar, Haberhauer coll. from Staudinger)

When Grum-Grshimailo restricted his analysis of the genus *Karanasa* to ten forms in the "Memoirs," he admitted that there were probably more and gave as one example "—*josephi* from Farab is not *josephi* from the southern portion of the Ghissar Mountains." In that we agree and separate the Ghissar or Hissar material as a race representing the extreme west of the variation of the unbranded *josephi-dissoluta* complex.

Male. Differs from *josephi* of Alai by the more uniform yellowish-brown color of the basal and median band areas, there being only a tiny light spot at the tip of the cell and a dark triangle extending outside the discocellular vein from the radius to vein M_3; the veins crossing the discal band are brown rather than concolorous with the band; the discal band is of even a more uniform shade; the ocelli are

much reduced, the second pair being small blind dots above, although pupilled below. The undersides of the two forms are alike.

There is a female from the Hissar Mountains in the collection of the British Museum. It is of the *josephi* group and has small ocelli. We designate it as the allotype of *Karanasa hissariensis.*

Holotype. Male. Expanse 42 mm. In the collection of the Carnegie Museum.

14. **Karanasa josephi** Staudinger *(Karanasa josephi josephi)*

Plate 3, fig. 23 ♀ (Alai); fig. 31 ♂ (Kara-Beles); fig. 32 ♀ (Kara-Beles); fig. 33 ♂ (Alai); fig. 34 ♀ (Alai); fig. 35 ♀ underside of fig. 34 (Alai).
Plate 9, fig. 33 ♂ (Artchi-Bashi).
Plate 11, fig. 32 ♀ (Alai occ.).
Plate 14, male genitalia.
Plate 16, male genitalia.

We hereby restrict the name of *josephi* to the unbranded form originally described from the Alai mountains by Otto Staudinger and O. Bang-Haas in Berliner Entomologische Zeitschrift, volume 26, pages 174-175 in 1882. The expansion of the concept of *josephi* to include the branded forms as proposed by Staudinger in the Stettin Entomologische Zeitschrift, volume 46, page 245 in 1886, quoted in the discussion of *Karanasa iskander* on page 62 of this work is declared invalid.

The original description (translation) follows:

"*Satyrus josephi* Staudinger (n.sp. or *Satyrus regeli* Alpherakyi var?). Of this interesting little species Haberhower sent me one hundred specimens and with only five females of the Province of Fergana which were unquestionably caught in the regions of Alai in July. I named it after the first name of this unusually energetic collector and explorer. The pieces varied from 37 to 48 mm. in span; altogether *josephi* is slightly larger than the *regeli* from Tian Shan recently described and figured by Alpheraky and of which it is probably a local race. Since anyone who is interested in the Central Asiatic fauna of Lepidoptera should have the beautiful work of Alpheraky I shall restrict myself to an outline of the differences between *josephi* and *regeli.* The main difference lies in the fact that the broad transverse band of *josephi* is of a vivid yellow-brown color instead of a dirty white. Only near the upper ocellus it is whitish yellow chiefly before the latter which forms a rather sharply indicated whitish patch. In none of my fifty *regeli* which I obtained from my friend Alpheraky is this band approaching the yellowish

tint of the figure which was apparently in this point falsely exaggerated by the colorist. In the diagnoses of Alpheraky this color is correctly described as *"fasciis albidis infumatis vel albido flavescentibus."* These bands are in *josephi* distinctly wider and the brown wings of the female are entirely yellow-brown with the exception of the marginal band. The two ocelli and a rather sharply outlined triangular spot at the discocellular. Also in one male is the dark basal half almost entirely suffused with brown. This never happens in *regeli* females or males. Also on the hindwings the dark basal half except an indented band is apparent in the yellow-brown in the females of *josephi.* On the frontwings the band of *regeli* is cut by the black veins especially on vein 4 so wide that it appears as two divided portions. This is never the case with *josephi* where the veins are only slightly indicated in black. The band of the hindwings in *regeli* is inwardly toward the black base much stronger indented than outwardly whereas in *josephi* it is scarcely at all or not at all indented inwardly but has very strongly projected points outwardly. The black exterior margin of the frontwings in *josephi* is much less indented or not at all. The underside of the hindwings with a zigzag pattern and white veins is similar in both species. The frontwings are in *josephi* naturally also yellow-brown; the hindwings much darker than in *regeli,* particularly the conspicuous wide zigzag line in the discus is not so sharp as in *josephi.* Furthermore, the black zigzag antemarginal line of the front wings in *josephi* is less indented than in *regeli.*

"Since with all the differences indicated heretofore all the intermediate forms are entirely missing between the two so it must be considered a good species until transitional forms will be found."

As was pointed out in the discussion of the forms *decolorata* and *iskander,* the generally accepted concept of *josephi* has shifted from the form originally described to forms found farther west. An important specimen in our collection throws light on the question as to what should be considered the actual *josephi.* We possess a male with a label "josephi, Turkestan, '81, Haberhower." This specimen doubtless belongs to the original series of Haberhower which served Staudinger for the description he published in the next year 1882, in which he refers to the 100 specimens he obtained through that collector: "In Fergana without doubt in the Alai region in July." Staudinger apparently did not have a more precise information as to where this series was obtained, as to the exact point in that region. The specimen reproduced in colors on Pl. 9, fig. 33, may be considered an official paratype of the species, at least one of the specimens which were consulted by the author at the time of his description. The description given by Staudinger corresponds to this specimen. There is even an interesting detail in the fact that he mentions that in one male the

dark basal part is almost entirely suffused with brown. This is practically the case with this specimen and it might have been the very one which was mentioned in these terms by Staudinger. Another peculiarity of this specimen is the small size of the lower ocelli which are reduced to small black spots. We have two more *josephi* males which fit into the description. One diverges only by larger ocelli and the other while displaying the reduced lower ocellus has a reddish suffusion over the base. In all these three cases, the back of the hind wings is relatively narrow, and in this regard they differ from the typical *dissoluta* of Trans-Alai which also never shows such a dark base of the front wings and such a reduction of the lower ocellus. Three females marked *Alai* and *Margelan* are of a russet tinge and a characteristic angular dark reddish brown mesial band running through the discocellular over the disk to the vein M_3. The underside of the real *josephi* is characterized by a slight development of the dark pattern in the discus of the front wings and a clear net of white veins on the hind wings. The specimen from Margelan may possibly have been collected by Maurer who lived there for years and sent material to Staudinger. He used to mark by the name of the town of Margelan, which lies to the north outside of the mountainous region of Alai, all the specimens he would collect in the adjacent mountains. They might also include specimens collected in the vale of Alai. A unique specimen of a male which was actually captured on the northern slopes of the Alai mountains in Artchi-Bashi was caught by the senior author during his trip to the Pamirs in 1908. It does not fit perfectly into *josephi* in the original sense. It is larger, has well developed ocelli, both pairs clearly pupilled, and a peculiar light ochraceous base of both wings. With this specimen might be associated the larger female with particularly well developed ocelli and labeled Margelan. It is probable, but not certain that this female was caught by Maurer on the northern slopes of the Alai range. These two represent an extreme in the development of *josephi* in the direction towards the related *dissoluta*. Grum did not have any specimens of *josephi* from the northern slopes of Alai and only one recorded from the southern slopes, at Djirtsche-Tal. Most of his material came from the extreme west of the Trans-Alai system in the vicinity of Pass Liagar-Mourda, where as on the southern slopes of the Alai, *josephi* flew at the same altitude and almost in the same vicinity with *dissoluta*. It may be that one or both

of our males of *josephi* other than the individual captured by Haberhower are derived from such material. We possess a pair from the region of Kara-Beles, Bukhara (Plate 3, figs. 31-32) that have a close affinity with both the northern Alai segregate and *dissoluta*. While the base of both female and male are flushed by the russet tinge, the form corresponds sufficiently close to the true *josephi* not to be separated from it subspecifically. The light base and the pupillation of both ocelli make it look not unlike the race from Artschi-Bashi, but it corresponds particularly closely to the specimen from Alai, Pl. 3, fig. 33, the precise origin of which is not known. Since Kara-Beles is to the south from the extreme west of the Trans-Alai system where Grum-Grshimailo found the true *josephi* both specimens might come from the same locality.

The true *josephi* leads not in the direction of *josephi auctorum* which is an unrelated species with androconia, but points toward the group of *dissoluta,* namely to the racial representative of this species in Darwas, Bukhara and western Pamir. The *dissoluta* from Vis-Harvi and Gursy-Tash and other localities in that region shows a clear leaning toward the type of *josephi*. The systematic linkage lies in this direction and is supported by the fact that forms of *dissoluta* are found flying together with *josephi*. It is a continuous systematic group the extreme limits of which are indicated by palest *dissoluta* of Trans-Alai, and the darkest *josephi* from the western Alai system, like the typical specimens in the original series collected by Haberhower. This clarifies somewhat the position of *josephi* and helps to disentangle it from the actual unrelated group of the forms (*decolorata-iskander*) marked by heavy androconia. It is associated with the basin of Zaravshan and the adjacent lands, whereas *dissoluta* inhabits the mountainous parts of western Pamir, the eastern part of the Alai system, and reappears in a related cycle of forms to the north from that region in the mountains of Tschotkal, Talastau, Alexander Mountains, Kandyk-Tau, roughly taking a mountainous territory straight to the north from the Pamirs.

The genitalia of the male of *josephi* have a medium length uncus, a little drawn down at the edges. The gnathos is cylindrical, slightly tapering to a blunt point and a little swollen at the base giving an elbow like effect. The valve has many small teeth and a small terminal tubercle. The elbow-like swelling at the base of the gnathos and the terminal tubercle are much less developed than in *iskander*.

15. **Karanasa dissoluta** Staudinger *(Karanasa josephi dissoluta)*

Plate 3, fig. 24 ♂ (Gursy Tash); fig. 25 ♂ (Gursy Tash); fig. 26 ♂ (Ters Agar); fig. 27 ♀ (Gursy Tash); fig. 28 ♂ (Aram Kungei); fig. 29 ♂ (Taldyk); fig. 30 ♀ (Atchik-su).
Plate 7, fig. 4 ♂ underside (Gursy Tash); fig. 8 ♂ underside (Aram Kungei); fig. 10 ♂ underside (Gursy Tash); fig. 15 ♂ underside (Taldyk); fig. 16 ♂ underside (Atchik-su).
Plate 8, fig. 10 ♂ (Kaindy); fig. 12 ♂ (Kaindy).
Plate 11, fig. 5 ♀ (Taldyk).
Plate 14, male genitalia.
Plate 16, male genitalia.

Karanasa dissoluta was described by O. Staudinger in Stettin Entomologische Zeitschrift, volume 47, page 245 in 1886. After a rambling and largely inaccurate discussion of *huebneri* and *josephi* he described *dissoluta* as follows: (translation)

"As *dissoluta* I designate such specimens which I received in similar numbers from Usgent and Osch. These are decidedly smaller but of all with much less dark pattern than var. *josephi*. The frontwings in both sexes are not only deprived of pattern as in *josephi* female, but also their basal part is mostly light grayish-yellow, much lighter than the rest of the red-brown portions of the wing. Also the hindwings are lighter and only a few varieties of *dissoluta* show in the middle an uneven and mostly subdued black dentate line (band) as a remnant of an outline of the vanished dark basal part. On the underside of the hindwings the white veins are usually less apparent."

Grum-Grshimailo commented at length in the "Memoirs" on the *dissoluta* of Staudinger. A complete translation of these may help in getting a correct picture of this very variable and wide ranging species. He wrote: (translation)

"This variety was described very superficially and I have no doubt that originally Staudinger meant to take as this form the one which was previously described by Erschoff as *wilkinsi*. I draw this conclusion, first, because Staudinger received his first specimens of *dissoluta* from the mountains surrounding Oche and Ousgent, the eastern part of the Alai range and of the mountains of Ferghana, and second, on account of the following lines in the description: 'The upper wings are in both sexes not to such an extent patternless as are the *josephi* female (?), but their basal part is mostly light grayish yellow,' a peculiarity which is only found in *wilkinsi*.

"This is the reason that it seems just to consider *dissoluta* as a synonym of *wilkinsi* and if I preserve this name for a totally different form I am doing that in order to avoid in the future a still greater confusion in the

group of the species of the *huebneri* type already sufficiently involved in a natural way and owing to Dr. Staudinger. The fact is that in later years Dr. Staudinger took for *dissoluta* an entirely different butterfly received from the northern slopes of the mountains of Trans-Alai, which to a certain extent approaches considerably *josephi,* leading to this latter species; in other respects it approximates *wilkinsi* and *intermedius.*

"Staudinger communicates (Stet.Ent.Z.1887, p. 60) that he has received a *dissoluta* from Maurer also from the mountains of Trans-Alai. Fortunately I happen to know the itinerary of this collector and that is the reason why there remains no doubt that he has not taken the true *wilkinsi* and that he has sent to Staudinger the form which I describe here as *dissoluta.*

"The form which I propose to name *dissoluta* shows the following characteristics: the shape of the wings is longer than in *josephi,* at the same time the butterfly is somewhat smaller; the coloration is uniform, imperceptibly paler toward the base and of a hue somewhat brighter than in *wilkinsi.* The marginal part is almost black and in the majority of cases very well marked. The principal element in the variability of this species, which on the northern slopes of Pamir manifests an extraordinary instability, consists mainly in the fact that the median band almost entirely merges with the ground color or else shows a considerable contrast in color. I do not know two specimens of this species absolutely identical and it is impossible to ascribe this form of the Trans-Alai to any of the kindred species as *Wilkinsi, Intermedius* and *Josephi,* which strengthens its right to be called a separate species. The discal part of the forewings is never covered with fulvous scales. One could not say as much about the hindwings, which are sometimes not only just as dark as in the *Josephi* from Ghissar but besides are broken up by the yellow veins in the same way as in the latter form. The coloration of the underside is just as much lacking in constancy and reminds one either of *Josephi* or *Wilkinsi* to such a degree that it is almost impossible to fix this form on the basis of the underside of the wings. If I did not know that these varieties form a single association of the specimens flying in a single locality covered with Festuca and entirely isolated near the upper branch of the river Aram, I would not have the faintest scruple in dividing them into two forms of which I would assign one to *Wilkinsi* and the other to *Josephi.*

"This *dissoluta,* is also found on the southern slopes of Alai, but already in another form very close to *Josephi*; it is not found on the northern slopes of these mountains. I have secured this butterfly on the upper current of the river Mazar (the mountains of Mous-tag, part of the Kara-koroum of the Himalayas) and also on the banks of the southern Beik. They have an altitude of 14,000 feet. The season of flight is the early part of July; the same season also near the river Aram-Koungei of the Trans-Alai mountains."

On the basis of the two writings alone as quoted above, *dissoluta* (Staudinger) should fall as a synonym of *wilkinsi* (Erschoff) and *disso-*

luta (Grum) is invalid because preoccupied by *dissoluta* (Staudinger). A further argument in favor of this concept is a specimen in the collection of the late Dr. William J. Holland in the Carnegie Museum obtained from Staudinger and labeled *dissoluta,* but unquestionably a *wilkinsi.* A check of other specimens sold by Staudinger to Dr. Holland shows, however, that the identification was correct in little better than half of the specimens, even his own species. In fact, Staudinger sent out as male and female of the same species an Ithomine and its Helioconid mimic, so we may assume that at best, he was a bit careless.

On the other hand, Grum-Grshimailo's two reasons for identifying Staudinger's *dissoluta* with Erschoff's *wilkinsi* do not stand up in the light of present knowledge. First, neither *dissoluta* nor *wilkinsi* is to be found in the immediate vicinity of Osch or Usgent — cities of the lowlands of Fergana. Species such as that described by Staudinger can only be obtained in the mountains. *Dissoluta,* as fixed by Grum is, contrary to his statement, found in the Alai mountains as far east as Taldyk Pass, so that if the collector took the road from Osch he could have taken either *dissoluta* or *wilkinsi.* If he took the road east from Usgent, he would get only *wilkinsi.* Second, the description of the base of the forewing as "mostly light grayish yellow" could apply to either species. Further, the failure of Staudinger to mention one of the outstanding characters of *wilkinsi,* namely the cutting of the marginal band by yellowish veins, weighs heavily against the probability that he had a pure series of *wilkinsi.* He probably had a mixed series of the two forms, possibly even all *dissoluta,* but very questionably all *wilkinsi.*[1]

We are on the horns of a dilemma: Grum knowingly designated as *his dissoluta,* a form that Staudinger *could* have had before him when he described his *dissoluta.* Did Grum fix the type form of *dissoluta* by eliminating *wilkinsi,* or did he sink *dissoluta* as a synonym of *wilkinsi* and then create a homonym in his own *dissoluta*? Inasmuch as there is a better than even chance that the two *dissolutas* are the same, we

[1] Dr. Bruno Gehlen of the Berlin Museum has examined the type in the Staudinger collection for me and reports that it bears three names—*wilkinsi,* Ersch, *dissoluta* Stgr. and *intermedius* Grum-Grshimailo, Usgent (Haberhauer). He writes further that the light ochre to rust brown of the discal field does not invade the basal third of the wings which are yellowish white and dark brownish suffused. The veins of the marginal band are *not* yellowish or red brown colored. This fits the Gr.-Gr. *dissoluta.*—WRS

shall follow the generally accepted usage of both a *wilkinsi* (Erschoff) and a *dissoluta* (Staudinger).

The butterfly now known as *dissoluta* varies considerably, both geographically and within a restricted population. The generalized form ranges from Eastern Bukhara, Darwas, Western Pamirs, Trans-Alai, Alai Valley and Alai Mountains as far east as Taldyk Pass. It merges with *wilkinsi* and *intermedius* in the central Pamirs, gives way to *hissariensis* in the west and appears to blend with *josephi* in the northwest. There is a gap in its distribution northward caused by the lowlands of Fergana, but it reappears in an altered form north of there and in the Alexander Mountains. We will confine the name *dissoluta* to the population found in the Trans-Alai and Alai regions. The Darwas and Bukhara forms separate out as *darwasica*. The northern relations come under the names of *arasana, angrena, talastauana, praestans* and *kasak*.

The range of the nomentypical form is the southern slopes of the Alai Mountains, the Alai Valley, the western Trans-Alai and adjacent Pamir from Taldyk Pass at the northeast to Kaindy at the southwest. Over the greater part of this range it flies with *wilkinsi* and *intermedia*. Although Grum maintains that the three species are separated ecologically, the senior author has repeatedly taken all three flying together in the Trans-Alai. The form *wilkinsi* drops out of the trio in the west and *dissoluta* in the southeast. The degree of differentiation between the three varies from place to place. *Karanasa dissoluta* exists in two morphs, one with a dark base to the hindwings and one with uniformly reddish hindwings. These two morphs appear in approximately equal numbers in collections from Gursy Tash, Aram Kungei, and Atchik-su in the Trans-Alai. At Kaindy in Pamir, only the dark one is found and it deviates in the direction of *leechi*. In the Alai Valley the general color is lighter, while in the western Alai Mountains, they are dark and tend towards *josephi*. The two specimens of *josephi* from Kara-Beles on plate 3, figs. 31 and 32 were at first considered to be *dissoluta*.

17. **Karanasa darwasica** nov. *(Karanasa josephi darwasica)*

Plate 3, fig. 18 ♂ paratype; fig. 19 ♂; fig. 20 ♂; fig. 21 ♀; fig. 22 ♀; (all from Visharvi).
Plate 9, fig. 34 ♂ (Visharvi); fig. 35 ♂ holotype (Visharvi).
Plate 11, fig. 2 ♀ allotype (Visharvi).
Plate 14, male genitalia.

The *dissoluta* from Darwas and Eastern Bukhara differ with sufficient constancy from those of the Trans-Alai and Alai to warrant being split off as a subspecies. The dark morph is the predominant form.

Male. Upperside. Differs from the nomentypical *dissoluta* in larger size, less fiery orange and darker browns. The median band that appears below vein M_3 as a trace if at all in *dissoluta* is well developed, approaching the coloring of *iskander* and *josephi.* The lightening of discal band between the anterior ocellus and the end of the cell is more pronunoced. The same is true of the anterior end of the discal band on the hindwing. The ocelli are larger and more irregular and there is a marked tendency to possess extra ocelli. The specimen chosen as type and shown to have three ocelli on plate 3, figure 35, has four, complete with pupils on the opposite wing. There is also a tendency for an ocellar spot to appear on the hindwing between veins Cu_2 and Cu_1. The underside is as in the nomentypical form.

There are no androconia.

The male genitalia has the uncus moderately long and deep. The gnathos is stout and tapers to a sharp point. It differs from typical *dissoluta* in being more stout and in lacking the elbow-like swelling where it joins to the tegumen. The valve is more coarsely toothed than *dissoluta.* The terminal tubercle reaches its greatest development in this form, having a length equal to the depth of the distal quarter of the valve.

Female. Differs from the dark morph of the nomentypical *dissoluta* in having larger size, paler orange color and by the tendency to have supernumerary ocelli and an ocellar spot on the hindwing.

Expanse ♂ 44 mm.; ♀ 47 mm.

Holotype, allotype and sixteen paratypes from Visharvi Pass, Darwas. All are in the collections of the Carnegie Museum.

16. **Karanasa oshanini** nov. *(Karanasa josephi oshanini)*

Plate 9, fig. 27 ♂ type (Katelmysh Glacier, Pamir, July 1912)

There is a single male *dissoluta* from the Katelmysh Glacier in east-central Pamir that comes closest to *darwasica,* but is tentatively separated out here.

Male. Differs from *darwasica* in having a generally duller tone, having the m_1 and m_2 lines of the median band distinct, and having the

inner edge of the marginal band and the outer edge of the median band produced towards each other on vein M_3 thereby almost separating the discal band in two as in *latifasciata*. The underside is pale but well marked, particularly the m_1 and m_2 lines on the forewing.

There are no androconia.

Expanse ♂ 42 mm.

This specimen, which is one of the Pamir *dissoluta* that converge with *wilkinsi* and *intermedia* in the direction of the high altitude *leechi,* might well be included with *darwasica.*

18. **Karanasa angrena** nov. *(Karanasa josephi angrena)*

Plate 4, fig. 1 ♂ holotype (Angren); fig. 2 ♀ allotype (Angren).
Plate 7, fig. 7 ♂ holotype underside (Angren).
Plate 9, fig. 26 ♂ paratype (Angren).
Plate 15, male genitalia.

Three specimens, two males and a female, referable to *Karanasa dissoluta* were taken near Angren in the Arasan region in the Tschotkal Mountains north of the valley of Fergana. We consider them to be representatives of a distinct race which we will call *angrena.*

Male. Slightly smaller than *dissoluta* of Trans-Alai and with the wings more rounded, the exterior margin being distinctly convex. The brown of the marginal band is as in *dissoluta,* but the basal and median-band markings are reduced to a narrow black discocellular line, a very faint indication of the m_1 line at the costa and a sparse dusting of brown scales between the anal vein and the anal margin. The bright russet of the discal band extends to the base of the wing. The lightening of the discal band at its anterior end is slight but is also evident along the costal edge of the cell. The ocelli are small, the hind one considerably reduced, but still faintly pupilled. The marginal band and basal areas of the hindwing are deep brown, the latter dusted with russet scales and with russet veins. The discal band is uniformly the same shade as that on the forewing.

The underside of the forewing repeats the upperside except that the lightened areas along the costa are more developed and the anterior half of the cell shows striae. On the hindwing the discal band contrasts less with the rest of the wing than in *dissoluta* and both edges of the median band are prominent.

The genitalia have the uncus with the sides drawn down a little

more than in *dissoluta*. The gnathos is slender, cylindrical with very little taper and with a rounded point; the "elbow" at the base is only slightly developed. The valve is blunt with the terminal tubercle moderately developed, more so than is indicated in the drawing on plate 15, but much less than the extreme of *dissoluta* shown on plate 14.

Female. The wings of the female differ from those of the male only in the slightly greater development of the ocelli and in the greater expanse of the slight lightening of the russet along the costa.

Expanse: ♂ 38 mm.; ♀ 40 mm.

Holotype, allotype and one paratype in the Carnegie Museum.

19. **Karanasa arasana** nov. *(Karanasa josephi arasana)*

Plate 11, fig. 6 ♀ type (Arasan-Bulak)

A female specimen taken on the slopes above Arasan-Bulak in the same general region inhabited by *angrena* might be considered as falling under that name but for the fact that it shows traits typical of *wilkinsi*. Since no *wilkinsi* has been reported from the Tschotkal Mountains we must, in the absence of a male, give a tentative name to this form. We will call it *arasana*.

Female. Differs from the female of *angrena* in being much lighter, in both the russet and brown shades. The marginal bands of both wings are narrower and cut by russet veins as in *wilkinsi*. The ocelli are reduced as in the male of *angrena*. On the underside the basal areas are more marbled and the inner border of the median band is obsolete.

Expanse: ♀ 40 mm.

Type female is in the collection of the Carnegie Museum.

20. **Karanasa talastauana** O. Bang-Haas *(Karanasa josephi talastauana)*

Plate 4, fig. 3 ♂ type (reproduction of the figure in Horae Macrolepidopterologicae plate 7, fig. 20, Talastau); fig. 4 ♂ (Talas-Alatau, Aulie Ata, Kasakstan); fig. 5 ♀ (same as fig. 4).

Plate 9, fig. 39 ♂ (Talas-Alatau, Aulie Ata, Kasakstan, 2500 m., July).

Plate 15, male genitalia.

Karanasa talastauana was described and figured in Horae Macrolep-

idopterologicae volume I, page 49 in 1927; a translation follows:

"*Satyrus huebneri talastauana* O. B.-Haas, subsp. nov. — t.7, f. 20 (♂) —

"*Satyrus pamirus aulietana* A. B.-Haas i. l.

Habitat: northwest Tian-Shan: Syr Darja, Talastau Mountains, southeast from Aulie Ata in the upper valley of the river Talass to the east of the Alexander Mountains. Size: 34 to 46 mm.

"It stands in pattern and size between *josephi* Stgr. and *pamira* Stgr. The forewing base is as clear as *pamira.* The base of the hindwing is partly filled with dark brown. The underside of the hindwings is brightly colored and the bands are more sharply dentate than in *pamira.*"

The genitalia of the male are very similar to those of *angrena* and differ by the almost complete loss of the terminal tubercle of the valve. The uncus has a very slightly larger hooked point. (The wrinkling of the end of the gnathos in the drawing is an artifact. WRS.)

Bang-Haas placed *talastauana* between *josephi* and *pamira;* this is not justified, the two being entirely different species. In reality it is an unusual form of *dissoluta,* characterized by a wider form of the wings, which are somewhat of the shape of *abramovi* and by its deeper color.

The firm of Staudinger and Bang-Haas appears to have continued the custom of the founder of sending out specimens from a new series under the same name as an old one when an old series was exhausted, because we have a cotype with both handwritten and printed cotype labels that fits well with the figure in Horae Macrolepidopterologicae except that it has yellow veins in the margin. It is one of a fairly uniform series of five which fit even better, all of which have the same data as used in the description. We have another set, merely labeled "Aulie Ata, Syr Daria," three of which are also labeled cotypes, but which are quite different, although a race of the same species *dissoluta.*

It may be well to straighten out the geography of this form and its relatives at this point. First, none of the ranges inhabited by this form or its immediate relatives is part of the Tian Shan System. The Talastau range is south of the western part of Alexander Mountains and joins with the latter range about a hundred miles from its eastern terminus. The headwaters of the Talass River drain the northern slopes of the Talastau range for about one hundred and fifty miles ranging from south-southwest to east-southeast of the town of Aulie Ata, which is in the lower part of the valley. The Djungaltau range runs parallel to the Alexanders and south of them. It is east of the

Talastau and is drained in a roundabout way by the Syr Daria rather than by the Talass. A third range, the Kandyktau, is northeast of the eastern end of the Alexander Mountains and is separated from them by the relatively low valley of the Tschu River which drains Lake Issyk-Kul.

From the north slopes of the Djungaltau range we have two specimens that fit exactly with the series containing the indefinitely labeled "cotypes" mentioned above. Inasmuch as the geographic variation of the *Karanasa* as a whole is rather continuous, *talastauana* as described and figured and as represented by our "Talastau" series must have come from the western end of the Talastau range where it comes nearest to *angrena* geographically as well as in pattern. The second "Cotype" containing series must have come from the eastern end or even from the Alexander Mountains as that would place them near to the Djungaltau whose *Karanasa* form they match. Geographically, this would also place them halfway between the original *talastauana* and a new form from the Kandyktau range; with regard to color and pattern, they are also halfway.

21. **Karanasa praestans** nov. *(Karanasa josephi praestans)*

Plate 4, fig. 6 ♂ paratype (Aulie Ata, Syr Daria); fig. 7 ♂ paratype (northern slopes Djungaltau, 3000 m., July); fig. 8 ♀ (same as fig. 7).
Plate 7, fig. 5 ♀ paratype underside (Aulie Ata, Syr Daria).
Plate 9, fig. 40 ♂ holotype (Aulie Ata, Syr Daria).
Plate 11, fig. 3 ♀ allotype (Aulie Ata, Syr Daria).
Plate 15, male genitalia.
Plate 16, male genitalia.

The name *praestans* is proposed for the *dissoluta* race coming from the Djungaltau and adjacent ranges and including the series sent out by the firm of Staudinger and Bang-Haas under the label of "Aulie Ata, Syr Daria."

Male. Forewing. The marginal band is wide and dark brown. The median band is represented by a dark bar between the discocellular vein and the m_1 line; the m_2 line is present in the cell as a faint to well developed line; behind the cell the band has its outer border deeply concave and is more or less filled with brown scaling. The basal area is lightly dusted with brown except between the anal vein and the anal margin where it is solidly dark brown. The discal band is bright

rusty orange lightened to cream at the anterior end. The ocelli are medium size with well developed pupils. The broad marginal band and the basal areas of the hindwing are very dark brown, the veins lightly russet. The discal band is an equal or slightly deeper rusty orange as compared with that of the forewing. There is a very variable eyespot in the Cu_1-Cu_2 interspace ranging from a faint spot to medium sized, pupilled ocellus.

The underside is very bright, its colors contrasting. On the forewing the median band is represented by three short lines near the costa and two below vein Cu_1. The light part of the discal band above is replaced by a larger white area extending from half way between veins M_3 and M_2 to the discocellular vein, the costa and outer border. On the hindwing the inner half of the discal band is white, the e_3, m_1 and m_2 lines deep brown, the veins white. There is no marbling on the median band.

The male genitalia are identical with those of *talastauana.*

Female. Differs from the male in the slight development of the transverse band which is represented by a discocellular mark, a red-brown shade between it and a very faint trace of a m_1 line, and an almost invisible trace of a m_2 line in the cell. There is also a brown dusting of the posterior half of the wing base that extends out to the middle of the anal border below the anal vein. All of these characters, faint as they are, are more developed than in *talastauana.* The hindwing is similar to that of the male except that the basal area has a dusting of russet scales. On the underside, the light part of the discal band of the hindwing is narrower and not so bright.

Expanse: ♂ 44 mm.; ♀ 47 mm.

Holotype, Allotype, 6 paratypes in the collection of the Carnegie Museum.

22. **Karanasa kasak** nov. *(Karanasa josephi kasak)*

Plate 4, fig. 9 ♂ paratype (Targaisk, Kandyktau, Kasakstan, 1400 m., July); fig. 10 ♂ paratype (Targaisk, Kandyktau, Kasakstan, 1400 m., July).

Plate 9, fig. 38 ♂ holotype (Targaisk, Kandyktau, Kasakstan, 1400 m., July).

Plate 15, male genitalia.

An extremely dark form referable to *dissoluta* is found near Tar-

gaisk in the Kandyktau range in Kasakstan. We will call it *kasak.*

Male. The forewings are slightly more pointed than those of the other northern *dissoluta* races. The margins are broader and darker than in *praestans;* the median band is the same shape but more filled with brown, only a small triangular russet spot remaining at the anterior distal corner of the cell. The basal area of the forewing is almost completely dusted with brown from the base outward. The rusty orange of the discal band is duller, darker. The ocelli are of medium size and pupilled. The hindwing has the wide margin and basal area dark brown with only a faint dusting of russet along the veins and in the center of the cell. There is a very small, but pupilled ocellus in the Cu_1-Cu_2 interspace. The underside is close to *praestans* but duller.

The genitalia of the male are identical with those of *talastauana* and *praestans.*

Expanse: ♂ 42 mm.

Holotype, three paratypes in the collection of the Carnegie Museum.

This is the darkest and the most northern representative of *Karanasa dissoluta.*

27. **Karanasa wilkinsi** Erschoff. *(Karanasa wilkinsi wilkinsi)*

Plate 1, fig. 14 ♂, fig. 15 ♀ (Rom. Mem. Lep. Pl. XV, f. 5a, 5b labeled intermedius).
Plate 4, fig. 16 ♂ ab. (Bordoba); fig. 17 ♂ (Aravan); fig. 18 ♀ (Akbossoga); fig. 19 ♀ (Bordoba).
Plate 8, fig. 14 ♂ (Bordoba).
Plate 9, fig. 17 ♂ (Kisyl-Art).
Plate 11, fig. 1 ♀ (Bordoba).
Plate 14, male genitalia.
Plate 16, male genitalia.

Karanasa wilkinsi was described by Erschoff in Horae Societe Entomologique de Rossicae, volume 18, page 244 in 1884. The types came from Lake Tschatyr-Kul north of Kashgar in Utsch-Tasch, near the Pass Suydam at 9,000 feet. A translation follows:

From Latin: — "the upperside of the wings is reddish ochre (ochraceo fulvis), the margin fuscous; the forewing with a spot on the transverse vein and two white-pupilled black ocelli; the hindwing shaded with fuscous from the base until the middle (the female with two black anal points). The underside of the forewing is pale reddish ochre with narrow ash-gray margins and two ocelli; the hindwing is grizzled, white veined with the median band

fuscous margined, limited by diffused pale strigae and obscured posteriorly."

"Expanse forewing 38-42 mm.

"Habitat in Semiretschie near Lake Tchatyr-Kul (9,000 feet) in the middle of June and near Utsch-Tasch in northern Kashgar flying during the last of August."

From Russian: — "Upperside of all wings reddish yellow ochre, with a blackish border along the outer edge, which is wider on the hindwings than on the forewings; the forewings near the outer edge have two black eye-spots with white pupils, in the shape of dots, and a blackish elongated spot on the transverse vein; the leading edge from the base to the transverse spot and likewise the inner edge up to the middle, are dusted lighter than the basic color; between the upper eye-spot and the spot on the transverse vein, the basic reddish yellow ochre color forms, as it were, a light yellow spot, which extends into the part forward of the upper eye-spot; the hindwings from the base almost to the middle are dusted with blackish scales, so that the remaining space forms as it were a central band of the reddish yellow ochre color, the ends of which are bent toward the outer edge of the wing; in the female in this band near the anal angle are two more or less noticeable dots. Below, the forewings are the same as on the upperside, but the basic ground color of the wing is paler, and the border at the outer edge is more gray, besides, in the central cell are two, sometimes three short, transverse, narrow stripes of dark color; the rear wings have a pattern almost identical with *S. huebneri* Feld., but the basic color is lighter, and the central band is more distinct and bordered with whitish color; in *S. huebneri* the ground color of the base and the central band are of the same dark color, while in *S. wilkinsi* the ground color of the base is lighter than the central band. The fringe of the wings is light gray, and dark on the extension of the veins. The outline of the wings is like that of the Himalayan form of *S. Huebneri* next to which is its (wilkinsi's) place in the genus *Satyrus*.

"It is named by me in honor of Alexander Ilyitch Wilkins, by whom the species was caught at Semiretchie, near the lake Tchatyr-Kul (9,000 feet) the 12th of June, and in northern Kashgar (Uch-Tash, Tuz-Ashu, near Sydam Pass) from the 15th to the 20th of August."

Grum-Grshimailo, in the "Memoirs," added the following to the original description:

(Translation) "I wish, however, to indicate here a certain peculiarity to which Erschoff did not pay attention and which though not very important is exceedingly characteristic to this species.

"Usually the exterior margin of the hindwing, invariably darker than the ground color of the wings on all the species of the second branch, is very distinctly pronounced. It is only *wilkinsi* which forms an exception to the general rule. Its border is frequently intersected along the veins by reddish-yellow scales, which in certain forms crowds out entirely the blackish brown

parts in such a way that its dark margin disappears entirely in the lower part of the wing and acquires an entirely indefinite contour toward the front angle. A somewhat similar phenomenon may be observed on the forewings more frequently in the females. Thus *wilkinsi* can be characterized as a species diverging from the others mainly through the narrowing down of the margin."

The genitalia of the male have the uncus rather short with a hooked tip and moderately drawn down sides. The gnathos is slender, cylindrical and bluntly pointed. The teeth of the valve are numerous and short, the terminal tubercle missing.

Karanasa wilkinsi is a complex of geographic forms similar to *dissoluta* in this respect. Like *dissoluta,* it is variable both geographically and within any definite locality. It is difficult to point out any single diagnostic character, perhaps the yellow or russet scaling of the veins in the outer border is the best. The *wilkinsi* group is the easternmost of three overlapping complexes of the russet type *Karanasa, dissoluta, intermedia* and *wilkinsi.* It flies alone in the southern Tian Shan and Issyk-Kul districts, overlaps the *dissoluta* complex a little in the eastern Alexander Mountains and flies with *dissoluta* and *intermedius* in the eastern parts of the Alai Mountains and Alai Valley and in the Trans-Alai. All three complexes tend to merge in the high Pamirs. With the exception of this last region, *wilkinsi* is fairly easily distinguished from the members of the other two complexes in any particular region, though some *wilkinsi* from A may approach some *dissoluta* from B. The form *wilkinsi* is always the lightest of the three, its border the least developed and even in the north where the russet forms get darker, it lags behind in the degree of development of the brown markings. It flies at elevations of from 9,000 to 13,500 feet.

The typical form has the russet areas pale, the median band poorly developed, and the basal area of the forewings, especially in the cell, a pale whitish yellow dusted with pale brown. It is restricted to the southern edge of the distribution of the complex from Aram Kungei in the western Trans-Alai Mountains through the Trans-Alai, the middle and eastern Alai Valley and Mountains to the Tian Shan and along it to the region of Tschatyr-Kul, the type locality. It fades out into the higher Pamirs whose northern edge it skirts.

26. **Karanasa robusta** nov. *(Karanasa wilkinsi robusta)*

Plate 4, fig. 14 ♂ paratype (Taldyk Pass, Alai Mts., 3000 ft., July); fig. 15 ♀ allotype (Taldyk Pass).
Plate 9, fig. 18 ♂ holotype (Taldyk Pass).

Grum-Grshimailo in the "Memoirs" recognized the *wilkinsi* of the Alai Mountains as differing from those of the Trans-Alai in being larger, less vivid and with greater development of the brown markings. Our specimens from the Alai Mountain region including the *"dissoluta"* that Dr. Holland bought from Staudinger fit into Grum's description except that they are brighter rather than less bright. This larger, more heavily bordered form of *wilkinsi* from Taldyk Pass in the Alai Mountains we designate as *Karanasa robusta.* It differs from the typical form further in the more uniform shade of the russet areas and in the lesser development of the russet veins through the outer margins.

Expanse: ♂ 43 mm.; ♀ 41 mm.

Holotype, allotype, two paratypes, all from Taldyk Pass, in the collection of the Carnegie Museum.

24. **Karanasa dublitzkyi** O. Bang-Haas *(Karanasa wilkinsi dublitzkyi)*

Plate 4, fig. 11 ♂ Khoum-Bel Berg, 3600 m., Alma Ata, Issyk-Kul Sept., July); fig. 12 ♂ cotype (Khoum-Bel); fig. 13 ♂ type (Khoum-Bel, from Horae Lep. vol. I, plate 7, fig. 13).
Plate 9, fig. 36 ♂ cotype (Khoum-Bel).
Plate 11, fig. 26 ♀ cotype (Khoum-Bel).
Plate 14, male genitalia.
Plate 16, male genitalia.

Karanasa dublitzkyi was described by Otto Bang-Haas in volume I of the Horae Macrolepidopterologicae on page 49 and figured on plate 7, figure 13, in 1927.
(Translation)

"*Satyrus huebneri dublitzkyi* O.B.-H. subsp nov.

"Habitat: North of Tian-Shan, the mountains of Khoumbel, 3,000 meter, July, Alma-Ata.

"Expanse: 34-37 mm.

"A much smaller race than the types of *josephi* Staudinger, Bez., 1882, p. 74, from Alai, which lie before me. The basal part of the front and hind

wings is mostly filled with dark brown. The veins are light, the ocelli are smaller than in *josephi*."

The uncus of the male genitalia is moderately short, with sides drawn down and pointed tip as in *wilkinsi*. The gnathos is slender, cylindrical, slightly pointed and turned out a little at the tips. The teeth of the valve are larger towards the tip but not as sparse farther back as shown on plate 14. There is a vestigial terminal tubercle.

The description by Bang-Haas wrongly attributes the form *dublitzkyi* to the complex of *josephi*, whereas it shows unmistakable affinities with *wilkinsi*, namely the interrupted dark marginal bands of the hindwings, which is one of the typical characteristics of *wilkinsi*. The peculiar light color of the wings near the very base is another trait denoting the *wilkinsi* group. It may be considered as the darkest representative of the *wilkinsi* complex with an unusually dark and contrasted underside of the hindwing. It is this aspect of the underside which constitutes the most distinct characteristic as compared with the representatives of *wilkinsi* in the Alai and Trans-Alai Mountains.

The type of *dublitzkyi* as represented in the Horae Macrol. by Bang-Haas is practically identical with the colored figures of the cotype shown in figure 36, plate 9 of this paper. It shows the veins interrupting the dark portions of the hindwings a little more clearly and is somewhat more like the rather extreme form shown in figure 12, plate 4 in this respect.

25. **Karanasa durana** nov. *(Karanasa wilkinsi durana)*

Plate 10, fig. 1 ♂ type (Dura Pass).

We have a single specimen referable to the *wilkinsi* complex taken by Sokolov at Dura Pass, southwest of Lake Issyk-Kul at the end of July 1909. On the basis of geographic position, one would expect it to be a form related to *dublitzkyi*, and if it were a female as we thought it was, it would fit nicely into the distributional picture of the *wilkinsi* group, but as *Karanasa* go, it is a freak and is probably not representative of its patria. The specimen has the habitus of a female, the long wings, reduction of the median band, lightening of the basal areas all point to a female, but the abdomen is that of a male. We first thought that someone had glued on a male abdomen to replace the lost female abdomen, a not infrequent occurrence, but when moisten-

ing in a relaxing chamber, soaking with alcohol and microscopic examination failed to support this view, we were forced to conclude that it is a male. We will call it *durana.*

Male. Disregarding the female proportions of the wings, the specimen stands between *wilkinsi,* of the Tian Shan, and *dublitzkyi* in color and pattern, being a little closer to the latter. It is much lighter than *dublitzkyi,* has a sandy tinge to the base and a thin light straw tint to the inner portion of the discal band on the hindwings. The light scaling along the veins that breaks up the dark marginal band is also of this same straw tint. The ocelli are small, subequal and pupilled. The median band on the forewing is limited to a bar at the end of the cell at right angles to the costa as in *wilkinsi* rather than at a slightly acute angle as in *dublitzkyi.* The basal area is about half and half brown and yellow scales. On the hindwing, the median band and basal areas are dark as in *dublitzkyi.* The underside of the hindwing is less varigated than in *dublitzkyi.*

Genitalia. The uncus is the shortest and stockiest of the entire northern group. The gnathos is straight, moderately short, oval in cross-section and bluntly pointed. The tip of the valve is slightly swollen as in *dublitzkyi* and moderately toothed.

Expanse: ♂ type 36 mm. In the collection of the Carnegie Museum.

23. **Karanasa kirgizorum** nov.

(*Karanasa kirgizorum* — position uncertain)

Plate 4, fig. 20 ♂ underside type (Alexander Mountains).
Plate 9, fig. 25 ♂ type (Alexander Mountains).
Plate 14, male genitalia.

From the collection of Tancré comes a strange looking unique male labeled as coming from the Alexander Mountains, caught at the beginning of August. For purposes of identification in later discussions we will call it *Karanasa kirgizorum.*

Male. Very small, very light in color with the dark portions of the wings also lighter than the usual brown. The discal bands are broad, the marginal bands of both wings narrow and divided by light veins. The median band is represented on the forewing only by a bar between m_1 and the discocellular and by a section of m_2 in the cell. The base of the forewing is the same pale straw color as the discal bands but liberally dusted with pale brown. The ocelli are small, equal

in size and lightly pupilled. On the hindwings the outer edge of the median band is accentuated but the rest of it and the base are light brown dusted with yellow. The underside is the same overall shade as the upper, the pattern being largely suppressed. It is lightly speckled with brown and the e_3, m_1 and m_2 lines are moderately developed, the first being fairly close to the margin.

The uncus of the male genital apparatus is relatively short and deep, the point hooked. The gnathos is slender, cylindrical, with conical point slightly turned outward. The valve tapers abruptly to a slender outer fifth which is toothed throughout with moderate spines; the terminal tubercle is barely detectable.

This specimen approaches the high altitude form *leechi* from the Pamirs. The small size and dull coloring being characteristic of forms living at the upper limit of climatic tolerance. The relatively great width of the discal bands brings this form into the orbit of the variable *latifasciata* group, but the breaking up of the marginal bands by yellow veins and the equality in size of the ocelli point to an association with the *wilkinsi* group where we place it.

28. **Karanasa intermedia** Grum-Grshimailo

(Karanasa leechi intermedia)

Plate 1, fig. 16 ♀ type (reproduced from Mem. Lepid. Romanoff, vol. 4, pl. 15. f. 7).
Plate 4, fig. 21 ♂ (Aram Kungei); fig. 22 ♀ (Aram Kungei); fig. 23 ♂ (Aram Kungei); fig. 24 ♀ (Aram Kungei); fig. 25 ♂ ab. (Bordoba); fig. 26 ♂ (Taldyk Pass); fig. 27 ♀ (Taldyk Pass); fig. 28 ♀ (Aram Kungei); fig. 29 ♀ (Atchik-su).
Plate 7, fig. 9 ♂ underside (Aram Kungei); fig. 13 ♀ underside (Atchik-su); fig. 14 ♀ underside (Aram Kungei); fig. 17 ♂ underside (Atchik-su); fig. 18 ♂ underside (Atchik-su).
Plate 8, fig. 13 ♂ (Aram Kungei).
Plate 11, fig. 10 ♀ (Aram Kungei).
Plate 14, male genitalia.
Plate 16, male genitalia.

Karanasa intermedia was named by Grum-Grshimailo on page 480 of the fourth volume of Memoires sur les Lepidopteres rediges par N. M. Romanoff in 1890, as the third member of the overlapping and at some places intergrading complexes of russet forms found in the Trans-Alai and adjacent regions.

(Translation) "*Satyrus intermedius* Gr-Gr, (pl. XV, fig. 7 ♀)

"Wings elongated, above tawny ocher, paler towards the base, margins dusky, forewing with spot on the transverse vein and two blind ocelli dusky black; hindwing with an indefinite band.

"The underside of the forewings, as in S. wilkinsi Ersch, but more brightly colored, the hindwing becoming gray with whitish veins, outer border broad, acutely toothed, finely margined and of a brownish shade, median band brownish gray, dusky margined."

"♂ ♀ 22-24 mm."

In addition to the Latin synopsis, Grum discussed the species further:

(Translation) "This species which I have found in the pass of Ters-Agar at an altitude of 10,000 feet, can be described both as a variety of *wilkinsi* and of *dissoluta*. I prefer to treat it as a distinct species.

"*Intermedius,* the reddest of all the species of this group, is principally characterized by the elongated shape of the wings and the coloration of the underside of the hindwings, invariably very pale and with an exceedingly simplified pattern. The latter is reduced to four bands of which the basal and exterior are almost entirely gray, and the two interior ones of a fulvous grayish. The black and brownish spots, which cover in the other representative of this group in a greater or less degree the underside of the hindwings, are in the majority of cases not visible at all. Of the two interior bands the one closer to the base is the darkest. It is, however, not so marked as to be really a contrast on the general background of the wing. The width of the four bands is approximately the same, a character which is not present in any of the other nine forms of this group. The veins are whitish, but are only slightly visible on account of the general grayish coloration of the wings, but the short white arrowheads between the veins emerging out of the indentations of the marginal band are typical in the species *josephi, abramovi,* etc., are present in the majority of cases. *Intermedius* finally shows in the coloration of the upper side of the wings some interesting features. We have mentioned already that it is the reddest of all the Satyrids of this group. One should add that the coloration of the surface of the forewings is uniform, the band is not at all accentuated outside of the presence of an oblong blackish-russet maculation on the transverse vein, and distinct only in the females; as to the base, the costal part and the regions surrounding the superior ocellus the orbit is slightly paler than the discal part of the wing. There are two small ocelli, the lower one being usually like a large point, and both are rarely centered with white. The fringe is simple (though in *josephi* it seems to be double as in almost all the other Satyrids of the type of *huebneri*) or at least it has the aspect of being so: 1, because it is very narrow; 2, because it is not so densely set with hair as in *abramovi* or *josephi.*

"*Intermedius* flies in July about mountain slopes covered with *Festuca*. It descends sometimes also on the "sais" (beds of alpine currents) where it prefers to fly near water, or to warm itself on stones exposed to the sun. Its habits are the same as those which we have observed in *wilkinsi*."

Karanasa intermedia is the southernmost complex of the *dissoluta-wilkinsi-intermedia group*. Its range extends from the Alai Valley south through the Trans-Alai, the western Pamir, Darwas to Alitchur and Pamir Post in the southern Pamir. It grades into *leechi* in the higher parts of the Pamir. The gradation from north to south is fairly uniform so that in breaking up this cline into local races one must deal with considerable overlapping.

We shall restrict the race *intermedia* to that form described by Grum, inhabiting the Alai Valley and the Trans-Alai. The type in the British Museum is a male with small ocelli and a faintly indicated inner margin to the discal band. The upper ocellus is surrounded by a very pale straw yellow area.

The genitalia of a male from Aram Kungei show the uncus of medium length with sides only slightly drawn down and with little or no hook on the point. The gnathos is cylindrical, slightly pointed at the tip. The valve has numerous short teeth, many of which are merely chitin spots on the costal surface; the terminal tubercle is not developed.

29. **Karanasa erubescens** nov. *(Karanasa leechi erubescens)*

Plate 7, fig. 11 ♂ type underside (Gursy Tash).
Plate 8, fig. 11 ♂ type (Gursy Tash).

In the west central Pamir, around Gursy Tash, there appeared a form bearing characters reminiscent of *dissoluta*. It has broader margins and much more developed ocelli than any other *intermedia*. The second ocellus is as large as or larger than the first and all are pupilled. The russet color on the disc is a deeper, darker shade than the fiery orange of the Trans-Alai forms. There is some brown scaling on the transverse band and on the basal areas. The underside is marked as in *intermedia* but much darker.

Four males and three females are in the collection of the Carnegie Museum.

30. **Karanasa jakobsoni** nov. *(Karanasa leechi jakobsoni)*

Plate 4, fig. 30 ♂ (Gursy Tash); fig. 31 ♀ (Gursy Tash); fig. 32 (Gursy Tash); fig. 33 ♀ (Visharvi).
Plate 7, fig. 12 ♂ underside (Gursy Tash).
Plate 8, fig. 9 ♂ type (Kaindy).
Plate 14, male genitalia.

Around Visharvi Pass in Darwas, and Kaindy in western Pamir and extending into the region of Gursy Tash is another form of *intermedia.* It differs from the form *erubescens* by having smaller, more nearly blind ocelli, the second of which is smaller than the first. The russet color also is lighter and brighter much as in the typical form. It differs from the typical race in having a much greater development of the brown scaling on the median band and basal areas, especially on the hindwing. The underside is marked as in typical *intermedia,* but the markings are darker (the specimen figured is by far the lightest of the series).

The genitalia of the male resemble those of the typical form except that the gnathos is wider at the base, tapering and more pointed, approaching *grumi* and *hodja* in this respect. The teeth on the valve are heavier than in the Trans-Alai *intermedia,* very few being reduced to spots; the terminal tubercle is not apparent.

33. **Karanasa alitchura** nov. *(Karanasa leechi alitchura)*

Plate 4, fig. 34 ♂ (Great Pamir) in British Museum).
Plate 10, fig. 7 ♂ type (Alitchur).

From Alitchur in the western part of the Great Pamir we have two specimens referable to the *intermedia* complex that show leanings toward *leechi* and possibly *bolorica.* A third specimen is in the British Museum.

Male. The wing form, ocelli, marginal bands and underside closely resemble the Trans-Alai *intermedia.* The size is small, the color as though faded and the entire area of the median band and basal sections deep brown on both wings; on the forewing the basal areas are lightly dusted with pale yellow. The pupils of the ocelli are single scales above, larger below.

Expanse ♂ 38 mm.

33a. **Karanasa alitchura** aberr. **fumigatus** Avinoff

Plate 10, fig. 8 ♂ type (Alitchur)

The aberration *fumigatus* was described by A. Avinoff in Horae Soc. Ent. Rossicae volume 39, in 1910 (translation)

". . . Beside that, among those modified Alitchur *leechi,* there occurred as aberrations specimens with particularly dark hindwings with the light band of the hindwings almost gone and in one case with wings practically entirely fuscous brown with a faintly indicated vestige of the light band on both pairs of wings producing a complete analogy with the form *hoffmani.* If it were necessary to indicate with a special name such extreme darkened form of Alitchur *leechi* I would offer the name *ab. fumigatus n. Omniao fusca,* (plate 14, fig. 12), as a brief characteristic of the peculiarities of this aberration. . . ."

The specimen has a normal pattern but the russet color is replaced by brown, the same brown as the dark markings. In other lepidoptera, this phenomenon has been shown to be the result of a single factor genetic mutation or developmental anomaly.

31. **Karanasa centralis** nov. *(Karanasa leechi centralis)*

Plate 4, fig. 37 ♂ (Pamir Post); fig. 38 ♀ (Aksu, Pamir).
Plate 10, fig. 3 ♂ holotype (Pamir Post).
Plate 11, fig. 4 ♂ allotype (Pamir Post).
Plate 14, male genitalia.
Plate 16, male genitalia.

In the eastern part of Pamir, extending from the lower northern slopes of Beik on the south through the high plains of Aksu north to Pamir Post on the river Murgab there flies a form of *intermedia* that gradually merges with *leechi* which inhabits the same general regions at higher altitudes. This transitional form is certainly not a true *leechi,* nor can it be completely merged with the *intermedia* from the Trans-Alai. For this reason we will call it *centralis.*

Male: Smaller than *intermedia;* pattern similar, russet colors paler, brown markings less intense. The pale parts of the russet around the anterior ocellus, in the end of the cell of the forewing and at the anterior end of the discal band of the hindwing are more conspicuous. The ocelli are small, the pupils reduced or missing. The underside is pale as in typical *intermedia.*

Female: Differs from the females of *intermedia* of Trans-Alai in the same ways as the male. Underside with slight marbling.

Expanse: ♂ 35 mm.; ♀ 41 mm.

This form diverges from the typical in the opposite direction from the dark *erubescens* and *alitchura* of the western Pamir.

32. **Karanasa gregorii** nov. *(Karanasa leechi gregorii)*

Plate 10, fig. 2 ♂ type (Beik Pass, China side, 4000 m., July, 1908).

Grum-Grshimailo took a butterfly (translation) "—on the upper current of the river Mazer (the mountains of Mous-tag, part of the Karakoram of the Himalayas) and also on the banks of the southern Beik.—" which he assigned to *dissoluta* rather than *leechi*. This is surely an interesting placement but the question remains open as to what kind of *dissoluta* it is since the true *dissoluta* is found in Trans-Alai and other related forms are described in this paper. Such forms being found in different regions from eastern and western Alai and all through the western Pamir. They are well defined geographical races and it would be difficult to surmise that they would be identical with a form discovered on the southern slope of the Hindu-Kush on the opposite side of the Pamirs. Such a form from Chinese Beik is actually shown on fig. 2 of Pl. 10. In the first place it is not quite certain whether it should be identified as being related to *dissoluta* when it also shows some traits of *intermedia*. Grum-Grshimailo was very keen in segregating his *intermedia* from *dissoluta* but for some strange reason did not take the trouble of speaking more precisely of this interesting butterfly he found in Kunjut.

Although the Chinese Beik specimen was not caught so far to the south, it differs from the true *leechi* with which it was flying, being a larger and brighter russet form. It has the distinct broad wings of *dissoluta,* standing well in comparison with figures 10 and 12 on plate 8. In pattern the inner margin of the forewings corresponds very closely with the specimens from Aram Kungei and Bordoba in the eastern Trans-Alai as shown on plate 4, figures 21 to 25. We consider the eastern Trans-Alai specimens to represent not *dissoluta,* but *intermedia.* There are no true *dissoluta* in the eastern Trans-Alai which is inhabited jointly by *intermedia* and *wilkinsi.* Among the typical *wilkinsi* there are found specimens like that shown on plate 6, figure

19, from Bordoba, which have a characteristic light ochraceous tinge to the base and only a slight tendency for the russet veins to break up the exterior border, as in the Hindu Kush specimen shown on plate 10, figure 2. This Chinese form, which we are inclined to place under *intermedia* rather than *dissoluta,* requires a special name since it possesses a characteristic paler aspect than its distinctly broader counterparts of the Trans-Alai, nor are the dark portions of the marginal bands so deep in tone. We will call it *Karanasa gregorii nov.* and assign it to the *intermedia* complex. This form, with *centralis* and *alitchura,* serves to connect the medium altitude *intermedia* with the high altitude *leechi.*

34. **Karanasa leechi** Grum-Grshimailo *(Karanasa leechi leechi)*

Plate 1, fig. 12 ♂ type, fig. 13 ♀ allotype (Rom. Mem. Lep. plate XV, figs. 3a, 3c).
Plate 4, fig. 36 ♂ (Beik).
Plate 5, fig. 1 ♀ (Beik); fig. 2 ♀ (Beik).
Plate 7, fig. 1 ♂ underside (Beik).
Plate 10, fig. 4 ♂ (Beik); fig. 10 ♂ (Beik).
Plate 11, fig. 33 ♀ (Beik).
Plate 14, male genitalia.
Plate 16, male genitalia.

Karanasa leechi was described by Grum-Grshimailo on page 473 in the fourth volume of Memoires sur les Lepidopteres — N. M. Romanoff in 1890. A translation follows:

"*S. leechi*: This species varies to the greatest extent and approximates considerably *wilkinsi, dissoluta,* etc. The forewings beginning from the exterior border toward the base show all the transitions between the dark brown to a grayish straw color. There are found sometimes individuals with a brighter coloration. In that case the transverse band always of the same hue has the ground color particularly accentuated owing to the absence of the reddish brown scales. This band is usually broad and is not always clearly defined inwardly by the russet brown. This color is in general more predominant in the males than in the females. The two ocelli vary in dimension, the one in the apex ordinarily more conspicuous. In some cases the lower ocellus disappears without any trace, but these instances are just as rare as in *intermedius* and *huebneri.* Certain specimens manifest, so to say, a positive phenomenon, namely the maculation at the apex forming a double eye with some ocelli or spots indicated on the hindwings. Beside these points, the position of which is indicated in this type, there are similar markings visible in other parts of the band. It is scarcely necessary to

mention these facts as they are not a rare occurrence among all the Satyrids, and are known by all lepidopterists.

"The white centers of the ocelli always present in *wilkinsi* are far from being constant in *leechi*. This character apparently so insignificant indicates an essential difference existing between these two species, and which is repeated in all the parallel forms, namely the representatives on the other side of the Pamir toward the south being distinguished by a weak development of the ocelli and contrarywise those to the north often with a perfectly formed ocellation. The fringe is grayish, sometimes brownish and interrupted opposite the veins by an indistinct indication of darker scales.

"The underside of *leechi* is particularly close to the one of *boloricus* though the variations in intensity and precision of the pattern are more marked in the latter species. The coloration is altogether more dusky and uniform than in *abramovi* or *josephi*. It is particularly the case of the coloration of the hindwings upon which the veination is of a scarcely noticeable tone.

"*Leechi* flies with *boloricus*, usually in far greater numbers than the latter. Its distribution seems to be quite restricted since it is not any more *leechi* but *dissoluta*, which flies on the southern slope of the Kounjout."

The genitalia of the male of *leechi* show no characters by which it may be separated from *intermedia*. The uncus is of medium length with sides moderately produced and slightly hooked at the tip. The gnathos is cylindrical, bluntly pointed, sometimes turned outward at the tip. The valve has slightly larger teeth; there is no trace of a terminal tubercle.

Grum's *leechi* all came from the Hindu Kush, but exactly similar specimens may be taken at sufficiently high altitudes along the eastern Pamirs as far north possibly as the Alai Mountains. In 1908, the senior author made a collecting trip from the Alai through Kisel-Art, along the eastern Pamir to Beik, taking more than five hundred *Karanasa*. He wrote up his study of *leechi* and its relatives in an article published in Horae Soc. Ent. Rossicae, volume 39, 1910. In it he treated the intergrading forms (*centralis, alitchura, gregorii*) as variations of *leechi*, but found true *leechi* in association with them. Excerpts (translated):

". . . A typical *leechi* conforming naturally with the description and figure in the fourth volume of Memoir sur L. L. is found on the passes Akbaital and Kizal-Art. It flies above 14,500 feet and is characterized by small size, light coloration with a slightly darkened base especially on the hindwings and a dull coloration of the reverse. On those two passes specimens of *leechi* are found in considerable number." . . . "Particularly interesting were

the results of collecting near Pamir Post where alongside with typical *leechi* are encountered specimens[1] in no way different in brightness, coloration and size from Trans-Alai specimens from Bordoba and the slopes of Peak Kaufmann. A similar mixed and unsettled character is shown by specimens of these Satyrids from Alitchur and Aksu, but here one should point out a certain peculiarity; on Alitchur specimens[2] of *leechi* acquired a peculiar outlook on account of darkening of the basal portions of both wings which become uniformly fuscus with a more or less bright russet band. . . ."

All of these specimens were lost to us when the present Russian government confiscated the collection, but sufficient material has been gathered together here and studied in the British Museum to confirm the deduction that *leechi* is a high altitude form of one or all of the *dissoluta-wilkinsi-intermedia* complex. Distribution records of these lower land (relatively speaking) forms seem to indicate that it is the *intermedia* complex that intergrades with *leechi*. The occasional disappearance of the lower ocellus in *leechi* also supports this conclusion.

35. **Karanasa mihmana** nov. *(Karanasa leechi mihmana)*

Plate 4, fig. 35 ♂ paratype (Mihman-yuli).
Plate 10, fig. 5 ♂ holotype (Mihman-yuli).

Although typical *leechi* has been taken at elevations as high as 17,000 feet, the specimens found at very high altitudes are usually a dark phase. Two specimens taken on the pass Mihman-yuli to the west from Beik at an elevation of 18,000 feet represent the extreme development of this dark phase. We will call them *mihmana*.

Male. The specimen is as small as the smallest of the *leechi*. The brown borders are much broader than in typical *leechi*, the median band and basal areas darker, the discal band narrow and very pale. On the underside the median crossband is the same shade of gray as the marginal band, as in *intermedia* rather than darker as in *leechi*. The markings are sharper than in *intermedia*.

Expanse ♂ 34 mm.

Type and paratype in the Carnegie Museum.

36. **Karanasa hunza** nov. *(Karanasa leechi hunza)*

Plate 10, fig. 6 ♀ type (Misgah Hunza, Tytler Collection).

[1] now *Karanasa centralis*

[2] now *Karanasa alitchura*

A single female among the *Karanasa bolorica* from Misgah Hunza in the Indian portion of the Hindu Kush in the Tytler Collection seems referable to the *leechi* group. To distinguish it we will call it *hunza*.

Female. This specimen bears somewhat an exterior resemblance to a *bolorica* female, but can be immediately distinguished on the following grounds: Although it is fuscous brown and has the somewhat characteristic light ivory band on both wings, the outline of this band is different inwardly; the dark median band does not run into a sharp angle on vein M_3, thus making the angle there obtuse. Further, there is no tendency for the discal band to be broken into a series of spots by brown veins. The exterior part of this band is also suffused with russet scales. On the underside the marbled basal portion of the hindwings is more evenly irrorated with a dark striation and does not show the distinct inner outline of the median band that shows through onto the upper surface of *bolorica*.

Expanse: ♀ 38 mm.

Karanasa leechi has never been found within the limits of British India. This specimen diverges from the typical Hindu Kush *leechi* and comes closer to the dark forms near Alitchur. It may be possible that this solitary specimen is a representative of a differentiated race, but lacking a male we cannot place it definitely with respect to its northern neighbors. It is also striking that it represents very closely the race *conradti* from way to the north at Tchatyr-Kul in the Tian Shan Mountains, from which it is distinguishable by its narrower discal bands especially on the hindwings and the far more variegated underside of the hindwings.

37. **Karanasa hoffmanni** Christoph

(*Karanasa hoffmanni* position uncertain)

Plate 5, fig. 22 ♀ cotype (Samarkand) in the British Museum.
Plate 6, figs. 23 & 24 ♀ from Schwanwitch "Patterns of Palearctic Satyrids."
Plate 10, fig. 34 ♂ (Samarkand).
Plate 15, male genitalia.
Plate 16, male genitalia.

Karanasa hoffmanni was described by Christoph on page 32 of volume 54 of the Stettiner Entomologische Zeitung in 1893.

Satyrus Huebneri Feld. var. *Hoffmanni* Chr.

(from Latin) "Among other varieties this one approaches most the variety *regeli* Alph., but differs in the male in the color being more obscure olivaceous-fuscus with the ochreous bands much darkened with fuscous. With the bands of the forewing not limited exteriorly, in the female wings being lighter, the bands less obfuscated than in the male, the underside ochreous, ashy, and the veins of the hindwings with a brownish tinge not white."

(from German) "About a dozen specimens of this interesting new variety from the Sarafschan Valley were received from Mr. A. Hoffmann of Eutin, in whose honor this form is named.

"It stands nearest to var. *regeli* Alpheraky but is much more olive brown, especially in the male, the immediate basal portion of the wings is lighter, more olive gray, particularly in the female. The dark mesial band which is in all other varieties of *huebneri* on the upperside at least at the outer portion either clearly delimited or slightly obfuscated, is here noticeable only through the effect of transparency from the underside. It is characteristic that the outer limit is clearly outlined and strongly darkened throughout as far as the inner margin in the olive-brown forms and only in *josephi* of the red-brown forms. The variety *hoffmanni,* however, although not at all clearly emphasized, the inner margin is [also] noticeable through a uniform dark basal area. The outer, originally ochreous band with the two ocelli of the forewing (the term band is not entirely appropriate but it is at least the best descriptive method) is limited on the innerside by the clearly blackish-brown median band proper, although less sharply than in variety *regeli.* On the outerside in the male, the zigzag outline produced between the veins blends gradually into the rich dark ground color. Also in the male this light band is largely suffused with a dark tone which is much lighter in the female and chiefly confined to the exterior part. Of the two ocelli, the upper one is clearly outlined in the male, the lower one as well as both in the female are not sharply outlined; mostly they have white centers.

"On the hindwing the zigzag outline of the transverse band is clearly marked but less sharply indented than in variety *regeli.*

"On the underside the forewings have the same coloring as *regeli,* but are suffused with a darker tint. The hindwings have a uniform brownish gray coloring without any white edges to the transverse band and whereas in all other *huebneri* varieties the veins are white, in variety *hoffmanni* they are brownish yellow."

The genitalia of the male have a medium length, hooked uncus with the sides drawn down rather deeply. The gnathos is cylindrical, moderately pointed and broadly joined to the tegumen. The valve is slightly swollen at the tip, well set with medium sized teeth at the tip and sparsely so back to the midpoint of the costa.

The figure of the female of *hoffmanni* (Plate 6. figs. 23, 24) reproduced from Schwanvitch's "Patterns of Palearctic Satyrids" is of particular importance since so few specimens of this rare butterfly are known. It is based on specimens in the Russian Academy of Science and is very close in its aspect to the unique female of *hoffmanni* in the British Museum (Plate 5, fig. 22). A comparison of the two specimens indicates their very close similarity, the Russian specimen being somewhat lighter. The representation of the underside given by Schwanvitch displays a complete correlation with the underside of the male of *hoffmanni* in the Carnegie Museum. Outside of these three collections — the Russian Academy of Sciences, the British Museum and the Carnegie Museum, there is only one other set, the few specimens in the original collection of Staudinger in the Berlin Museum and possibly scattered specimens sold by the firm of Staudinger and Bang-Haas in former years. No set of *hoffmanni* has ever been recorded outside of the original series collected over sixty years ago, with the exception of the male purchased by the senior author from Maurer in Margelan in 1908 on his way to the Pamir — the one in Carnegie Museum.

Karanasa hoffmanni is somewhat of a mystery; it has the appearance of being a color-replacement sport such as the *fumigatus* aberration of *Karanasa alitchura.* Such mutations, however, do not usually come in dozens and are always found flying with the normal form from which they arose. In Saravshan there is no russet form with ocelli of the type of *hoffmanni,* the nearest possible candidate being the true *josephi* from which *hoffmanni* differs strongly on the underside. On the other hand, if we consider it to be one of the black and white series whose markings have become diffused, it is widely separated geographically from its relatives.

39. **Karanasa latifasciata** Grum-Grshimailo

(Karanasa latifasciata latifasciata)

Plate 5, fig. 16 ♂ (Oldjabai); fig. 17 ♀ (Oldjabai).
Plate 8, figs. 4, 5, 6, 7 ♂ (Oldjabai).
Plate 11, fig. 31 ♀ (Oldjabai).
Plate 15, male genitalia.
Plate 16, male genitalia.

Karanasa latifasciata was described on page 193 of volume 7 of the Annuaire Museum St. Petersburg in 1902.

Satyrus regeli var. *latifasciata* nova.

From Latin:—"On the upperside the band is wide on all wings, slightly indented, pale yellow, pale ochreous at the outer margin; beneath the discal area of the forewing is pale yellow.

"One male in central Thian-Schan, in the valley of the river Sarydshass, August 18, 1901, Mr. Kucenko, collector."

From Russian: —"Much has been written previously concerning *Satyrus regeli* which was caught in the valley of the Jasa River. This form has a wide band which has a light oak color. Especially interesting is the variety *latifasciata* because this form appears between two groups, the blackish lead forms and the yellowish forms. The group appears in Central Asia."

Male genitalia. The uncus is moderately short and has the sides drawn down deeply, the gnathos is straight, cylindrical and bluntly pointed with a slightly developed shoulder. The valve is slightly expanded on the end and has irregular teeth; there is no terminal tubercle.

The true *latifasciata* of Sarydgas varies from specimens having a broad band of a russet tint approximating the *leechi-dissoluta* group to ones that are not unlike the true *regeli,* but often those *regeli*-like specimens do not show the division of the band on vein M_3 between the two ocelli. Some of the males have an even pale russet coloration and a breaking of the marginal band of the hindwing by yellowish veins. This is more evident in the females and tends to show a certain affinity with *wilkinsi.* Two *latifasciata* specimens from the Alexander Mountains without any further indication of the locality were obtained through dealers, and they correspond well to the *latifasciata* of Oldjbay on the Sarydgas. It is unfortunate that no more precise indication of the origin of these specimens can be recorded, since the distribution in the Alexander Mountains would be valuable.

40. **Karanasa obscurior** nov. *(Karanasa latifasciata obscurior)*

Plate 5, fig, 19 ♀ allotype (Kara Kara); fig. 20 ♂ transitional (Kara Kara); fig. 24 ♂ paratype (Kara Kara).
Plate 10, fig. 11 ♂ paratype (Kensu Ravine); fig. 12 ♂ holotype (Turgen Pass).
Plate 11, fig. 30 ♀ transitional (Kara Kara).

From Turgen Pass, Kensu Ravine and Kara Kara in the mountains directly east of Lake Issyk-Kul, northern offshoots of the Tian Shan

system, come peculiarly blurred and darkened forms of *latifasciata*. This northern race we will call *Karanasa obscurior*.

Male. Differs from the typical *latifasciata* from Sarydgas and Oldjbay in having a much broader marginal band on the hindwing diffusing into the transverse discal band and narrowing it considerably. The marginal band on the forewing, though not widened, also suffuses the discal band much as in *hoffmanni*. The outer edge of the median band is less concave than in the typical form and it and the basal areas are denser blackish-brown. On the underside the white edgings of the bands are reduced; giving the wings a darker aspect.

Female. Differs from the females of *latifasciata* by more contrasting light and dark coloration, a more pronounced darkness of the basal portion and a wider and less distinctly limited marginal band, especially on the forewing.

Expanse: ♂ 38 mm.; ♀ 42 mm.

Holotype, allotype and five paratypes in the collection of the Carnegie Museum.

This form is as variable as the typical *latifasciata,* two of the specimens from Kara Kara being scarcely distinguishable from extreme specimens of *latifasciata* from Oldjbay.

38. **Karanasa occidentalis** nov. *(Karanasa latifasciata occidentalis)*
Plate 10, fig. 9 ♂ type (Naryn).

From Naryn, at the opposite end of the distribution of *latifasciata* from the form described as *obscurior* comes another darkened form which we will call *occidentalis*.

Male. Differs from typical *latifasciata* by having wider, darker, more diffused blackish-brown markings and from *obscurior* in having the light markings ivory white as in *regeli* rather than ochreous russet.

Expanse: ♂ 37 mm. Type in the collection of the Carnegie Museum.

47. **Karanasa regeli** Alpheraky *(Karanasa regeli regeli)*

Plate 1, fig. 22 ♂ type (reproduced from Alpheraky's figure in Horae Ent. Rossicae).
Plate 7, fig. 3 ♂ underside (Tekkes).
Plate 10, fig. 13 ♂ (Yuldus).
Plate 11, fig. 19 ♀ (Yuldus).
Plate 15, male genitalia.
Plate 16, male genitalia.

Karanasa regeli was described by Alpheraky in the Horae Soc. Ent. Rossicae, volume 16, page 419, in 1881. A translation follows.

"*regeli* Ersch. in litt. nov. sp., Plate 15, fig. 23; ♂ ♀, 36-45 mm.
From Latin. "Frontwings slightly olive-fuscous (or of a brownish tinge) with whitish maculation of a smoky or whitish yellow tinge.

"On the frontwings the bands have two black ocelli with white pupils (very rarely blind); on the hindwings the bands are narrow, exteriorly dented; inwardly not dentate although distinctly outlined. The hindwings from below, white veination with a fuscous-gray discus (sprinkled with more obscure markings), this discal part being irregularly outlined with a white limiting band, and an interrupting antemarginal line composed of sharp fuscous indentations. The fringes are on both wings whitish with alternate gray."

From French. "Butterflies of the District of Kuldja, 1881; Dr. Albert Regel.

"Dr. Albert Regel with whom we had the pleasure of becoming acquainted in Kuldja was the first to take this charming species in the mountains surrounding the Valley of Kuldja; I do not know the exact locality. He has transmitted it to Mr. Erschoff who has sent me a drawing of it and he has authorized me to describe it under the name of *S. regeli* Ersch. *in litt.*

"I have encountered the pretty butterfly on the Yuldus in considerable numbers. I have taken it between 8,000 and 10,000 feet. A very large number of individuals of this species which I have taken between the 20th of July and the 7th of August showed malformations of the wings.

"The wings on the upperside have a band of a more or less light tint with a tinge toward the olivaceous, slightly verging toward the olive. Certain individuals are even quite light and have the discal cell of the frontwings whitish, or of the tint of the exterior band; the fringes checkered with gray-brown, as well as the large exterior band which is provided with two ocelli pupilled with white, on the obverse and the reverse; the frontwings are of a light smoky white or yellowish color. The exterior band of the hindwings, smaller in proportion but more clearly outlined than on the forewings, is dentate outside and straight interiorly. The exterior band on both wings shows brown veins. From below the frontwings repeat the pattern of the upperside but the veins between the band and the fringe are whitish.

"The hindwings are of a gray-brown color with the discal part marbled with darker brown and irregularly outlined with white exteriorly. The veins are white, or whitish, with a series of sharp indentations of a dark brown placed between each pair of veins between the discal part and the exterior border.

"The species seems to vary considerably and I have not observed two identical individuals. My description consequently cannot be more detailed in view of the fact that the width of the bands, the general tint, as well as the underside of the hindwings varies in different individuals, but I hope

that with the fine drawing by Mr. Land and my description it will be sufficient to give a good idea of this species. I possess one male in which the black spots of the frontwings do not bear white pupils.

"*Satyrus josephi* Staudinger *in litt.*, which was received through Staudinger from Fergana is very close to *Satyrus regeli* and is in my opinion — notwithstanding an entirely different appearance of the pattern — nothing but a well pronounced variety of this one. The underside of the wings does not permit a specific separation."

Male genitalia. The uncus is of medium length with well developed terminal hook and moderately drawn down sides. The gnathos is small, cylindrical, bluntly pointed and with expanded elbow-like attachment approaching that of *K. iskander.* The valve is slightly swollen at the tip and the teeth are small; the terminal tubercle is quite small and gives a square-ended appearance to the valve.

Karanasa regeli was the first of the black and white group to be described. Many others have been described as varieties of it that are better considered as separate species or forms of other species. The nomentypical form is found in the parallel ridges of the Tian Shan System between the main divide and the Boro Choro Mountains to the north. This is the Yuldus District east of Kuldja and lies in Chinese Turkestan. A series of specimens in the Carnegie Museum from Karagaitash on the Tekkes River in the upper valley south of Kuldja have on the average wider bands than specimens from Yuldus, tending in the direction of *korlana,* but they come within the extremes of the Yuldus forms and can be considered typical *regeli.*

The typical form differs from its other races by a rather light fuscous coloration, medium development of well pupilled ocelli, and a light band of ivory color with a very faint fuscous tinge exteriorly. The basal portions of the forewing of both sexes scarcely show any perceptible lightening.

46. **Karanasa ruckbeili** nov. *(Karanasa regeli ruckbeili)*

Plate 5, fig. 15 ♂ ab. (Burkhan); fig. 23 ♀ (Burkhan).
Plate 8, fig. 3 ♂ (Burkhan).
Plate 10, fig. 21 ♂ holotype (Burkhan); fig. 23 ♂ ab. (Burkhan).
Plate 11, fig. 20 ♀ allotype (Burkhan).

In the western end of the Boro Choro Mountains, north of the Russian city of Djarkent, *Karanasa regeli* develops a brighter, more

contrasting form. Most of our series were collected near Burkhan by Ruckbeil in whose honor we name the form *Karanasa ruckbeili.* It differs from the typical *regeli* in the following particulars::

The coloration is extremely contrasting. The fuscous brown is of a very deep tinge and the base of the forewing shows a tendency toward a lighter coloration; the median band on the anterior half of the wing retains an intense dark color between the outer border (m_1) and the discocellular vein and sometimes even to the inner border (m_2) which is almost half way down the cell, making a distinct dark blotch in that area. The median band has a tendency towards breaking up near the anal margin. The most typical character lies in the ocelli, enlarged to a proportion never found in the true *regeli.* These ocelli are not only enlarged in area, spreading into the adjacent interspaces, but are at times duplicated, in one instance there being a succession of four pupilled ocelli in the band of the forewing. The exterior portion of the whitish discal band is tinted with ochreous much more widely than the same area is tinted with fuscous in typical *regeli,* particularly on the hindwings. Two characters that appear frequently in *regeli,* namely the small pupilled ocellus in the second interspace at the edge of the marginal band on the hindwing and the light streaks along the veins through the marginal band, are more commonly encountered in *ruckbeili.*

The underside has the same pattern and the same even brown and white coloring as the typical form.

Expanse: ♂ 42 mm.; ♀ 48 mm.

48. **Karanasa korlana** Staudinger *(Karanasa regeli korlana)*
Plate 10, fig. 29 ♂ (Korla Mts., Chinese Turkestan).

Karanasa korlana was described by Staudinger on page 56 of "Catalog der Lepidopteren" in 1901 as a variety of *Karanasa abramovi* Erschoff. A translation of the single line Latin diagnosis follows:

"a.) v. Korlana Stgr. Band of the wing ochraceous-whitish, outwardly brownish tinted. Tian Shan Mountains (Korla Peak)."

Karanasa korlana is from the mountains near Korla in Chinese Turkestan at the eastern end of the Tian Shan System, south of the main ridge. It is a large insect and has the widest discal band of the *regeli* group. The wings are pointed, the ocelli moderately developed

with the second one tending to be larger than the apical one. The basal areas are lighter than in typical *regeli* and have diffused whitish patches at the anterior corners of the cell and along the veins that blend with the dark in such a way as to give the impression that one is seeing the highlights and shadows of a crumpled surface. This optical illusion, scarcely discernible in other varieties, is quite marked. Since *korlana* has a large dark base, smaller ocelli, roundly scalloped rather than sharply zigzag exterior edges of the discal band and an ochreous suffusion of the outer portions of the band, it belongs with *regeli* rather than *abramovi*.

Expanse: ♂ 45 mm.; ♀ 43 mm.

49. **Karanasa aksuensis** nov. *(Karanasa regeli aksuensis)*

Plate 7, fig. 2 ♂ type underside (Ak-su).
Plate 10, fig. 27 ♂ type (Ak-su).
Plate 15, male genitalia.
Plate 16, male genitalia.

A series of specimens labeled as coming from Ak-su, in Chinese Turkestan about three hundred miles west of Korla, by the firm of Staudinger and Bang-Haas differ sufficiently from the other *regeli* forms to warrant designation as a local race. Since Ak-su is a desert city, the true locality must be in the mountains at the headwaters of the Ak-su River which crosses the border into Russian Turkestan, the headwaters having cut through the main ridge at this point. We will call the form *Karanasa aksuensis*.

Male. Larger than either *regeli* or *korlana*. The basal areas of the wings are darker than in *korlana* and do not present quite so well the illusion of being crumpled. The discal band is about the same width as in *korlana* but appears wider because the veins through it are lighter, the ocelli are smaller and the suffusion of the exterior portions with ochreous is less. The smaller ocelli have blurred outlines and tend toward blindness.

The underside has the same pattern as the other *regeli* forms but is more contrasty by virtue of wider white lines and darker edges to the brown.

The genitalia of the male differ from those of *regeli* in that the terminal tubercle of the valve is a little larger and the teeth along the

inside of the costa are longer while those along the outside are reduced to flattened bosses.

Expanse: ♂ 49 mm. Type and four paratypes.

41. **Karanasa tancrei** Grum-Grshimailo *(Karanasa regeli tancrei)*

Plate 5, fig. 13 ♂ type (Alexander Mountains); fig. 14 ♂ cotype (Alexander Mountains) both in the British Museum; fig. 18 ♀ (Alexander Mountains).
Plate 10, fig. 14 ♂ (Alexander Mountains).
Plate 11, fig. 36 ♀ (Alexander Mountains).

Karanasa tancrei was described by Grum-Grshimailo on page 128 of volume 27 of Horae Societis Lepidoperologicae Rossicae in 1893. A translation from the Latin follows:

"Wings above olivaceous dusky brown, frequently tending toward clay color at the base, dusted with greenish; transverse band whitish clay colored, marked with two black, white-pupilled ocelli. Beneath, the wings are as in *S. bolorica,* but paler, more indefinite.

"♂ 18-20 mm.; ♀ 19 mm.

"This species, which in the system of the genus should be placed between *regeli* and *bolorica,* was collected in the Alexander Mountains (Oriental Tian-Shan Mountains) by Ruckbeil in 1891 for the German lepidopterist Rudolph Tancré, in whose honor I name it."

There is considerable uncertainty as to the reliability of the locality data on the specimens of *tancrei* in the Grum-Grshimailo collection in the British Museum. It is the cotype (Plate 5, fig. 14), much lighter than the type, that may have been found in a locality other than that of the type specimen with the pronounced dark bases of both pairs of wings. This light specimen may not have come from the Alexander Mountains at all,[1] but from certain regions near Kashgar — two hundred and fifty miles to the south and on the other side of the Tian Shan divide. It was from Kashgar that Tancré obtained the bulk of

[1] In the notes left by Dr. Avinoff there is the following quotation wrongly credited to Grum-Grshimailo in his original description. The style is that of Grum, but I have not been able to locate the source.
From French:— ". . . it may be surmised with certainty that they belong to the original collection and that Tancrey undoubtedly had specimens from different localities and that the authenticity of the places where the specimens were collected may be in some instances considered not conclusive."
Regardless of the authenticity of the quotation, the statement appears to fit the facts. W.R.S.

the series under the name *tancrei* in the British Museum. We have three such Tancré specimens with their characteristic black-bordered labels, in the Carnegie Museum. On the label is written "Tancrei Grum Nia Kashgar." We have not been able to locate "Nia" on any maps, but it must not be far from Tchatyr-kul, since in that district are found some of the whitest specimens of the *tancrei-conradti* group.

Until more reliably documented specimens are obtained from the Alexander Mountains, we will restrict the name *tancrei* to the specimens from the Alexander Mountains having a dark base and assume that the lighter ones came from other localities. It is quite possible that none of them came from the Alexander Mountains.

43. **Karanasa conradti** Alpheraky *(Karanasa regeli conradti)*

Plate 10, fig. 15 ♂ (Nia, Kashgar); fig. 26 ♀ (loc.?) the false *erschovi.*

Plate 11, fig. 18 ♂ (loc. ? Kashgar Region); fig. 35 ♀ (Nia, Kashgar).

Karanasa conradti was described by Serge Alpheraky on page 346 of volume six of Iris in 1894. A translation from the Latin follows: :

"*Satyrus huebneri* Feld. variety *conradti* Alph., a form between variety *regeli* Alph. and variety *abramovi* Ersch.

"Differs from the first (by having) the ocelli of the anterior (wing) more thickened, the hind one placed nearer the margin; from the second (by having) the ocelli nearly blind; from both (by having) the underside of the wings much paler and less marked, considerably variable.

"♂ ♀ Kashgaria."

The genitalia of the male *conradti* have the uncus short, hooked, the sides deeply drawn down. The gnathos is short, cylindrical, with slightly pointed tips turned out at the end. The valve is turned up a little at the end, terminal tubercle not developed but valve square on the end; the teeth are small close-set and heavily chitinized.

The correct identification of *conradti* and its varieties is rendered difficult through the fact of the inaccessibility of the type which is preserved in the Museum of the Academy of Science in Leningrad, Russia, and the uncertainty concerning the specimens of *tancrei* from the Grum-Grshimailo collection in the British Museum referred to above. One must particularly consider the light cotype of *tancrei* in

connection with specimens labeled as coming from Kashgar. The senior author, in conversation with the describer of *conradti,* had Alpheraky's assurance that it is those light specimens with the outward shifting of large ocelli recorded by Tancré from Kashgar that should be considered his true *conradti* as distinct from the darker *tancrei* of the Alexander Mountains.

42. **Karanasa eburnea** nov. *(Karanasa regeli eburnea)*

Plate 5, fig. 10 ♀ type (Utchianunak, Kashgar).
Plate 11, fig. 9 ♀ type (Utchianunak, Kashgar).

A female of the *conradti* group, of exceptional size and lightness, taken at Utchianunak in the Kashgar Region, is preserved in the British Museum. For convenience in this discussion we will give it a name *Karanasa eburnea.*

Female. Nearest in appearance to *conradti* but much larger. The median band and basal portions of the wings are a pale brownish clay color and are not sharply marked off from the white transverse band which is also clayish tinged in its outer portions. On the forewing the inner edge of the marginal band is only slightly scalloped, there being no points along the veins. On the hindwing the veins through the marginal band are light as in *wilkinsi* and there is virtually no scalloping. The two ocelli on the forewing are large and dark and placed outwardly as in *conradti.* There is a black spot in the second interspace on the hindwing.

Expanse: ♀ 48 mm. Type in the British Museum.

This specimen appears to be an extreme in size and paleness of the complex of *conradti* forms found in the Tian Shan Mountains immediately north of Kashgar. Specimens from the entire region are likely to be given the label of that lowland city. There is a great range in altitude, and since size in this genus is to a certain extent a function of altitude, *eburnea* may represent the extreme low altitude form.

44-45. **Karanasa regeli** forms **arpensis** and **turugensis** nov.

In the vicinity of Lake Tchatyr-kul in the portion of the Tian Shan Mountains known as Kashgaria there are two intergrading high altitude forms which are intermediate between the forms *conradti* and *pungeleri.*

Those found north of the divide around Tash Rabat at an elevation of 11,000 feet on the headwaters of the Arpa River are very light. They have an oyster-white discal band and ground color; the markings — with the exception of the ocelli — varying from patterns greatly reduced both in extent and intensity of brown to patterns moderately complete and distinct, but dull. This form we will call *Karanasa arpensis.*

Plate 5, figs. 3 ♂, 6 ♀, 7 ♂, 8 ♀, 9 ♀ (Tash Rabat, 11,000 ft.).
Plate 7, fig. 19 ♂ underside (Tash Rabat); fig. 20 ♂ holotype underside (Tash Rabat).
Plate 10, fig. 18 ♂ holotype (Tash Rabat); fig. 19 ♀ allotype (Tash Rabat).

On the south slope of the divide, still at the high altitude of 11,000 feet at Turug-art, there is a similar form also with an oyster-white discal band, but with the median band and basal area markings varying from moderately complete and dull to complete and sharply delineated, from grizzled brown to dark brown. This form we will call *Karanasa turugensis.*

Plate 5, fig. 4 ♂, 5 ♂, 11 ♂ aberration (all Turug-art, 11,000 feet).
Plate 10, fig. 16 ♂ holotype (Turug-art); fig. 17 ♀ allotype (Turug-art).
Plate 15, male genitalia.
Plate 16, male genitalia.

These two high altitude forms of the *conradti-pungeleri* complex show a bimodal distribution of characters. The north slope forms (*arpensis*) include all the light ones while the south slope forms (*turugensis*) include all of the dark ones. Nevertheless, there is a distinct overlap. A longer series than our nineteen would tend to make this overlap more evident but should not disturb the bimodality of the distribution.

The genitalia of both *arpensis* and *turugensis* are practically identical with those of *conradti.*

The specific relationships of these forms will be discussed later.

50. **Karanasa pungeleri** O. Bang-Haas *(Karanasa regeli pungeleri)*

Plate 5, fig. 12 ♂ type (Yuldus) (reproduction of plate III, fig. 2 vol. XXIV Iris).
Plate 10, fig. 20 ♂ (Yuldus).
Plate 11, fig. 37 ♀ (Yuldus).
Plate 15, male genitalia.
Plate 16, male genitalia.

Karanasa pungeleri was described by Otto Bang-Haas on page 29 of volume 24 of Iris in 1910. A translation follows:

"*Satyrus pungeleri* n. sp. Plate III, fig. 2.

"Of this new species from the region of Yuldus I received a number of specimens of both sexes. This species belongs to the *regeli* group. It is distinctly smaller than *regeli* and is colored in a more quiet and uniform way. The ground color of both wings on the upper side is of a uniform grayish black (somewhat darker than *Sat. mamurra v. graeca* Stgr.). The antemarginal band is white, rarely flushed in a faint way with yellowish; the veins, particularly on the forewings, are marked on it in grayish black; on the forewings there are two black ocelli pupilled with white of which the lower one in the second cell is slightly, although not very much, larger than the other. The ocelli are, nevertheless, so small that the space between the two veins is not filled, differing in this regard from *regeli* Alph. and *abramovi* Ersch., which have much larger and extended ocelli, also have these two species almost invariably small ocelli in the interneural space 2 on the hindwings a small ocellus which appears only extremely rarely in *niobe*.[1] The narrow gray marginal band runs in an even way with a slightly undulating outline without forming sharp indentations in the white bands; these bands are evenly wide and curved near the edge; thus while the smaller ocelli on the forewing take so little space, the white band looks quite different and appears much clearer than in related species; the underside of the forewings differs from *regeli,* etc., to a lesser degree, while the hindwings are entirely different; the antemarginal band, which is white on the upperside is on the underside tinted with yellow and suffused with a blackish shadowing; the discal band appears much sharper; the presence of the white zig-zag pattern, and the complete disappearance of the white veins are particularly characteristic of *niobe*.

"The body and the antennae correspond to the darker coloration of the wings. The gray fringes, especially on the forewings, are clearly checkered with black.

[1] Note: An apparent mistake based on a catalogue name used for this form in the price list of Staudinger and Bang-Haas prior to the description. This mistake appears twice in this description. A. A.

"This size is from 37-39 mm.

"I name this new species in honor of the outstanding authority on Palearctic Macrolepidoptera, Judge Püngeler."

The genitalia of the male are almost identical with those of *regeli.*

Karanasa pungeleri is apparently a high altitude form of the *regeli* group. Although our cotypes are labeled as taken at 2,500 meters — less than 10,000 feet —, and Alpheraky is on record as having taken *regeli* at elevations of from 8,000 to 10,000 feet in the same general region — Yuldus, about the size of Pennsylvania — it is highly unlikely that the two forms fly together or even at the same altitude in different parts of Yuldus. The difference in the undersides is quite marked, but it comes as a result of the reduction of the marginal band and general obfuscation of *pungeleri,* which are characteristic of other high altitude forms such as *leechi.*

The nearest forms to *pungeleri* known to us are the *turugensis* specimens from 450 miles to the west-southwest.

51. **Karanasa abramovi** Erschoff *(Karanasa abramovi abramovi)*

Plate 1, fig. 20 ♂; fig. ♀ (reproduced from Rom. Mem. Lep., vol. 4, pl. XVII, figs. 2a, 2c).

Plate 10, fig. 28 ♂ (Tash Rabat near Lake Tchatyr-Kul).

Karanasa abramovi was described by Erschoff on page 245 of volume 18 of Horae Societis Lepidopterologae Rossicae in 1884.

From Latin: — "Wings fuscous above, grizzled from the base almost to the middle with olive; with a common white band. The forewing marked with two large ocelli, the hindwing with one small anal ocellus: marked on the underside as in *S. regeli* but the median band of the hindwings distinctly set off by pale shades on both sides. ♂ ♀."

From Russian: — "Expanse of the anterior wings 40-42 mm.

"Habitat in Semiretchie.

"This species resembles *S. regeli,* but differs from it by the width and color of the band on the upperside, which is twice wider than in *regeli,* and white in color, while in *regeli* the band is yellowish or dirty white; the eyespots in this band of *S. abramovi* on the forewings are almost twice as large as in *S. regeli,* and the lowest eyespot is not in the middle of the band, as in the latter, but nearer to the edge; besides that on the underside of the forewing of *S. regeli* the space between the base and the band is gray-yellow, while in *S. abramovi* only the base is gray-yellow, and the middle of the wing is dark and forms as it were a blackish band; on the hindwings the

pattern is identical with *S. regeli* except that the central band stands out boldly from the basic color of the field of the wing. In other respects this species is very similar to *S. regeli,* and it may be only a form of the latter, but in any case it deserves a special name.

"Both species *S. abramovi* and *S. regeli* without intermediates from one to the other, were taken by Mr. A. Wilkins at Semiretchie, near Lake Tchatyr-Kul, in the middle of June, and in the valleys of Utch-Tash, in northern Kashgar, at the end of August."

The *Satyrus regeli* form that Erschoff reports as flying with his *abramovi* is now known as *Karanasa conradti* Alpherakyi. There has been considerable confusion with respect to the taxonomy of *abramovi* as will be shown in the discussion of the next form, where a comparative description is given.

53. **Karanasa regula** Staudinger *(Karanasa abramovi regula)*

Plate 5, fig. 27 ♂ (Akbossoga); fig. 29 ♂ (Kisil-Art); fig. 30 ♂ (Bordoba); fig. 32 ♀ ab. (Akbossoga); fig. 34 ♀ underside (Akbossoga).
Plate 8, fig. 1 ♂ (Bordoba).
Plate 11, fig. 29 ♀ (Akbossoga).
Plate 15, male genitalia.
Plate 16, male genitalia.

Karanasa regula was described by Staudinger on page 556 of volume 48 of Stettiner Entomologische Zeitung in 1887. A translation follows:

"*Satyrus regeli,* var. *regulus* Staudinger.

"Of these beautiful species I obtained this autumn fourteen specimens of which six are entirely fine specimens of males and two good females which Mr. Maurer has found in Trans-Alai. *Satyrus regulus* is close to *S. regeli* Alpheraky and I might hold it for a large conspicuous race. My smallest male is 39 mm., my largest female 45 mm., so these specimens are considerably larger than *regeli* to which it corresponds rather closely in coloration and pattern. The black wings have a greenish gray admixture (like scales in the basal portion) and on the outer side have a yellowish-white strongly indented wide band which has on the forewings two very large black, white-pupilled ocelli. The indentation of the band of this form varies considerably in the specimens which are before me so is it also the case with the hindwings where in two specimens outwardly the outline does not run in points but scalloped in a wave-like fashion. In one specimen of a male the points are much shorter and in another almost even size but usually two or three are drawn out much longer. One slightly shifted black, white-pupillated ocellus

which is in the area of the second white indentation. Also this white band varies in width and the contour is differently outlined. Quite analogously these observations can be seen in the smaller *regeli,* though the dark fringes are more or less strongly checkered with white. Usually on the forewings they are very light whereas the fringes on the hindwing show a lighter mixture and not so much a distinct checkering. The underside of the wings of *regulus* is naturally very close to that of *regeli.* On the forewings *regulus* has in the middle a rather broad transverse band which is in the upper part at the discocellular suffused with yellowish white. In *regeli* this band is usually indicated inwardly by a dark more or less pronounced band, but in the specimen which Ruckbeil brought last year from the district near Kuldja it is almost as dark as *regulus.* This *regeli* also varies on the upperside by a considerable brown suffusion of the white bands as compared with the original form of Alpheraky and constitutes already a slight local race of the latter. The dark and whitish gray marbled underside of the hindwings shows the white veins in *regulus* almost as much as in *regeli* and varies in both forms considerably, especially is it so in the case of the exterior strongly indented and scalloped black line where those points and curves vary in length and form. Also is expected a variation of the black outline of the slightly accentuated dark discal band. In a sense, however, this pattern is the same in *regulus* as in *regeli* and I consider that the first cannot be looked upon otherwise than a fine large local race of the latter. In conjunction with that I think that at the present after I have received from Maurer a large quantity of *josephi* together with its variety *dissoluta* and *regulus* that *regeli* and *josephi* are two distinct species."

Grum--Grshimailo disagreed somewhat caustically with Staudinger's comments at the end of his description and agreed with his subsequent placing of *regulus* in synonymy to *abramovi* and gave the following distribution for what he considered to be *abramovi*:

"*S. abramovi* flies 1, in the central part of the vale of Alai and reaches there almost the limits of the Bach-Alai. It means the zones or steppes covered with Festuca; 2, in the mountains which surround this vale from the south at the mouth of Touz-dara; 3, on the southern slopes of the Alai Range; 4, in the valley of Kitschi-Alai; 5, on the pass of Yagatach-art, upon the steppes covering the western slope; 6, according to the communication of Wilkins somewhere in the vicinity of Tchatyr-kul. My observations show that this species does not extend beyond the altitude of 10,000 feet, and is found in July and the beginning of August."

The first four of these regions harbor what Staudinger described as *regulus,* the fifth, a lighter form and the sixth, the true *abramovi.* The form *regulus* has been considered a synonym of *abramovi* since shortly

after its description, but in actuality the best known form found in all of the collections which have representatives of this group is the butterfly of the Alai region which Staudinger made originally known as *regulus*. On the color plates are represented both *regulus* (*abramovi auctorum*) and a specimen of the true *abramovi* Erschoff, a topotype from Tchatyr-Kul, which may serve in default of being able to obtain a photograph of the type of Erschoff preserved in Russia. The original description naturally would fit both forms so it is imperative to redescribe more precisely the original *abramovi*:

Male. Wing elongated. The band is clearly divided by vein M_3, is of an ivory tint, ocelli pupilled and moderately large. The dark basal half of the wings grows gradually paler toward the root of the wings without indicating a clear-cut light patch. On the underside the hindwings have a moderately marbled pattern with white veins. As compared with *regulus* typical *abramovi* is slightly smaller, has more yellowish tint in the band, has a more uniform grayish basal portion of the forewings, the ocelli are smaller, the underside of the hindwings is not so contrasting in its marbled effect of white, gray and black. Conversely *regulus* would be characterized by its more robust aspect, definitely larger ocelli, with a frequent ocellation in the marginal cell Cu_1-Cu_2 of the hindwings. The bands are clear white, the discal cell shows a clear whitish patch with sharp outlines exteriorly, the underside is unusually contrasting, the general shape of the wings is somewhat rounder.

The male genitalia of *Karanasa regula* (formerly *Satyrus regulus)* has the uncus medium in length and depth of the sides, slightly hooked. The gnathos is cylindrical, round on tip and lacks the elbowed effect at the base such as is indicated in *regeli*. The valve has no swollen tip and the terminal tubercle is better developed than in *regeli*.

Fruhstorfer described a form in Seitz' Macrolepidoptera of the World, volume 9, page 308 in 1911 which must fall as a synonym to *regula* Staudinger. This name, *minutianus* is one of the few in Karanasa that cannot be applied to a geographical race not previously described.

"*Eumenia regeli minutianus* subsp. nov. Related to *korlana* Staud. but easily distinguishable from it by the broader black mesial band of the wings and in particular by the almost twice larger ocelli of the forewings. Also the anal ocellus of the hindwing upperside is more conspicuous than in examples from Naryn and Tian Shan. Abundant in Alai."

The description raises many questions. In the first place, what *korlana* could be found in Naryn and Tian Shan at the same time? The form *korlana* is the extreme eastern representative of the *regeli* group. In Naryn is found only *latifasciata* and a race of *abramovi*. His description bespeaks a representative of the *abramovi* group; the following two points — the extreme increase of the ocelli, and the widening of the mesial band presupposing mutely a light base not mentioned in the description — fit nicely into the characteristics of *abramovi*. Since the locality is given as Alai where no forms of *regeli* have ever been recorded, and where according to Fruhstorfer his butterfly is found in abundance, it must well be the Alai race of *abramovi* which was described by Staudinger under the name of *regulus*. The comparison with *korlana* remains a mystery, however, since the latter has a faint ochreous brown suffusion in the exterior part of the light discal band which is not mentioned in the description. Such a suffusion is absent in the *abramovi* forms which must have been known to Fruhstorfer. The point of view stated here can only be conclusively verified by examination of the type which is preserved in his collection in the Chateau de Mileant at Nice. All efforts to obtain a photograph of the type have failed.

53a. **Karanasa** aberration **ershovi** Avinoff

Plate 5, fig. 33 ♀ (Akbossoga).
Plate 10, fig. 25 ♀ Type ? (Akbossoga); fig. 26 ♀ figured as type in the original description; Maurer collection; locality unknown.

In 1910 the senior author described a yellow aberration of the female of *abramovi* on page 250 of volume 39 of the Horae Societis Entomologicae Rossicae.

From Latin:— "Ab ♀ ochraceous Alai Mountains."

From Russian:— "*Satyrus abramovi* Ersh. ab. *ershovi* nova. Pl. XIV, fig. 16. "It is distinguished by the intensely ochreous tint of the light portion of the pattern of the wings on the upperside (except the white pupils of the ocelli) and on the underside of the forewing. It is interesting to note that similar yellow variants occur, likewise only in the females, on other Satyrids with white bands."

Unfortunately the specimen originally figured and shown here on plate 10, figure 26, is a female of *conradti*. It was caught by Maurer

and sold without locality data. The specimen that should have been figured is a true *abramovi* from Akbossoga which we show on plate 10, figure 25. Whether one should accept the description as the author wrote it or the figure as it was printed is rendered academic by the fact that the yellow forms of the females have no particular significance in this paper. Since the name would, at best, be used as a quadrinomial we will let the validity of it pass.

52. **Karanasa naryna** nov. *(Karanasa abramovi naryna)*

Plate 5, fig. 25 ♂ paratype (Naryn); fig. 26 ♂ (Issyk-Kul); fig. 33 ♀ (Alexander Mts. Tancré).
Plate 8, fig. 2 ♂ holotype (Naryn).
Plate 11, fig. 28 ♀ allotype (Naryn).

From the Naryn Basin and the valley of Issyk-Kul there comes a race of *abramovi* that is as large as *regula* but has the brown markings paler, the ocelli a little smaller, the discal bands on the average a little wider and the underside of the hindwing a little less contrasting. On the other hand, it is larger, deeper brown and has larger ocelli than typical *abramovi*. In its general appearance it is larger and brighter than *abramovi* and paler than *regula*. We will call this form *Karanasa naryna*.

While geographically *naryna* comes closer to the Tchatyr-Kul *abramvoi* than to the Alai *regula*, the systematic affinity is closest between it and the latter.

55. **Karanasa kasakstana** O. Bang-Haas *(Karanasa abramovi kasakstana)*

Plate 5, fig. 28 ♂ cotype (Talas-tau).
Plate 10, fig. 24 ♂ cotype (Talas-tau).

The *abramovi* representatives from northwest of the Naryn-Issyk-Kul regions in the general vicinity of the Alexander Mountains tend to approach the dark forms from the Alai. The darkest of all has been described by O. Bang-Haas on page 108 of volume 50 of Entomologische Zeitschrift, Frankfort-on-Main, in 1936.

Translation: "*Satyrus regeli kasakstana* O. B-H. subsp. nov.

"Habitat Kasakstan, Aulie Ata, Talas Alatau, 2500 m. July, three males: size 41-42 mm. The background is of a uniform black-brown color, darker

than in *abramovi,* without any indication of a lighter base. The bands are of a brilliant white, narrower than in all the *regeli* races. On the upper wing there are from six to seven maculae in these bands and five to seven elongated maculae on the hindwings. The underside of the hindwings is similar to that of *abramovi.*"

Bang-Haas considers *abramovi* to be a subspecies of *regeli* in the above description, we treat them as separate species. From our point of view, our cotype of *kasakstana* is clearly a form of *abramovi,* there being no trace of the ochreous-pale fuscous-clay colored suffusion to the outer portion of the discal band so characteristic of the *regeli* forms.

54. **Karanasa lactaea** nov. *(Karanasa abramovi lactaea)*

Plate 5, fig. 31 ♀ type (Yagatch-art).
Plate 10, fig. 22 ♀ type (Yagatch-art).

A striking form of *abramovi* was taken by Grum-Grshimailo at Yagatch-Art on August 10, 1884. This female, now in the collection of the Carnegie Museum, represents the extreme in the lightening of the median and basal areas and may be a race or an aberration. We will call it *Karanasa lactaea.*

Female: Like the females of *abramovi-regula* except that the basal area of the forewing is entirely oyster white dusted lightly with brown scales; the median band is represented only by a deep brown bar bounded by the discocellular vein, vein M_3, the m_1 line and the radius vein, a faint trace of the m_2 line in the cell and a small blurred spot in the cell Cu_2-A_2. On the hindwing the basal area is evenly dusted white and brown while the median band is brown only in the two most anterior interspaces. The underside of the forewing repeats the pattern of the upperside; that of the hindwing shows more white than specimens of *regula.*

56. **Karanasa pamira** Staudinger *(Karanasa pamira pamira)*

Plate 1, fig. 19 ♂ (reproduced from Rom. Mem. Lep. Pl. XV, fig. 7 as *intermedius* ♀).
Plate 6, fig. 1 ♂ (Daraut Kurgan); fig. 2 ♂ underside of fig. 1; fig. 3 ♂ (Aram Kungei); fig. 4 ♀ (Aram Kungei).
Plate 10, fig. 37 ♂ (Aram Kungei).
Plate 11, fig. 14 ♀ (Aram Kungei).
Plate 13, male genitalia.
Plate 16, male genitalia.

Karanasa pamira was described as *Satyrus pamirus* by Staudinger beginning on page 61 of volume 48 of Stettiner Entomologische Zeitung in 1887 in a rambling discussion translated below.

Satyrus pamirus Staudinger. Also this beautiful species I obtained in quantity together with the foregoing one (*regeli-regulus*) and with *josephi* from the Trans-Alai. It looks at first glance very much like *josephi* and is particularly like its var. *dissoluta* which I obtained, by the way, in all transitions to *josephi,* to such a degree that it could be taken for a large form of it. My smallest male is measuring 44 mm., the largest female 50 mm. The ground color of the upper side of the wings is brown as in *josephi* but somewhat lighter (with a more yellow admixture than in that species).

"The marginal bands form a broad black edge on the front wings; inwardly they are almost straight or very slightly jagged in a saw-like fashion while in *josephi* these indentations are sharper. Both black ocelli with the white pupils are in general larger than in *josephi.* Sometimes under the lower ocellus there is a third small ocellus, in one case two black spots. Adjacent to the front edge is an elongated triangular black patch. Between this macula and the upper ocellus is a lighter subdued whitish yellow patch as in *josephi.* Beyond this spot toward the inner margin are usually two indistinct blackish spots one over another which are at times entirely lacking. In one specimen among my many males the whole basal half of the wing as far as these enlarged spots is suffused with brown-black scales. On the hind wings the outline of the black margin has usually a pair of large points while it is outlined inwardly in a softer wavy contour. Beyond the discal cell is seen, as in *dissoluta,* an uneven black patch. Only in the specimen which was mentioned heretofore is the whole basal portion darkened. In other specimens it is only so in part, mostly it is entirely light and also this brown coloration is slightly flushed with gray (as a suffusion of hair). Not rarely there appear in this basal portion indistinct light yellowish patches which produce once in a while an indefinite transverse band. In the lower corner there usually is a black blind ocellus which rarely is conspicuous in size. The white fringes are on the front wings considerably well pronounced. The white fringes of the front wings are rather strongly interrupted with gray and very lightly so on the hindwings. The underside of the wings is naturally very like that of *josephi* (var. *dissoluta).* The front wings are predominantly pale yellow-brown with both ocelli and with a grayish black in the marginal band. The latter is broken up by white veins as it is never the case in *josephi. Also* inwardly it is not outlined with such strong indentations which are always present in *josephi.* At the narrow gray-brown edge at the discocellular only a few dark striations, never a dark spot. The basal portion is mixed with dark granules only in this dark specimen which was mentioned before. The under side of the hind wings which is marbled with black, gray and white, shows very conspicuous white veins; the coloration is

often prevailing dark with the whitish discal band. Sometimes it is entirely light with the indication of the three indented black lines constituting the pattern. The shape and the degree of indentation of these transverse lines is variable, but the third (the antemarginal one) never bears such sharp points in *pamirus* as in *josephi*. This together with the larger size is the chief trait of differentiation which I was able to observe between these two species that fly together and that are much alike. Also should be mentioned the much less indented outlines of the front wings. Because both these species were caught flying together they must be two different species and they cannot be a local race of one another. I consider it probable that they can produce a mixed offspring and I think that I have before me two hybrids of these species. Those two males occupying in their size 39-40 mm. and in the degree of indentation of the corresponding lines are midway between the two species. They also have on the upper side more black than the usual *pamirus*. Their basal portion of the hind wings is almost completely black and also in the middle part of the front wings there is a rather well defined black transverse band, which is the case in only one of my *josephi males*. It may be, however, that these two individuals are only unusually large aberrant *josephi* males. Also it may be that *Satyrus pamirus* in other localities will appear in a darker form what may be in the unique dark male in this locality only an actual aberration. Thus two forms correspond to analogous forms among the *josephi*."

Grum-Grshimailo's comments in the "Memoirs" are translated below:

"It (Pamira) is the largest and the most differentiated of all the other Satyrids of this group, which nevertheless did not prevent Staudinger to write: "So that one might take it for a large form of *Dissoluta-Josephi*." Besides its size the under side of the hind wings show quite essential differences. The background is very pale, but the white veins contrast very clearly. Taken altogether the totality of distinguishing characters is so great that I am at a loss to assign a proper rank in the classification of the species of this group. Meanwhile it has to take its place in an eccentric circle.

"The largest of my specimens is 58 mm., the smallest, a male 46 mm. This species flies at an altitude from 8500 to 9000 feet in a locality along the right bank of Touz-Darya, at the opening into the vale of Alai. It prefers the steppes covered by bushes of Artemisia, Echinospermum and other plants of this type. It flies together with *Satyrus Lehanus* and is sometimes quite frequent in July. It likes sunny places and prefers to remain motionless upon bushes of Echinospermum or to sit upon the bare places of the soil."

The separation of *pamira* from all the other forms of the *huebneri* cycle is more firmly established when one considers the structure of the male genitalia. The uncus is of medium length with the sides drawn

down only along the posterior half so that it appears to have a neck; the tip is pointed but not hooked. The gnathos is stout, circular in cross section and slightly tapering for the first three-quarters; the last quarter is flattened outwardly to a feather edge like the blade of a maple seed. The outer half of the valve is straight and gradually tapers with the costal surface at the tip sloping down to a vestigial terminal tubercle; the entire costal surface being coarsely toothed. There are no androconia.

Karanasa pamira is the northernmost of a series of related forms found along the western border of the Pamirs and the northwest Hindu Kush, a series that varies in an almost uniform cline from the lightly marked russet forms of the Alai Valley to the almost completely black-brown forms from the Koh-I-Baba in Afghanistan. We will restrict the true *pamira* to the forms from the Alai Valley and the Trans-Alai.

57. **Karanasa ornata** nov. *(Karanasa pamira ornata)*

Plate 6, fig. 5 ♂ (Gursy Tash); fig. 6 ♂ (Gursy Tash); fig. 7 ♂ underside, fig. 8 ♂ (Kulika).
Plate 10, fig. 38 ♂ holotype (Gursy Tash).
Plate 11, fig. 15 ♀ allotype (Gursy Tash).

There is a distinct change in *pamira* as one passes around the end of the Trans-Alai Mountains southwestward into Bukhara. The specimens taken at Gursy Tash and Kulika constitute a separate race which we will call *Karanasa ornata.*

Male. The same size and configuration as *pamira* but the basal portion of the forewing is considerably darkened and the median band is either complete or nearly so. The base and median band of the hindwing are dark brown with light veins and an overlay of pale hairs. The discal band of both wings is light along its inner edge, becoming gradually intensified outwardly, reaching a deeper shade of rusty orange than in *pamira.* The ocelli are as in *pamira,* averaging, perhaps, a trifle larger and with larger pupils. The undersides show no constant difference.

Female. The dark pattern on the forewing is accentuated but not as much so as in the male, the median band showing as a faint reddish outline behind the spot at the end of the cell. The base of the hindwing is only a little less dark than that of the male.

58. **Karanasa holbecki** nov. *(Karanasa pamira holbecki)*

Plate 6, fig. 17 ♂ paratype (Gushkon Pass, Darwas).
Plate 10, fig. 40 ♂ holotype (Gushkon Pass, Darwas).
Plate 11, fig. 17 ♀ allotype (Gushkon Pass, Darwas).
Plate 13, male genitalia.

A third in the series of *pamira* forms is found south of the Bukhara-Pamir borderland in Darwas. This form, which comes closer to the next one (*alpherakyi*) than to the last one (*ornata*), was taken by Holbeck on Gushkon Pass in August 1913. We will call it *Karanasa holbecki* in his honor.

Male. The size and shape of *pamira* with the following differences. The median band and basal areas of both wings are almost uniform dull brown of about half the intensity of the marginal bands and discocellular spot on the forewing. There is an outward bulge in the outer margin of the median band between the anal vein and vein Cu_2 and an outward point on the anal vein. The discal band is deep rusty orange along the edge of the outer margin fading rapidly to pale brownish yellow next to the median band. The ocelli are blind. The underside of the forewing has the median band and basal areas pale reddish brown lightly striated, and with the m_1, discocellular and m_2 lines distinct. The ocelli are pupilled. The hindwings are as in *pamira*.

The genitalia are of the *pamira* type, but the feathering of the tip of the gnathos extends for only one-sixth of the length and the teeth of the valve are fewer and coarser. The terminal tubercle is much more developed. There are no androconia.

Female. Differs from *pamira* and *ornata* in that the russet colors are dull, appearing as though faded. The base and median band are pale yellowish brown with the discocellular spot darker and the division between the median and discal bands vague. The dull black ocelli have minute white pupils. The underside is as in the male.

Expanse: ♂ 49 mm.; ♀ 48 mm.

The males of *holbecki* have the appearance of being yellowish *alpherakyi* while the females more nearly resemble those of *pamira*.

60. **Karanasa alpherakyi** Avinoff *(Karanasa pamira alpherakyi)*

Plate 6, fig. 9 ♂ (Pamir Post); fig. 10 ♀ (Pamir Post); fig. 11 ♂ underside (Nestijilga); fig. 12 ♂ aberr. (Pamir Post); fig. 13 ♂ aberr. underside (Pamir Post); fig. 14 ♀ underside (Pamir Post); fig. 15 ♀ (Pamir Post); fig. 16 ♀ upperside of fig. 10 (Pamir Post).
Plate 10, fig. 39 ♂ (Pamir Post).
Plate 11, fig. 16 ♀ (Pamir Post).
Plate 13, male genitalia.
Plate 16, male genitalia.

Karanasa alpherakyi was described by the senior author on page 240 of volume 39 of Horae Societis Entomologicae Rossicae in 1910. The type and allotype were figured in color on plate 14 of that volume.

From Latin: "*Satyrus alpherakyi* sp. nov. Belongs to the section of *Satyrus huebneri*. Has the stature of *Satyrus abramovi*. The wings both more or less concolorous, fuscous with a band of a dilute ochreous color or whitish. The ocelli are large and blind or partly blind, nearer to the interior margin of the band (not near the exterior margin as in *S. regeli tancrei* Gr.-Gr.). The female is distinguished by having the basal portion of the forewings tinted ferrugineous. The underside of the hindwings has the basal areas with a more uniform striation than in the other members of this group. The veins are white as in *S. josephi* Staudinger. Flies together with *S. dissoluta* Staudinger transitional to *leechi* Gr.-Gr. (Plate XIV, f. 99. 13-15.) From Russian: "This interesting butterfly which I dedicate with profound regards to our distinguished lepidopterist S. N. Alpheraky was caught in the mountains near Pamir Post where it was flying on the same slope with *leechi (transitus wilkinsi-dissoluta)*,[1] although in general it occupies a lesser altitude not above 13,000 or 14,000 feet. Whatever might be the treatment of this *Satyrus* in a more detailed survey of the group it has, I dare say, no less right for a specific independence than *intermedius, josephi,* and *pamirus*. From all the rest of the eastern Pamir forms it differs by its size as it is not smaller than *Satyrus abramovi*. The most distinct character is the dark base of the wings, the unusual whitish transverse bands and the marked development of the black ocelli, which in reverse to *abramovi* are almost entirely deprived of a white pupil. In some of my specimens the light band is slightly tinted with a russet yellow tinge exteriorly. A similar tint is noticeable in the middle of the primaries of one of the females. The females are a very peculiar type different from *leechi* and on account of the darkening basal half of the wings standing in contrast to the light band, are

[1] Described elsewhere in this paper as *centralis*.

somewhat reminiscent of a pale *josephi.* On the underside there is also a certain likeness with this form on account of the prominent white veins of the hindwings which are, however, more uniformly marbled especially in the base. The ocelli on the other hand are entirely different since in *josephi* the lower ocellus has a tendency to be reduced to a black dot which is not observable in any one of my specimens of *alpherakyi.* Besides the males of *alpherakyi* have no trace of the androconia present in *josephi.*[1] Furthermore *alpherakyi* differs from such representatives of the dark group as *regeli, tancrei* and *conradti,* and the yellow aberration of *abramovi* on account of the underside, far more uniform in tone and more evenly reticulated with black striation, also by a different position of the ocelli in the band nearer the base than in representatives of the dark group with the light band. By the form of wings *alpherakyi* approximates more the russet subgroup than *abramovi.* In systematic record *alpherakyi* should be placed in an intermediate position between *josephi* and *regeli* although it leans closer to the russet group and tends to a certain kinship with *Satyrus pamirus.*"

A study of the genitalia of the male of *alpherakyi* confirms the final statement above and renders the other relationships invalid. They are of the *pamira type.* The outer half, approximately, of the gnathos is feathered. The teeth of the valve are still fewer and stouter than in *ornata* and the tip of the valve is more rounded off to a moderately well developed terminal tubercle.

Pamir Post, the type locality of *alpherakyi,* is far to the east in the Pamirs and represents a side branch from the main curve of distribution of the *pamira* forms down the western edge of the Pamirs into the Hindu Kush. It is also off from the cline in the butterflies from the bright orange to black, and while darker than *holbecki,* it is much duller than both it and the next form to the south. The aberration figured on plate six has all the characteristics of a very high altitude butterfly and may represent an *alpherakyi* reared in an exposed location. At the other extreme, the specimens collected along the stream Nestijilga south of and lower than Pamir Post, are much brighter with a moderate orange suffusion over the outer half of the discal band and are thus transitional to the next form to the south.

[1] Now *Karanasa iskander.*

59. **Karanasa kafir** nov. *(Karanasa pamira kafir)*

Plate 6, figs. 18 and 19 ♂ reproduced from Schwanwich "Pattern of Palearctic Satyrids"; fig. 20 ♂ holotype (Nuksan Pass); fig. 21 ♂ paratype (Nuksan Pass); fig. 22 ♀ allotype (Nuksan Pass).
Plate 10, fig. 41 ♂ holotype (Nuksan Pass, Hindu Kush, Kafirstan).
Plate 11, fig. 27 ♀ allotype (Nuksan Pass, Hindu Kush, Kafirstan).
Plate 13, male genitalia.

A series of three males and a female taken at Nuksan Pass in the northeastern Hindu Kush Mountains constitute another step in the *pamira* cline and at the same time with *hodja* and *grumi* illustrate a peculiar phenomenon in the Karanasa, namely that in any particular region the color characteristics of all the different local races tend to converge. This population we will call *Karanasa kafir.*

Male. Size and form as in a large *pamira.* Marginal and median bands very dark brown, the basal areas only slightly less dark so as to make the inner edge of the median band barely detectable. Discal band wide, cream colored at its inner edge and suffused from the outer border with deep bright orange as deep as in *pamira* but restricted to the outer part of the band. The ocelli are bright black with single-scale pupils or none. The underside is as in the other *pamira* forms.

The genitalia are of the *pamira* type; the sides of the uncus near the tip are more deeply drawn down. The feathering of the tip of the gnathos is restricted to the last fifth. The teeth of the valve are larger and fewer than in any of the forms to the north; the terminal tubercle is vestigial.

Female. Markings as in the male except that the basal areas and the interior of the median band are a lighter grayish brown on which the inner border (m_2) of the median band stands out as in *alpherakyi.*

Expanse; ♂ ♀ 53 mm.

In his paper "Patterns of Palearctic Satyridae," B. N. Schwanwich figured the upper and undersides of a butterfly which he called *Satyrus josephi.* This illustration, reproduced herein on Plate 6, figures 18 and 19, is definitely not that of the true *josephi* or the branded *iskander,* but is a dark race of *pamira* as may be deduced from the peculiar hairy surface of the uniformly dark base. The figure fits well with the form *ornata* from Gushkon Pass and even better with the form *kafir* from Nuksan Pass, the gray suffusion of the discal band

in the black and white illustration matching the type and intensity of the orange suffusion of the latter form. Schwanwich does not mention locality or absolute size, and in the absence of these we tentatively assign the form illustrated to *kafir*.

61. **Karanasa haslundi** nov. *(Karanasa pamira haslundi)*

Plate 12, fig. 2, male genitalia — normal; fig. 3, male genitalia — attentuated form; fig. 5 ♂ holotype, upper and undersides (Marak, Koh-I-Baba, Afghanistan); fig. 6 ♀ allotype, upper and undersides (Marak, Koh-I-Baba, Afghanistan); fig. 12, variation in the males (Koh-I-Baba, Afghanistan); fig. 13, males having the type of genitalia shown in figure 3; fig. 14, variation in the females.

Mr. Neils Haarlov of the Third Danish Expedition to Central Asia in 1948 collected one hundred and three specimens of a striking *Karanasa* from the Koh-I-Baba Mountains in the main chain of the Hindu Kush, west of Kabul, Afghanistan. This melanchroic butterfly fits into the *pamira* group of which it is the darkest. We will call it *Karanasa haslundi* in honor of the leader of the expedition, Henning Haslund-Christensen, who died in the field.

Male. On the upperside of the forewing the marginal band, median band and basal areas are a rich black-brown which encroaches on the deep reddish orange discal band from the median and tornal areas so that the posterior portion of the discal band seldom reaches to the anal vein. The discal band is more or less obscured by the blackish suffusion, the extreme being reached in a specimen with the whole forewing black-brown except for a narrow white bar proximal to, and a thin orange crescent distal to the anterior ocellus. A medium sized anterior ocellus is always present; it is deep black with a minute pupil or occasionally blind. The space above vein M_3 between the anterior ocellus and the median band is white and occasionally the white extends beyond the ocellus to the marginal band. There is a strong tendency to the reduction and loss of the second ocellus with 29% having only a blind spot under a millimeter in diameter and 45% having no spot at all. The hindwing is solidly rich black-brown with an occasional faint trace of an orange discal band beneath, as it were,

the dark suffusion. On the underside, the markings are as in *pamira* except that the brown is a blackish brown and the light (white and orange) markings are smoky.

There are no androconia although the triple length scales along the median band give a vague appearance of a brand.

The genitalia are of the *pamira* type and somewhat variable. By breaking off a little of the tergum of the last abdominal segment where it overlaps the genitalia it was possible to examine the tips of the structures without dissection. Seventy-three of the seventy-seven males gave the following variability. The uncus is of medium length with the sides of the posterior half drawn down from slightly to twice the width of the anterior half. The gnathos is long, stout, heavily chitinized and feathered at the tip, the amount of feathering varying from nearly half the length to almost none. The valve has the costal edge straight, slightly rounded at the tip as in *pamira* and the teeth are numerous and coarse.

Female. The female has the wing form and markings of the *pamira* group and differs in that the hindwing is entirely suffused with black-brown with traces of the orange discal band occasionally present. On the forewing the brown markings are developed about as in *alpharakyi* females but blurred and darkened. The whole forewing not covered by the markings except the white area immediately around the anterior ocellus is a deep brownish orange. The ocelli vary as in the male. The underside is as in the male.

Expanse: ♂ 50-54 mm.; ♀ 52-58 mm.

The variability in the markings of the male are what is to be expected of the melanic-suffusion type of pattern. The females are much more uniform.

We wish to report a peculiar deviation in the male genital armature. Four of the seventy-seven males have all of the genital structures "attentuated" (Plate 12, fig. 3). The uncus is of normal length but narrow, the sides not drawn down, the lower edge being straight. The gnathos has the same length and curvature as the others but is very thin and only slightly flattened on the tip instead of feathered. The teeth on the valve are small and get smaller towards the tip and there is no costal tubercle near the base as in the others. All of the structures are present but in a form that one might call emaciated. Three were

taken on the slopes of Mt. Shah Fulada and the other near the nearby village of Puistagoli. There are no intergrades. In color and pattern, although all four lack the secondary ocellus, each may be matched by males with normal armature. The probability that they represent a separate species is remote. We believe that they represent a genetic mutation such as that which accounts for the color dimorphism of Colias females. We have been unable to find a similar condition in the other forms studied.

62. **Karanasa haarlovi** nov. *(Karanasa moorei haarlovi)*

Plate 12, fig. 4, male genitalia; fig. 10 ♂ holotype, upper and undersides (Kotal Pass, Koh-I-Baba, Afghanistan); fig. 11 ♀ allotype, upper and undersides (Surta, Koh-I-Baba, Afghanistan).

Mr. Neils Haarlov of the Third Danish Expedition to Central Asia caught a pair of *Karanasa* referable to the *moorei-gilgitica* group of the *huebneri* complex. We will call it *Karanasa haarlovi.*

Male. Forewings moderately pointed, outer margin slightly convex. Brand very broad and continuous from vein M_2 to anal margin, overlapping the lower corner of the cell. Median band is half the width of the brand from vein M_2 to the radius which it meets at right angles; a point extends along vein M_3 into the discal band. The base is brown, dusted with russet in the cell, with the thin brown m_2 line cutting across this dusting. The marginal band is dark brown, broad, with deep indentations into the discal band along the veins. The veins in the marginal band are dusted with russet. The discal band is reddish orange to vein M_3, white from M_3 to R_4; vein M_3 is dark brown. The anterior ocelli are large with minute pupils and each has a small spot touching it above vein M_1. The posterior ocelli are half the size of the anterior and have single scale pupils.

The hindwing, except for the discal band, is solidly dark brown with a faint russet dusting along the veins. The transverse discal band is dusky orange, narrow, and deeply scalloped along its outer edge; the inner edge is straight between veins Cu_2 and M_3.

The underside of the forewing has the markings behind the middle of the cell obsolete except for the marginal band and the second ocellus. The ground color in this area is dusky orange. The front half of the cell has faint striae, the corresponding part of the median band is

grey edged with black and the anterior ocellus is surrounded with white. The hindwing is mottled grey-brown with the borders of the median band (m_1, m_2) and the inner border of the terminal band (e_3) moderately heavy and almost black. The e_3 line is so deeply notched inwardly along the veins that the discal band has the appearance of a row of feather tips almost separated at their bases. The veins are light and prominent.

The androconia are plentiful, of medium width and with very long necks, falling into the classification A; they measure .291 x .030 mm. (Text figure 4)

The genitalia. The uncus is short and very deep with the sides not much drawn down. The gnathos is of the feathered type, broad and thin at the base, widening to twice that width at the four-fifths mark and then tapering rapidly to an eighty degree diamond-shaped point. The general form is nearest to the *astorica* on Plate 13, but the tip is more the shape of that of the right hand *rohtanga* on the same line. The valve tapers for the first three quarters and is uniformly thin from there, the teeth are medium sized and the terminal tubercle scarcely noticeable.

Female. Forewing as in male but with the orange shadings lighter and the dark androconial areas replaced by a sparse dusting of reddish-brown scales over the pale orange. On the hindwing the e_3 and m_1 lines are accentuated, the former having very deep points. The markings of the underside duplicate those of the male.

Expanse: ♂ 43 mm.; ♀ 51 mm.

Holotype and allotype in the Carnegie Museum.

63. **Karanasa moorei** Evans *(Karanasa moorei moorei)*

Plate 3, fig. 4 ♂ (Chitral, Evans); fig. 5 ♀ (Darkot, Chitral, 13,000 ft., Tytler); fig. 6 ♂ (Darkot).
Plate 9, fig. 20 ♂ (Utzen Nullah, 9,000 ft. Chitral, Leslie & Evans 1901).
Plate 11, fig. 24 ♀ (Chitral, 13,000 ft. 145).
Plate 13, male genitalia.

This form was first described from specimens mistakenly identified as *leechi* Moore by Evans in the Journal of the Bombay Natural History Society, volume 21, page 563 in 1912.

". . . hubneri is a very variable form; Chitral specimens, called *leechi* by Moore, are larger with deeper bands and the ocelli on the forewing above have prominent white centers. *Leechi*. Groum from Samarkand was described first; it is a much smaller and paler insect. I propose to call the Chitral race *moorei* as *leechi* must be abandoned. . . ."

Moore in his description of *leechi* gave as its habitus "Skoro La, Baltistan; Chonging Valley, N. Ladak." This district is the home of an entirely different race than that from Chitral, so Evans was describing a new form, not renaming an old one.

The specimen of the true *moorei* received from the British Museum was caught in August 1901 in Utzen Nallah, Chitral by Leslie and Evans and is presumably part of the type series. It has both ocelli faintly pupilled and a third black ocellus below the lower one, but the series as a whole tends to have blind ocelli. A character of the race is the even development of both ocelli as compared to the tendency to the loss of the lower ocellus in most Indian forms. The form is large and has an even dark coloration with a russet sheen and with a well defined light discal band which is tinted with russet exteriorly. A peculiarity of the *moorei* male is the heavy coating of long hairlike scales over the basal part of the wing including the androconial patches.

On the underside the white pupillation of the ocelli is quite distinct. The basal portion of the hindwings has an even marbled surface which fails to emphasize the dark median band. The light veins stand out very clearly.

The androconia are .237 x .033 mm. They have relatively short necks and fall into the classification B, tending toward C. (Text figure 4)

The male genitalia. The uncus is short and deep with a small hooked point. The gnathos is very broad, the lower edge swollen like the rachis of a feather, the upper edge thin and irregularly waved. The tips of the valves are evenly slender and curved upward with numerous irregularly sized teeth that extend over the end to the ventral side. There is no terminal tubercle.

64. **Karanasa gilgitica** Tytler *(Karanasa moorei gilgitica)*

Plate 3, fig. 1 ♂ (Ghizer, Gilgit); fig. 2 ♂ underside (Gilgit, 3000 m. Aug.); fig. 3 ♀ allotype (negative was reversed) (Yasin, Gilgit); fig. 17 ♂ underside (Gilgit).

Plate 9, fig. 21 ♂ type (Ghizar, Gilgit).

Plate 11, fig. 23 ♀ (Gilgit, 3000 m, Aug.).
Plate 13, male genitalia.
Plate 16, male genitalia.

Karanasa gilgitica was described by General Tytler in the Journal of the Bombay Natural History Society, volume 31, page 254 in 1926.

"28. *Karanasa moorei gilgitica,* subsp. nov.

"Very similar to *K. moorei moorei* Ev., but on the *upper* and *underside* of both sexes the yellow markings are rather washed out and have lighter colored patches; on the underside of the hindwing the light markings are paler.

"Expanse: ♂ 52 mm.; ♀ 56 mm.

"Five males and six females were received from Yasin and Ghizer in Gilgit.

"Colonel Evans placed his *moorei* as a race of *regeli* but it is quite a different looking insect and it is better I consider to keep it separate."

Supplemental description. The general color of the male is dark brown without the overall russet sheen of *moorei,* or the orange dusting of *haarlovi.* Only a single specimen of eight males and nine females has a pupil in the ocellus. The veins crossing the pale discal band are orange. The angle of the apex of the forewing is narrower and the width of the brand, particularly at the anal border, is wider than either the above forms. The female has the brown markings more reduced than the other two forms, the median band being sometimes almost faded out.

The androconia are plentiful and a little narrower than those of *moorei,* and with longer necks, placing them in group A. They measure .249 x .030 mm.

The male genitalia are essentially identical with those of *moorei.*

65. **Karanasa dubia** nov. *(Karanasa moorei dubia)*

Plate 3, fig. 7 ♀ allotype (Punial, Gilgit); fig. 9 ♂ paratype (Gilgit); fig. 10 ♀ paratype (Gilgit).
Plate 9, fig. 12 ♂ holotype (Baroghil Pass 3800 m); fig. 13 ♂ paratype (Karamber Pass 4500 m), fig. 22 ♂ (Gilgit) (Tytler's type); fig. 23 ♂ ab. (Gilgit).
Plate 11, fig. 22 ♀ (Yasin, Chitral) (Tytler's allotype).
Plate 13, male genitalia.
Plate 16, male genitalia.

In the Tytler collection there are nine, and in the Avinoff collection an additional twenty-one, specimens of *Karanasa* from Chitral and Gilgit, all from quite high altitudes of from 14,000 to 17,000 feet, only two having been taken as low as 11,000 feet. Tytler had set his nine aside, had selected types, and had given them a name, *dubia,* but in his final publication on this group, had decided against describing it. We find that this group of butterflies fills a gap in the diagnosis of the Indian *Karanasa,* so we will make official the cabinet name given by General Tytler.

Karanasa dubia nov. Male. Differs from both *Karanasa moorei* and *K. gilgitica* in having smaller size and duller colors. The inner edge of the discal band is less indented on the veins, in some cases almost straight; the outer edge of the same band is also much less scalloped. The color of the band is almost a uniform rusty yellow with rarely a trace of the light inner portions found in *moorei* and *gilgitica.* The ocelli are much reduced, the second one being either missing or represented only by a small dot. On the underside the markings are as in *moorei* but duller and less contrasting.

The androconia are short with thin necks and come in class B, measuring .235 x .033 mm.

The genitalia of the male have the uncus and gnathos of the *huebneri* type, differing in no way from *moorei* and *gilgitica,* but the valve has a terminal tubercle developed. It is hemispherical and about half the depth of the tip of the valve in diameter.

Female. Like the male, it is smaller and duller than its *moorei* and *gilgitica* counterparts. The discal band has a less scalloped outer edge and the inner edge is so vaguely marked that the rusty yellow of the band gradually merges with the yellowish brown of the base. The color of the band is also more uniform as in the male.

Unfortunately the specimens chosen by Tytler as types — and figured by us on the colored plates before we discovered that the form had not been described — represent the closest of the series to *moorei* and *gilgitica;* they also come from the lowest altitude, 11,000 feet. The male shown on Plate 9, figure 12 and the female shown on Plate 3, figure 7, are closer to the general run. We will designate these as holotype and allotype respectively.

Expanse ♂ 25-44 mm., holotype 40 mm.; ♀ 42-47 mm., allotype 44 mm.

Holotype, allotype and twenty-six paratypes in the collection of the Carnegie Museum.

Karanasa dubia is apparently the high altitude form of which *moorei* and *gilgitica* are differentiated offshoots in Chitral and Gilgit respectively. Its range on the map covers the ranges of the other two, but whereas they are found at from 8,000 to 11,000 feet, *dubia* is taken at from 14,000 to 17,000 feet, there being a zone of overlap or intergradation between.

69. **Karanasa modesta** Moore *(Karanasa modesta modesta)*

Plate 1, fig. 3 ♂; fig. 4 ♀ (not a female but a male).
Plate 3, fig. 8 ♀ (Deosai Plains, 13,000 ft.).
Plate 9, fig. 9 ♂ (Deosai Plains, 13,000 ft.).
Plate 13, male genitalia.

Karanasa modesta was described by Frederick Moore in "Lepidoptera Indica," volume 2, page 41, (1893-96). The *leechi* with which the comparison is made is *leechi* Moore, now known as *pallida* Tytler.

"*Karanasa modesta* (Plate 102, figs. 1, 1a, ♂ ♀).

"Male. Smaller than *K. leechi*. Upperside with the entire basal areas and outer borders darker brown, and of a vinescent tint, the discal band narrower on both wings, prominently defined, and of a paler ochreous. *Forewing* with a large conjoined black subapical spot situated above and below the lower radial veinlet, and a smaller black spot between the lower median veinlets; *glandular patch* indistinct. Underside. *Forewing* similar to *leechi*, the conjoined black subapical spot with its upper portion minutely black pupilled; the lower median spot as above. *Hindwing* with similar markings to *leechi*, the discal and submarginal sinuous-line being nearer together; the veins white lined.

"Female. Upperside slightly paler than in male, the discal band on both wings also paler and somewhat broader; a single black subapical spot only present on the forewing. Underside. *Forewing* much paler than in male; a single subapical spot only as on upperside. *Hindwing* as in the male."

"Expanse, ♂ 1-5/8, ♀ 1-6/8 inch.

"Habitat. — Deosi Plains; Kokser, Lahul.

"Distribution. — The type specimens were taken by Mr. J. H. Leech in the Deosi Plains, 13,000 feet elevation, in August, 1887; other specimens were also obtained by Mr. McArthur at Kokser, on the Chandra River in Lahul, in July, 1888, and on the Bara Lacha Pass in August."

Since two similar forms fly together in the Deosai Plains the question arises as to which of the two should be considered as the true *modesta*. There are two series of specimens in the British Museum from the

Deosai Plains, of which one set — the lighter — is labeled *modesta* and the other — the darker — as an "unnamed race" from the same locality. The description by Moore comparing it with *leechi* refers to "a darker brown base of a vinaceous tint." The figure shows this uniformity of the base with an indication of darker androconial patch and a characteristic blind double upper ocellus. Since no specimen in the British Museum is designated as type, it seems that the attribution of the name *modesta* should be switched from the lighter to the darker form which fits better Moore's description, and which, incidentally, displays in several individuals a double upper ocellus. It is from this dark series that I received my pair which was correctly marked *modesta* by the lepidopterists of the British Museum. The comparison of this male specimen (Plate 11, fig. 9) with the reproduction of the figure by Moore (Plate 1, fig. 3) should confirm the identity of this butterfly.

The matter of the female of *modesta* should be studied in connection with the clarification of an obvious mistake in the plate of Moore. This figure with a bright russet band and the single upper ocellus surely does not portray a female at all as there are no females of that aspect in the whole *Karanasa group*. It is unquestionably the figure of a male showing the loss of the lower ocellus. Such is also the opinion of Captain N. D. Riley and its correctness is supported by the fact that in the British Museum series of the Deosai form there are instances of males with the single ocellus not unlike the rather crude reproduction in the "Lepidoptera Indica." In reality the female of *modesta* is not unlike *pupilata* but showing blind ocelli, and with the discus reddish ocher with a lighter russet band running into a still lighter ochraceous tint in the upper part. This band is accentuated by a dark discocellular maculation on the forewings. The base of the hindwing is darker toward the discus, and the veins are strongly marked with orange.

The genitalia of the male fall within the normal variation of the Indian forms of *huebneri*.

The androconia are long with thin necks and fall into the classification A. They measure .280 x .027 mm. (Text figure 4).

70. **Karanasa gemina** nov. *(Karanasa modesta gemina)*

Plate 2, fig. 13 ♀ allotype (Bara Lacha Pass, Lahoul) specimen in the British Museum.

Plate 9, fig. 24 ♂ Holotype (Bara Lacha Pass, H. McArthur coll., Aug. 1888.).
Plate 13, male genitalia.

Description. Male. Identical with *modesta* from Deosai except that the discal crossband is broader.

The androconia average .242 x .029 mm., being of two kinds as in *chitralica,* with the small, narrow, long-necked variety more numerous. They are type B.

Expanse: ♂ 40 mm.

The type is one of the specimens actually before Moore when he described *modesta*; it was caught by H. McArthur on Bara Lacha Pass in 1888, is labeled as "T. % N." and is in the *huebneri* series of the Leech Collection. All the specimens of *modesta* from Lahoul differ constantly from those of Deosai and thus form a slightly differentiated race.

A series of four specimens supposedly from Rohtang Pass in southern Lahoul falls within this group. They differ in having a slightly greater lightening of the anterior end on the discal crossband, but agree in all other characters including the androconia. There is some doubt as to the authenticity of the locality for this series, which was obtained from a European dealer, because included in it were a pair of typical *balti,* specimens that could have come from no farther south than northern Ladak. They — the *balti* — are larger, with broader wings and paler browns than the rest of the series or any other material from the general area.

67. **Karanasa astorica** Tytler *(Karanasa astorica astorica)*
Plate 2, fig. 26 ♂ cotype (Rupal, Astor); fig. 27 ♀ (Rupal, Astor); fig. 28 ♂ ab. (Rupal, Astor).
Plate 9, fig. 8 ♂ (Rupal, Astor).
Plate 11, fig. 12 ♀ cotype (Rupal, Astor).
Plate 13, male genitalia.
Plate 16, male genitalia.

Karanasa astorica was described by General Sir Harry Tytler in the Journal of the Bombay Natural History Society, volume 31, page 254, 1926.

"31. *Karanasa huebneri astorica,* sub-sp. nov.

"The form of *huebneri* occurring in Astor is very close to *K. h. modesta* M., which occurs further east in the Deosai Plateau, but in the *males* the

orange of both wings extends more into the brown basal area and in the *females* the orange colour replaces the brown basal area of the forewing as in the form *cadesia M.,* which however is not a racial form but a casual variety and which occurs in both the races of *modesta* M. *and astorica* mihi. The female of *modesta* M. has not the orange of the forewing so extended as in the female of *astorica* mihi.

"Expanse: ♂ 46 mm.; ♀ 48 mm.

"The types are in my collection and ♂ and ♀ paratypes are in the British Museum."

All of the specimens of *astorica* now in collections appear to have been taken in Rupal, Astor at about 12,000 feet altitude in August, 1926. The types and cotypes seem to have been exchanged since the writing of the description, the former being now in the British Museum while the Tytler Collection in the Carnegie Museum has the cotypes.

The russet coloring is very bright with scarcely any apical lightening. The brown in the marginal band and the basal half is dark but shot with russet. The ocelli are blind. The females have bright russet color far more intense than in true *huebneri, balti,* etc., and by that character can be easily recognized in the whole group. On the whole, *astorica* may be described as a darker form of *huebneri* with a more intensive and uniform russet tint in the bands.

The male genitalia do not offer characters that deviate significantly from the rest of Indian *huebneri.* The *androconia* are small and fit into group D. They measure .218 x .030 mm. (Text figure 4).

68. **Karanasa baltorensis** nov. *(Karanasa modesta baltorensis)*

Plate 9, fig. 15 ♂ type (Baltoro Mt., Shigar, Baltistan, 5,000 m.).
Plate 13, male genitalia.

Male. Similar to *astorica* but with a somewhat less brilliant russet coloring. The brown median band is produced outwardly along vein M_3 making it sharply angled rather than straight as in *astorica.* The anterior ocellus of the type is doubled as sometimes occurs in *modesta* and pupilled as is infrequently evident in both *modesta* and *astorica.* The type specimen has all of the ocelli well developed including even black spots in the second interspaces of the hindwing, but the other specimens assigned to the series have a variable development of this character including the loss of the second ocellus. The hindwing has less invasion of the basal areas by russet scales, only the veins showing

some orange. Underside as in *astorica* except for the greater development of the pupils of the ocelli.

The female differs from that of *astorica* by the greater development of the brown in the basal areas and a clearer demarcation of the median crossband on the forewing.

Baltorensis may be distinguished from *balti* with which it flies by the darker brown color of the base, by the more intense and more uniform russet color of the band and by the deeper scalloping of the outer border of this band.

The male genitalia are of the *huebneri* type.

The androconia are broad and short, belonging to group C. They measure .215 x .029 mm.

Expanse: ♂ 40 mm.; ♀ 48 mm.

The type comes from Baltoro Mountain at Shigar in Baltistan. Other specimens referable to the name are a pair from Macheribroun in the Karakorams, a pair from Noun-Koun and a female from Pense Pass, both in northern Zanskar. *Baltorensis* is an outpost of the orange *modesta* section of *huebneri* in a region inhabited mainly by representatives of the pale section.

71. **Karanasa expressa** nov. *(Karanasa astorica expressa)*

Plate 2, fig. 18 ♀ paratype (Skardu); fig. 19 ♀ paratype (Skardu); fig. 20 ♀ paratype (Fotu-la); fig. 21 ♂ paratype (Tchang-Tchen-Mo); fig. 22 ♀ paratype (Tchang-Tchen-Mo); fig. 23 ♂ paratype Peang Mont., Leh.); fig. 24 ♀ paratype (Lama-yuru); fig. 25 ♂ paratype (Nya, Ladak).
Plate 9, fig. 14 ♂ holotype (Bura Deosai); fig. 16 ♂ paratype (Skardu).
Plate 13, male genitalia.
Plate 16, male genitalia.

Description. Male. Similar to *astorica* and *modesta,* differing from the former by less pointed wings, paler brown markings and paler russet both on the upper and under surfaces; differing from the latter by the strong diffusion of russet over the basal portion of the wings on the upper side. In the female the dark portions have a peculiar greyish-brown tint. The russet shades of the female are paler than those of *astorica* and about the same as those of *modesta.* With our short series of *modesta,* no good differentiating character can be given for the females.

The genitalia are of the *huebneri* type; the androconia belong to group C, and measure .259 x .029 mm. (Text figure 4)

Expressa is the name proposed for those bright forms of *huebneri* found in the general region of Ladak to the east of the Deosai Plains and south of Shayok River, but not reaching to the higher valleys along the Tibetan border. Specimens from Bura Deosai, Skardu, Fotu-la, Peang Mountain, Nya, Lama-yuru, Nira, in the Zanskar Mountains, Yum-Ladak and Nye-Tal all in Ladak and from Tchang-Tchen-Mo on the border of Rupshu, from elevations of 3500 to 5000 meters, are sufficiently alike to be included in one race. This form serves as more or less of a transition between the bright *astorica* and the pale *huebneri* groups.

72. **Karanasa balti** Tytler *(Karanasa astorica balti)*

Plate 2, fig. 12 ♀ cotype (Skoro-La) in British Museum; fig. 14 ♂ (Skoro-La); fig. 15 ♀ (Skoro-La); fig. 16 ♂ (Kardong); fig. 17 ♀ (Kardong).
Plate 9, fig. 6 ♂ variety? (Pamir); fig. 7 ♂ (Skoro-La) cotype.
Plate 11, fig. 11 ♀ cotype (Skoro-La).
Plate 13, male genitalia.

The name *balti* was substituted by General Harry Tytler for *leechi* of Moore in the Journal of the Bombay Natural History Society volume 31, page 255 in 1926. *Leechi* was described by Frederick Moore in "Lepidoptera Indica" volume 2, page 41, 1893-96.

"32. *Karanasa huebneri balti,* sub-sp. n. = *K. leechi,* nec Gr.-Gr.

"Males darker and rather larger than *K. h. pallida* mihi; some males are very close to *K. h. astorica* mihi but the females are very different and are much paler.

"Expanse: ♂ 48 mm.; ♀ 50 mm.

"There is a good series of this form from Skoro-La, Baltistan and from Kardhong in the British Museum.

"This insect was given the name of *leechi* by Moore but this name must fall as *Karanasa leechi* Gr-Gr. has priority and was given to a very different form of *Karanasa* from the Hindu Kush Mountains."

Moore's description:

"*Karanasa leechi* (Plate 101, figs. 4, 4a, ♂ ♀)

"Male. Similar to *K. Hübneri,* somewhat larger. Upperside of a paler fulvous, the ends of the median veinlets ochreous-speckled, the outer borders uniformly dark-coloured. *Forewing* with the basal area, including the cell, cinerescent ochraceous-brown; with a well defined blackish broad inner-discal

glandular patch extending throughout its length to the inner edge of the fulvous band, the patch clothed with broad serrate-tipt pale scales and numerous long bulbous *androconia* with tasselled-tip, these latter being narrower than in *K. Hübneri;* the sinuous submarginal edge of the fulvous band more acutely defined; within the band is a subapical blind black spot, a very small spot also being present between the lower median veinlets, and below the upper spot are sometimes two or three minute black speckles. *Hindwing* with a somewhat broader fulvous band, the outer edge of the band more acutely sinuous; the ends of the median veinlets not ochreous. Underside. *Forewing* paler than upperside, but somewhat clouded in the middle, *the basal and cell strigae obsolete,* the subapical black blind-spot prominent, the lower median small spot sometimes absent. *Hindwing* paler than in *K. Hübneri,* the strigae less, and more speckled throughout with whitish-cinereous edgings to the markings; with similar disposed subbasal, median, and submarginal sinuous lines, but the two latter are more acutely pointed, and the subbasal line is excurved within the cell (not angled as in *Hübneri*); veins white lined.

"Female. Upperside paler fulvous than in *K. Hübneri,* the costa and outer borders, and the basal areas also paler. *Forewing* with the edges of the discal band less defined; the subapical and lower black spot as in male. *Hindwing* with the fulvous band comparatively broader, its outer sinuous-edge being slightly nearer the exterior margin of the wing. Underside. Both wings as in male.

"Expanse, ♂ 1-6/8 to 1-7/8, ♀ 1-7/8 to 2-1/8 inches.

"Habitat.—Skoro La, Baltistan; Chonging Valley, N. Ladak.

"Distribution.—Obtained by Mr. J. H. Leech on the 'Skoro La, Baltistan, at 15,000 feet elevation, in July, 1887,' and by Mr. H. McArthur, in the 'Chonging Valley, 15-17,000, July and August, 1889,' this valley being situated between the Upper Shayok river and the Dépsang plains in North Ladak."

Balti is the replacement race for *expressa* to the north of the latter. Its distribution extends from Kardong in Ladak into Baltistan and the Karakoram Mountain System, and includes the light forms from the Deosai Plains. The Carnegie Museum has specimens from Kardong, Skoro-La, from Noun-Koun and Pense Pass in northern Zanskar, from Tasserpo Pass and Sasser Pass in Baltistan, and from Macheribroun in the Karakorams. In all of the specimens there is a tendency for a lightening of the discal crossband at its apex and along its inner border. *Balti* is paler than *expressa* and brighter than *huebneri*; there is no sharp line of distinction from either. The brown scaling on the basal areas is more reduced in *balti* than on the other two.

The androconia measure .233 x .028 mm. and fit into type B.

The genitalia are of the *huebneri* type.

73. **Karanasa pallida** Tytler *(Karanasa astorica pallida)*

Plate 2, fig. 11 ♀ cotype (Chongking).
Plate 9, fig. 4 ♂ cotype (Chongking); fig. 5 ♂ (Chongking).

The form *pallida* was described by General Sir Harry Tytler in the Journal of the Bombay Natural History Society, volume 31, page 255, in 1926.

"33. *Karanasa huebneri pallida,* sub-sp. nov.

"The race of K. huebneri from the Chongking Valley can readily be distinguished from its allies by the extremely pale colouring of both wings in both sexes.

"It is very close to the typical form from Lahoul but the yellow colour on both wings enters the brown basal area which it does not do in Felder's form.

"There is a good series of this form from the Chongking Valley in the British Museum.

"Expanse:—♂ 42 mm.; ♀ 41 mm.

"The types are in the British Museum and paratypes are in my collection."

Karanasa pallida was collected by McArthur in August 1889 in the Chongking Valley at an elevation of from 15,000 to 17,000 feet. The pair which came to us from the Leech collection is very similar to typical *huebneri* and differs by a reduction of the dark suffusion of the basal part of both wings. There is complete intergradation with *balti,* in fact, *pallida* and the *balti* from Kardong have the same elongated narrow androconia which differs from those of the other *balti,* being type A. The race is smaller than *balti* and the tendency to the reduction of the ocelli and the impoverishment of the brown pattern is carried even farther, particularly in the type female. Altogether, *pallida* and *balti* are scarcely distinguishable, and were both included in the series from which Moore's *leechi* were described.

74. **Karanasa huebneri** Felder. *(Karanasa huebneri huebneri)*

Plate 1, fig. 1 ♀; fig. 2 ♀ underside. (Plate LXIX figs. 8, 9 of Reise der Novara, Felder.) figs. 7, 8 ♂ ♀ from Moore, Lepidoptera Indica, Plate 101, figs. 3, 3a. (This is *rohtanga* sp. nov.)
Plate 9, fig. 1 ♂ (Shigri, Lahoul, 15,000 ft. August 1884, G. Young); fig. 2 ♂ "problematica" Rohtang Pass, 4053 m. July.
Plate 11, fig. 41 ♀ (Shigri, Lahoul, 15,000 ft. August 1884, G. Young).

While the species name *huebneri* may, in its broadest sense, be applied to most of the Karanasa found in India, the assignment of the name to a particular population is made difficult by many factors, not the least of which are the redescriptions by various authors supplementing the indeterminate original description by Felder. We preface our discussion of this name by reprinting the more important of these.

Karanasa huebneri was described by the Felders in Reise der Novara, page 494, in 1867.

"Satyrus hübneri nobis.

"Tab. LXIX. Fig. 8, 9 fem.

"♂ Alae supra saturnatiores, Quam in S. Agave, fascia multo laetius fulva, extus acute dentata, a margine magis distante, in anticis intus subdiffusa, haud venis fuscis divisa maculisque plane caecis ornata, in posticus breviore, ramum subcostalum secundum haud exceedente, absque ocello.

"Alae subtus etiam saturatiores, quam in S. Agave, anticae disco toto fulvescente, medio saturiore, litura sola discocellulari fusca divisa, ocellis minoribus, superiore late et diffuse ochraceo circumdato, striga submarginali antrorsum magis reducta, quam et in S. Geyeri, posticae venis omnibus albis, strigus ut in S. Geyeri, sed multo saturatioribus et gracilioribus, basali minus flexuosa, angulum rectum formante, discali postice haud declivi, submarginali a margine magis recedente acute reducta, extus cano limitata, puncto ocellari nullo.

"♀ Alae supra fascia fulva in anticus introrsum effusa, in posticis usque ad ramum subcostalem primum protensa.

"Habitat: HIMALAYA OCCIDENTAL: LAHOUL: SHIGRI, SPITI, DISHUNGDEO (Dr. Stoliczka). Cll. F.

"Zunachst verwandt mit *S. Agave* (Esp.), die Vonderflügel bedeutend schmäler, die Hinterflügel im Innersaume kürzer."

Marshall and de Niceville's translation and supplementary description was published in "Butterflies of India, Burmah and Ceylon," volume I, page 189 in 1883.

"— Male. Upperside darker than in *Satyrus agave* [Esper — *Satyrus alcyone,* Fabricius, nec Wein. Verz.] the fascia much deeper fulvous, outwardly acutely dentate, more distant from the margin; in the forewing inwardly rather diffused, not at all divided by fuscus veins, and distinctly marked with blind spots; in the hindwing shorter, not extending beyond the second subcostal nervule, without an ocellus. Underside also darker than in *S. agave.* Forewing with the entire disc fulvescent, darker in the middle, divided by a single swarthy discocellular litura, the ocelli smaller, the upper one broadly and diffusely circled with ochraceous, the submarginal striga more drawn back anteriorly than in *Satyrus geyeri.* Hindwing with all the

nervules white, the streaks as in *S. geyeri,* but much darker and more slender, the basal streak less flexuous forming a right angle, the discal streak not at all sloping hindwards, the submarginal streak more receding from the margin, acutely drawn back, outwardly defined with hoary white; no ocellar dot. Female: Upper side with the fulvous fascia diffused inwardly in the forewing, and in the hindwing extending to the first subcostal nervule."

"The following description is taken from the plate:

"Female. Upper side brown, the fulvous fascia sharply defined both inwardly and outwardly on both wings by dark lunulate lines, and with ochreous patches on it at the costal and inner margins of the forewing, and at the costal margin of the hindwing. The forewing with a black subapical spot, and another on the lower median interspace both on the fulvous band; the hindwing with no spots. Underside. Forewing with the outer margin pale brown, and the costal margin narrowly so; the rest of the wing fulvous, the outer dark lunulate line defining the fulvous, and the two black spots as on upperside, two short brown streaks across the cell and two beyond it. Hindwing with the basal half pale brown, the outer half greyish; the extreme margin dark brown; a dark brown highly dentate submarginal line inwardly suffused with brown; another almost equally dentate defining the pale brown basal half, a subbasal dark, somewhat dentate line; and an incomplete basal line with a spot beyond it in the cell, dark brown; the nervules white."

Frederick Moore wrote the most complete redescription in Lepidoptera Indica volume 2, page 39:

"Imago.— Male. Upperside deep fulvous, exterior marginal line blackish, the end of the median veinlets on both wings ochreous-speckled. Cilia ochreous-white, alternated with dusky-brown. *Forewing* with the base, costal border, and exterior margin cinereous ochreous-brown; an incipient upper portion of a dusky brown pale-bordered excurved discal line beyond the cell, which also curves along the subcostal veinlet, extends along the radials, and then sinuously edges the dark outer border of the wing; between the radials is a prominent subapical black spot with white pupil, and on the lower part of the disc is a short broad dusky-black *glandular patch,* which is clothed with a few short oval and some long, broad, dentate-tipt pale scales, and blackish *androconia* with lengthened-bulbous base and hair-like tasselled tip. *Hindwing* with the base and abdominal border cinerescent purplish brown; crossed by an ill-defined inner-discal excurve angulated diffused dusky line, and a darker outer-discal obtusely-sinuous blackish line, and thus enclosing a curved medial-discal fulvous band. Underside. *Forewing* paler fulvous, yellowish below the costal border; the base, the costal and outer border brownish-cinereous, finely speckled with brown scales, the ends of the outer veins being white speckled; some short blackish strigae crossing the base of the cell, the upper discal curved line (the lower portion being also very

finely indicated) and sinuous submarginal line, and the subapical black spot, as on the upperside. Hindwing ochreous-cinereous, numerously covered with short blackish strigae and intervening speckles, which are thickest disposed at the base; veins prominently white lined; crossed by an indistinctly-defined angulated subbasal and a more distinct medial-discal excurved angulated black line, the latter having a whitish outer border, and beyond is a submarginal distinct black sinuous line.

"Female. Upperside slightly paler fulvous. *Forewing* with the base pale cinereous purplish-brown, the outer border somewhat darker; crossed by an inner discal diffused blackish line, which is acutely angled outward on the upper median veinlet, the line also extends along the subcostal and then sinuously and prominently edges the dark outer border, thus enclosing a discal fulvous band, within which is an upper and a lower black spot. *Hindwing* with the entire basal area and outer border cinereous purplish-brown, enclosing a prominent fulvous medial-discal band, which is edged with an inner and an outer black sinuous line. Underside. *Forewing* somewhat paler; markings as in the male, except that the discal line is more distinct, and the submarginal line more sinuous, there being also two black spots of the same size as those above. *Hindwing* also somewhat paler, with transverse black lines more acutely defined, the subbasal line more distinctly angled within the cell, and both the discal and outer sinuous line being pale-bordered externally. *Body* cinereous-brown; collar, side of palpi, and legs beneath cinereous-white; antennae cinereous-brown, tipt with ochreous, with a rather stout short club, the tip being obtuse.

"Expanse, ♂ 1-5/8 to 1-6/8, ♀ 2 inches.

"Habitat.— Lahul; Spiti: Deosi Plains, Stakpila Pass, N. Kashmir.

"Distribution.— Dr. Felder (Reise Nov. 494) gives "Lahul and Spiti" as the localities of the type specimens. Under this species, a specimen of the female is recorded in "Second Yarkund Mission," Lep. p. i., as having been taken by the late Dr. F. Stoliczka at Leh in September."

There were other redescriptions by Charles B. Antrum in Butterflies of India, by C. T. Bingham in Fauna of British India, but no one admitted having seen a specimen from Lahoul or Spiti.

The correct establishment of the type of *huebneri* is hindered by the fact that no specimens of this species are preserved in the Felder material acquired by the Tring Museum, and inquiries to this effect brought about negative results. The description of the male is so indefinite and general that it would fit a number of local races of the *huebneri* cycle. Two facts are of a guiding order, namely, the colored figure of the female and the reference to the locality where the butterfly was captured as being Lahoul. Thus the race found in this region of the general habitat of the group should be considered topotypical.

A series from that locality preserved in the British Museum is marked on this ground as *huebneri,* typical. A pair from that series collected over fifty years ago for Leech is in the Carnegie Museum collection and figured on the plates accompanying this paper, the male being shown in colors. The description of Felder fits sufficiently well the aspect of the male although the matter of the second ocellus of the front wing must be of a variable order. About half of the original series of Leech including this specimen show the secondary ocellus, and the other half of the series do not denote any indication of it. Also the dark base indicated in the description is usually only faintly shown in the specimens from this locality. The female fits fairly accurately the drawing in the Novara Reise. (AVINOFF MSS.)

Rohtang Pass lies within the limits of the region of the original description, but the specimens available to us from that locality at first failed to fit into the *huebneri* of Felder. We had five males and three females. Four of the males have very pointed wings and no trace of androconia and one of the females fits well with this quartet. The other male comes close to *huebneri* of Felder, but the two remaining females that presumably should belong with it come closer to the northern races allied to *modesta* than to Felder's figure. At the time of the death of the senior author, these were grouped into two series tentatively named "rohtanga" for the androconialess ones and "problematica" for the others. The recent acquisition of a new series from Rohtang Pass from a European dealer (while the authenticity of the data is questioned because of the inclusion of a pair of falsely labeled *balti*) gives us four male specimens that fit well with the two "problematica" females. These males are unquestionably of the *modesta-gemina* group and are assigned to the latter form. We now have two series, such as is found over most of Kashmir, a bright series (*gemina*) and a pale one (*problematica*), and a *third series without androconia.* With the female "problematica" assigned to *gemina* and the male to *huebneri vera,* the problem dissolves.

The "problematica" male differs from the description of Felder only by having very slight shading of fuscus on the veins across the discal band, a variable character. It has the same kind of heavy, no-necked androconia as the Shigri specimen from the Leech collection. These androconia measure .214 x .034 mm., and belong in class E. (Text figure 4)

We then consider as being true *huebneri* the pale series of androconia-bearing Karanasa from Shigri and Rohtang Pass and adjacent territory.

66. **Karanasa pupilata** Tytler *(Karanasa pupilata)*

Plate 2, fig. 35 ♀ (Shandur Pass, Chitral, 11,000 ft.).
Plate 9, fig. 10 ♂ holotype (cotype) (Chitral); fig. 11 ♂ (Shandur Pass, Chitral, 11,000 ft.).
Plate 11, fig. 21 ♀ allotype (cotype) (Tarben Nallah, Chitral, 8,000 ft.).
Plate 13, male genitalia.

Karanasa pupilata was described by General Sir Harry Tytler in the Journal of the Bombay Natural History Society, volume 31, page 254 in 1926.

30. *Karanasa pamirus pupilata,* sub-sp. nov.

"There was a series of a *Karanasa* form from Jhila Drosh, Chitral, in the British Museum and there are also a pair from Chitral in my collection which are different to other geographical forms of *Karanasa huebneri* and its allies and appears to be for the present best placed as a race of *K. pamirus.* In appearance the butterfly is somewhat like *K. pamirus safeda* mihi, but the white patch on the inner edge of the upper ocellus on the forewing is not so well developed and there are no white patches on the inner edge of the ochreous band on the upperside of the hindwing as in that form; on the underside the cell in the male is not marked with white as in *safeda.*

"Expanse: ♂ 45 mm.; ♀ 48 mm.

"The types are in my collection and paratypes are in the British Museum."

The male genitalia do not have any significant deviation from that of the typical Indian *huebneri* group.

The androconia are of variable width, short and with short necks, group D. (.214 x .035 mm.) (Text figure 4)

This form has nothing to do with *pamirus* and stands not far from *moorei* from which it differs chiefly by uniform brick colored band without any trace of the lighter tinge inwardly with the exception of the portion near the upper ocellus in the male, and a bright uniform spread of the russet brick color over the whole mesial portion in the female without any differentiation from the usual light band. As referred to in the description by Tytler, his collection contains a

pair from Chitral identical according to his statement with the series from Jhila-Drosh, Chitral, in the British Museum. Tytler compares *pupilata* with *safeda* with which it has some traits of alikeness, but also many points of difference. If it were not for the pupillation of the ocelli (present only in the upper ocellus in the specimens of Tytler) one might be inclined to place this form in affinity with *modesta*. The male is labeled only "Chitral" and the female comes from Tarben Nallah, Chitral. The specimens bear the yellow circle of the cotype label, yet the article by Tytler clearly states that the types are in his collection and the paratypes are in the British Museum. Thus these two specimens must be considered as the actual type individuals of this form.

The holotype appears to have come from a different place than the allotype and the series from the British Museum; it is larger, has a narrower band on both wings, and the ocelli are different in size, the lower one being smaller and blind.

75. **Karanasa safeda** Tytler (*Karanasa safeda safeda*)

Plate 9, fig. 37 ♂ type (Safed Koh).
Plate 11, fig. 8 ♀ allotype (Safed Koh).
Plate 13, male genitalia.
Plate 16, male genitalia.

Karanasa safeda was named by Tytler in the Journal of the Bombay Natural History Society, volume 31, page 254, in 1926.

"29. *Karanasa pamirus safeda,* sub-sp. nov.

"The form of Karanasa from the Safed Koh, Kurram Valley, sent me by Colonel Evans agrees closely with specimens of *K. pamirus josephi* Stdgr. from Bokhara. It is better placed for the present as a race of *pamirus* than as a race of *huebneri*.

"I made no note as to how this form differs from *josephi* Stgr. as I was under the impression that Colonel Evans had described it; but on my return to India he informs me that he did not describe it and although he had appointed types he then thought it was not good enough and asked me to describe it myself. I was unable to do this as I have not the specimens with me. There is however a specimen in the British Museum presented by Colonel Evans labelled *Safeda* Evans and placed as a race of *huebneri* and I think it better to leave this form under the name given it by Colonel Evans than to change it.

"The male type is in my collection and a male paratype in the British Museum."

It is wrong on the part of Tytler to place this form as a new subspecies of *pamirus* with which it has nothing in common. In the description the author mentions that it agrees closely with specimens of *pamirus josephi* from Bukhara. It is this association of *josephi* with *pamirus* that has put General Tytler on the wrong track since *josephi* is not conspecific with *pamirus*. Although Tytler gave no formal description of *safeda,* the comparison with *pupilata* in his description of that form on the same page is sufficient to characterize *safeda*. The Tytler form of *safeda* is more plainly recognizable by comparison with the figure of *pupilata* illustrating the same article. The specimen designated as type is in the Tytler collection now in the Carnegie Museum. Three more males and the allotype female are in the British Museum. The description of the allotype and a more complete description of the type follow.

Karanasa safeda. Male. The forewings are moderately pointed, the outer edge being almost straight between veins Cu_1 and R_5. On the forewing, the base and marginal band are deep brown dusted with russet, the veins outlined with russet scales. The outer edge (m_1) of the median band is sharply angled on vein M_3 and vein M_3 is dusted with brown. The discal band is russet, lightened at the anterior end, markedly so between the ocellus and the median band. The ocelli are well developed and all pupilled. The hindwing is like the forewing except that there are no ocelli, the cell is dark, the veins passing through the marginal band are so bordered with russet that they cut the band into blocks. There are three pale triangles on the inner edge of the discal band in the spaces above M_3, M_2, and M_1.

The underside of the forewing duplicates the upperside except that the base is russet, the light anterior part of the cell is broken up by striations and the light anterior part of the discal band is accentuated. On the hindwing the brownish russet and white discal band contrasts strongly with the vinaceous-brown base and border, and the basal strigae lines separating these bands are dark brown.

The androconia are numerous, short, moderately narrow and with no necks, similar to those of *huebneri* in group E, measuring .203 x .030 mm. (Text figure 4)

The genitalia deviate slightly from those of the rest of the *huebneri* group by having stouter spines on the valve which is slightly enlarged at the tip.

Female. Of a russet coloration with a contrasting subapical portion of the discal band of the front wing which also shows a lighter portion near the lower ocellus. The dark portion of the base is not very prominently indicated and the median band is reduced to a discocellular patch and another patch between the anal and cubital veins adjacent to the discal band. On the hind wings the russet band has a light ochreous spot in the front part. The dark antemarginal band of the hind wings is distinctly broken up by the light russet suffusion along the veins. The general aspect in terms of coloration and distribution of the dark pattern has similarities with the true *josephi,* although the transverse discal band is not indicated in a continuous form. On the other hand like *wilkinsi* it shows very prominent interruptions of the exterior dark band. The ocelli are about equal in size and both pupilled.

Expanse ♂ 38 mm., ♀ 40 mm.

Karanasa safeda, from almost the extreme south of the distribution of the genus is superficially almost identical with specimens of *Karanasa dublitskyi* from almost the extreme north. This is most noticeable in the male.

77. **Karanasa cadesia** Moore *(Karanasa cadesia cadesia)*

Plate 1, fig. 9 ♂ (Moore's type from Pr. Z. S. London, 1874, Plate 66, fig. 7).
Plate 2, fig. 29 ♂ (Kalapani, Astor, 12,500 ft.); fig. 30 ♂ (Rupal 12,000 ft.); fig. 34 ♂ underside of fig. 29 (Kalapani, Astor).
Plate 9, fig. 19 ♂ (Burzil Pass, Deosai, 12,000 ft.).
Plate 11, fig. 7 ♀ (Deosai Plains) in British Museum.
Plate 13, male genitalia.
Plate 16, male genitalia.

Karanasa cadesia was described by Frederick Moore in the Proceedings of the Zoological Society of London for 1874, on page 565.

"Hipparchia cadesia, n. sp. (Plate LXVI. fig. 7.)

"Allied to H. hübneri, Feld.

"*Male.* Upperside bright ferruginous; exterior marginal line blackish; cilia yellowish alternated with brown; fore wing with the base, costal, and exterior border pale brown; a subapical pale-bordered black spot with a white central dot; subcostal vein and its branches blackish, terminating in a transverse sinuous submarginal line: hind wing with the base, abdominal and outer border brown, the veins being ferruginous; a submarginal series of

blackish lunules.

"Underside: fore wing paler ferruginous, the costal and outer borders being fawn-colour; a few transverse brown strigae within the cell; veins below the apex terminating in a pale streak: hind wing ferruginous white, numerously covered with short blackish strigae, which are thickest at the base; veins prominently whitish; a broad curved transverse median band with black outer dentate lunules; outer margin and base of wing suffused with brown. Body and legs brown. Antennae yellow, tip ferruginous.

"Exp. 1-7/12 inch.

"*Hab.* Cashmere: Boorzil valley towards Stakpila Pass, 11,000 ft. (Capt. H. B. Hellard R. A.)"

The genital structures of *cadesia* are not significantly different from the other members of the *huebneri* complex. There are no traces of androconia.

Marshall and de Niceville in their Butterflies of India, Burmah and Ceylon, volume 1, page 189 describe a female taken at Leh, Ladak as:

"We have seen only a single specimen of *H. cadesia,* a female taken at Leh in Ladak by the late Dr. Ferdinand Stoliczka, Ph.D., on the 8th of September, 1873, and now in the Indian Museum, Calcutta. In Moore's figure of the species the underside of the hindwing has the transverse fasciæ very slightly dentate, but in the specimen here these lines are as highly dentate as in *H. huebneri.* No sexual mark is shown in the figure or mentioned in the description.

The female differs from the male in having a small black spot on the first median interspace on both sides of the forewing; it is very closely allied indeed to the female of *H. huebneri,* the only noteworthy features being the complete suffusion of the basal area of the forewing with fulvous, and the very small size of the black spots in *H. cadesia.* Both these characters are variable in *H. huebneri;* and while so far as the types are concerned, there is no difficulty in separating them; it is probable that when more is known about these rare species, it will be found that the line of separation between them cannot be maintained."

While we have not seen the specimen referred to by Marshall and de Niceville, their description of it would fit better an extreme of *expressa* than *cadesia.*

Staudinger placed *cadesia* as a synonym of *huebneri* without having seen a specimen:

(Translation: "Felder describes this species as out of the West Himalayas (Lahoul, etc.). Later Moore described it out of Kashmir as *cadesia.* However,

this name probably should be merged as a synonym of *huebneri* because the specimens described as *cadesia* belong to the typical *huebneri* form. . . ."

Staudinger later sent out specimens from Turkestan as *cadesia* and the name came to be considered in connection with *josephi,* the original concept of *josephi* having been transferred to Bukhara specimens.

Tytler places *cadesia* as an aberration of *modesta* and there are two specimens, males, in his collection, both from Rupal Valley, Astor, 12,000 feet. Although they were collected together with a large series of *astorica,* some of which bear the same date, August 20, as one of the specimens of *cadesia,* yet they are definitely distinct insects; first, *cadesia* has always one upper ocellus *only,* with a clear white pupil. Just one male of *astorica* lacks a second ocellus, but this produces only a superficial alikeness with *cadesia.* Second, *cadesia* has no vestiges of androconia which are prominent on *astorica.* Third, *cadesia* is smaller than *astorica.* Fourth, the most definite distinction between the two insects lies in the exterior dark band of the front wings. This distinction is particularly clear on the underside. The dark antemarginal outline (e_3) does not form a set of arcuate markings as in *astorica* and the rest of the *huebneri* forms, but runs practically in tandem, almost straight, dark interneural dashes. This dividing line between the brownish gray antemarginal portion and the russet discus of the wing has an entirely different aspect than in any of the other *huebneri* forms. Russet veins also break through the marginal band on the hindwings.

The two males differ slightly in that one has dark scaling covering almost half of the basal area while the other has only a dark suffusion at the very root of the wing. This latter specimen corresponds very closely to the one from Deosai Plains received through the courtesy of the British Museum. The other two specimens in the British Museum from Astor and Baltistan are also close to the lighter specimen from Rupal. Two specimens of females preserved in the British Museum from Deosai Plains should be ascribed to *cadesia.* They look exactly like the male with one single, white-pupilled ocellus, a uniform russet coloration of the wings without any indication of the median dark band except a slight shade at the cell end. There is apparently no sexual dimorphism. The female is only slightly larger and has rounder wings. Thus the total number of known specimens of *cadesia* consists

of two males and two females in the British Museum and three males in the Carnegie Museum. Except for the marked differences in the male genitalia, *cadesia* might be considered as an Indian representative of the *wilkinsi* group.

Cadesia is found only in Baltistan, Deosai and Astor.

76. **Karanasa rohtanga** sp. nov. *(Karanasa rohtanga rohtanga)*
Plate 2, fig. 31 ♂ (Rohtang Pass, Kangra India, 4053 m.).
Plate 9, fig. 3 ♂ type (Rohtang Pass).
Plate 11, fig. 13 ♀ allotype (Rohtang Pass).
Plate 13, male genitalia.
Plate 16, male genitalia.

Karanasa rohtanga Male. Forewing narrow, pointed; costal and exterior borders deep vinaceous-brown, basal area dusted with pale brown and russet. The median band is represented by a reddish brown patch at the end of the cell and a vague russet shade extending from it to the anal border parallel to the outer border. The brown of the base comes out almost to this line. *There are no androconia.* The discal band is pale ocher lightened slightly above vein M_2 and almost imperceptibly so at the anal margin. The ocher color extends into the area normally occupied by androconia as in many females of the *huebneri* group. There is a single small blind ocellus. Hindwing with the marginal band as on the forewing, basal areas more deeply brown with the outer edge of the median band distinctly darker. The discal crossband is the same color as on the forewing.

Underside. Costal and outer margins are very pale brownish gray, the disc and posterior half of the cell are a pale orange lightened to cream on the tornus and costa. The hindwing is brownish and gray with the outer (e_3) and inner (m_1) zigzag lines and the basal (m_2) line prominently dark brown.

The genitalia do not differ significantly from those of the other Indian *huebneri* forms, having a short deep uncus, broad flattened gnathos feathered along its entire dorsal edge and moderately large-toothed valves.

Female. The dark parts of the pattern are of a light brown tint. The discal band on the front wing is well marked only exteriorly. Inwardly it spreads over the whole discal portion of the wing, melting gradually with the dark basal portion. It is of a pale straw color with

a very slight ochreous tint. The ocelli are large and blind, the upper one spreading below into the adjacent cell. On the hindwings the broad light band is of the same ochreous tint as on the forewings. It is characteristic that the light portions of both pairs of wings are not tinted distally with a brighter hue, if anything they are faintly lighter.

Expanse ♂ 42 mm., ♀ 44 mm.

This form is easily distinguished from the two other Lahoul forms (*huebneri* and *gemina*) by the absence of androconial patches on the male and by the pale color and obsolescence of the median band on the forewing of the female. Two of the males have minute second ocelli.

Holotype, allotype and three paratypes in the collection of the Carnegie Museum.

TAXONOMIC RELATIONSHIPS

It is ordinarily good practice to proceed from the known to the unknown and since all of the previous work on the taxonomy of *Karanasa* has been on the basis of color and pattern we should begin our discussion with that phase. However, our findings with respect to the androconia and the male genitalia render invalid many seemingly obvious conclusions based on color and pattern, and so, by dealing with these two phases first, we will be able to dispense with considerable futile discussion.

GROUPINGS BY GENITALIA

The genitalic structures of the male, usually employed as the ultimate criteria in distinguishing species and determining interspecific relationships among the lepidoptera, serve to clear up doubtful points and to reinforce color criteria in some directions but introduce further complications in others. It has been possible to make preparations from only one or two of a kind for most of the subspecies and, consequently, we do not feel qualified to make any sweeping conclusions based on so few specimens. A fairly satisfactory key has been made up, for instance, but the evidence on which it was built is not statistically reliable. We have, though, dissected out several moderately long series of specimens and one quite long one. The series vary in number of specimens from four to seventy-six and are of two types, the first consisting of a number of specimens taken from a single population center, the second made up of single examples taken from various points in the distribution of a widely ranging subspecies. The *haslundi, bolorica, hodja* and *expressa* series are examples of the first type and the *dissoluta, iskander, latifasciata* and *leechi* series represent the second. The evidence from these may be tentatively extended to apply to the whole group. In each of the first type — the local series — there is a certain amount of variability, no two are alike, but the variability is quantitative and continuous within narrow limits; there are no structures that are present in one specimen and missing in the next, the structures do not take on different forms, there is just the expected random variation. Since these four local populations representing three major divisions of the group do not show significant variation, it

is reasonable to assume that similar conditions exist in the others.

At this point it might be desirable to digress a little to discuss an interesting problem that arose in the analysis of the longest series — the seventy-six *haslundi.* The extremes of the variation in this series are widely divergent and if the variation were continuous, the male genitalia would be virtually useless for taxonomic diagnosis. The variation, however, is not continuous but bimodal with no intergrades. Seventy-two specimens have the organs stout, heavily chitinized and well developed; four have the organs of the same length, position and general form as the others, but they are slender to the point of emaciation, (they call to mind the thin man of the circus sideshow), they are not heavily chitinized and the characteristic structures (feathering, teeth, etc.) are in an undeveloped state. The differences in genitalia between these two coexisting groups, while purely those of stoutness and degree of development, are much greater than those between related forms geographically removed from each other. In other words, the more or less constant differences between *pamira* and *alpherakyi,* between *kafir* and *haslundi,* differences that are correlated with other variable characters and with geographic distribution, are much less than those between specimens of identical appearance possibly caught in the same sweep of a net. Except for the genitalia, the four specimens are normal in every way, actually indistinguishable from the seventy-two, the former falling inside the range of variability of color and pattern of the latter. If there were only one or two specimens of each group, it would be entirely logical to describe them as two species, but with all the facts available we are forced to the conclusion that here we are dealing with a simple genetic mutation, the same general kind of setup that produces either white or yellow females in *Colias.* If so, there is raised this question: — Are we ever justified in describing a form on genitalic differences alone? — or on any single character? If the answer is "no," the next logical step is: — Are genitalia ever of value as sole criteria for the separation of species?

The series that involve specimens from various points within the distribution of a widely ranging population vary in certain respects with reference to geography. For example, in the *dissoluta* series the specimens from the Alai Valley and the Trans-Alai mountains have only a vestigial terminal tubercle on the valve, while at the western end of the Trans-Alai the terminal tubercle is slightly developed. To

the southwest at Gursy Tash on the edge of Bukhara, it is fairly long and at Ters Agar, it is long and thick. If we add to this series the one southwest of it in Darwas that we have described as a separate population (subspecies), *darwasica,* we find that the terminal tubercle has now become very long and thick. We consider *dissoluta* and *darwasica* to be subspecies of the same species. In the *iskander* series, two characters vary geographically as the terminal tubercle does in *dissoluta-darwasica,* namely the terminal tubercle and the shape of the base of the gnathos. Two of the *latifasciata* slides were made a long time ago and the specimens and data lost, so while they show the same type of variation as do the *dissoluta* and *iskander,* we cannot make any geographical correlation. The *leechi* series, although well documented, does not show a cline in any character, but has a peculiar variability that will be discussed below.

On the basis of genitalia alone, disregarding all other characters, we can divide *Karanasa* into three groups. Two of them are well differentiated, only slightly variable and recognizable at a glance, even without dissection. The third group is made up of a variety of more or less intergrading forms whose extremes show greater differences than those that separate off the first two groups, but which show an INTERLACING of characters that more often hinders than helps in taxonomic differentiation.

The first group, separated easily from all of the others, is the *pamira* group. In these the posterior half of the valve is wedge shaped and equipped with very stout teeth which are at least twice the size of those of any other *Karanasa.* They also have gnathi that are cylindrical at the base but feathered at the tip, the tip turning up and out with the outer edge flattened. An approximation of the shape can be produced by pinching a piece of lead wire and pounding out one side of the pinched part to a thin edge with a hammer; the unhammered part will have a circular cross-section and the hammered part will have a thin wedge-shaped cross-section. In this group come *pamira, holbecki, ornata, alpherakyi, kafir,* and *haslundi.* Geographically the populations are to be found in the order given from northeast to southwest along the western edge of the Pamirs with *alpherakyi* as a side branch from about the center eastward into the Pamirs. While there is variation in the feathering of the gnathos and the coarseness of the teeth, the long series of *haslundi* shows that the former has no taxonomic value.

With regard to the more stable tooth character, there is a cline from *pamira* to *kafir,* from north to south, in which the teeth get larger and fewer, but in *haslundi,* the most southern representation, the tooth size reverts to that of *pamira.* There may possibly be an altitudinal correlation there, *pamira* and *haslundi* coming from the lowest altitudes.

The second group we will call the *huebneri* group. It includes all of the russet forms in Kashmir and one from Afghanistan, all from south of the divide of the Hindu Kush Mountains. All of the forms, dark phases and light, pupilled and blind, branded and without androconia, that we have presented under the racial names of *haarlovi, moorei, gilgitica, dubia, modesta, gemina, astorica, baltorensis, expressa, balti, pallida, huebneri, pupilata, safeda, cadesia and rohtanga,* have male genital structures that do not differ significantly from each other from any standpoint. All have gnathi that are short, broad and feathered from base to tip, the cross-section at any place being wedge shaped with the thin edge uppermost. All have numerous fine teeth covering approximately the posterior third of the costa of the valve in a compact band several teeth wide. Only one or two specimens show a terminal tubercle. Judging from the genitalic structures alone, all are the same, so the genitalia are of no help in analyzing the complex. The coexistence of two or more distinct kinds, however, blocks the assumption that they are all the same species. They do, however, invalidate some very convenient relationships formerly advanced on the basis of color and pattern, particularly between the unbranded *cadesia* and the *dissoluta* complex and between *safeda* and *dublitzkyi.*

The third group has as its prime character an unfeathered gnathos. The length, diameter, taper, shape of base and point of the gnathos, the form, teeth and terminal tubercle of the valve, and the length and form of the uncus combined in various ways may be used to separate most of the populations and establish relationships in this complex, but, as mentioned above, the few dissections that we have been able to make do not warrant statistically the classification of the populations on that basis alone.

It is interesting to note that while combinations of characters will delimit a form, almost all of the single genitalic variables show clines in development that are related to geography and not only cut across boundaries of forms (in the taxonomic sense) but even of well differ-

entiated species. A case in point is the variation in the terminal tubercle of the valve. It is characteristic of *Karanasa* caught in the drainage basin of the Amu Daria along the western edge of the Pamirs and on the mountain ranges flanking the valley. It does not cross the main ridge of the Hindu Kush nor does it invade the Alai Valley and its contiguous ranges. It appears sporadically and minutely developed among forms in the Tian Shan. It reaches its greatest development in Darwas, Bukhara and Zaravshan in two well differentiated species groups, *darwasica* of the *josephi* group and *decolorata* and *iskander* of the branded group. It has medium development there in *grumi,* and in *mushketovi, maureri, josephi, roborovskyi* and *dissoluta* around the fringe of the basin. In *jakobsoni,* the *intermedia* group representative in the basin, it is poorly developed. In *alpherakyi* and *ornata,* the *pamira* group representatives, it is fair sized while only poorly developed in *kafir* from the divide of the Hindu Kush and vestigial in *pamira* and *haslundi* which come from just outside of the basin. It also appears developed to a slight degree in some *dubia* and in *haarlovi,* the only two members of the *huebneri* group that reach the divide of the Hindu Kush. Thus a single character, the terminal tubercle, reaches its greatest development about the middle of the eastern edge of the Pamirs in representatives of two species groups, a lesser development in another and still less in a second species of one of the groups. As one moves away from this center, the development of the terminal tubercle becomes less, regardless of species group, and along the southern fringe of its spread even effects a completely different fourth group where that group reaches the rim of the basin.

The shape of the gnathos can be shown to have a similar but entirely independent relationship to geography. At the eastern end of the Hindu Kush on both sides of the divide *bolorica* and *chitralica* have extremely stout, strongly tapering gnathi which rival the uncus in size; westward in the Chodja Mahomet Mountains, a northern bastion of the Hindu Kush, is found *hodja* with almost identical gnathi. As one passes northward into the Pamir a little way, *mushketovi* and the *grumi* from Pshiharv Pass are encountered whose gnathi, while still strongly tapering, are only a little over half the diameter at the base as the first group, and finally at Vis-harvi Pass in the middle of Darwas the gnathi of *grumi* are more slender with hardly any taper while *darwasica* of the *dissoluta* and *jakobsoni* of the *intermedia* group have gnathi

that have a tendency to taper and that are stouter than their relatives farther north. North from Vis-harvi, all the forms have slender, cylindrical gnathi.

Another genitalic character that cuts across population and species lines while diminishing from a center of maximum development is the shape of the base of the gnathos. In the forms *iskander* and *decolorata,* in Zaravshan on the northern boundary of the Amu Daria basin, the shaft of the uncus develops a little anteriorly from its junction with the tegumen, making it look as though it had been "stoved" or dislocated by a blow on the tip. We have called the effect "elbowed." The form *darwasica* and *mushketovi* to the south have this character developed to a less degree. The *dissoluta* of western Trans-Alai and the Alai valley have it in a decreasing cline from west to east as also does *josephi. Karanasa roborovskyi,* from between the Trans-Alai and Darwas, has a slight development in keeping with its geographical position. *Karanasa wilkinsi* from the eastern end of the Alai Valley has a slight development as do the *leechi* from northern Pamir. Within this spread of the character, *maureri* and *intermedia* show no development of the "elbow."

These three are the most obvious of the genitalic characters that behave as though each had arisen in a certain kind of butterfly in a definite place and had to spread to coexisting species to a greater or less degree and had also spread out in increasing dilution from the center of origin regardless of species lines. The junior author has encountered a similar phenomenon in the color pattern in the moths of the genus Platysamia, a North American silk worm.[1] It was shown that the red band of *Platysamia cecropia* appears in a reduced form in members of the *Platysamia gloveri-P. columbia* complex wherever they come into contact. The amount of red scaling decreases as one moves away from the point of contact. In this instance, it was established by breeding experiments that the method of transfer across species lines was by infrequent hybridization in which, although the female hybrid is completely sterile, the male is partially fertile when crossed back to a parent species and complete fertility is reestablished only after several generations of such back crosses. Perhaps these genitalic characters

[1] Hybridization and the Phylogeny of the Genus Platysamia. Ann. Carnegie Museum, volume 25, 1937.

and some of the color and pattern characters are transferred among the *Karanasa* in a similar way.

It is not desirable that all forms of this third group be keyed out here on the basis of their genitalia alone, a few examples of the usefulness of these characters will suffice. The forms *bolorica, chitralica* and *hodja* separate out as a group from their color and pattern cline with *grumi, mushketovi* and *iskander* on the basis of their total lack of a terminal tubercle and the distribution of the teeth on the valve. The *wilkinsi* group has a characteristic enlargement of the end of the valve. The *abramovi* group can be separated from the *regeli-tancrei-conradti* complex by the shape of the uncus. *Karanasa* forms *iskander* and *decolorata* stand out from *grumi* and its allies on the basis of the "elbowed" gnathos. Lack of differences between genitalia of different forms is also of great assistance, particularly in correlating high altitude and medium altitude populations. Thus, *conradti, arpensis* and *turugensis* have identical genitalia confirming both the latter pair as high altitude phases of the former and the close relationship indicated by the bimodal cline in pattern between the latter two. Similarly *leechi* is shown to be the high altitude representative of *intermedia* although specimens of *leechi* from the northern Pamir suggest *wilkinsi* as their lower altitude counterpart. The form *roborovskyi* was included by us with *regeli* and *abramovi* in the fuscous and ivory division until a dissection showed that its genitalia are almost identical with those of *josephi.* This and the finding of androconia places *roborovskyi* in the *decolorata-iskander-grumi* complex where the genitalia fit almost as well as with *josephi,* and the pattern and color fit better. Had it had to be placed with *josephi,* it would have introduced a pattern combination contrary to the trend in that group.

GROUPINGS BY ANDROCONIA

The specialized scent scales, the androconia, on the forewings of the males are of considerable assistance in diffentiating butterflies. In the first description of a *Karanasa, huebneri* by Felder, no mention of their presence was made. Neither were they recorded in subsequent descriptions by Grum-Grshimailo, Staudinger, Tytler and others. Frederick Moore in his *Lepidoptera Indica* first described them in connection with *huebneri* as "with lengthened bulbous base and hairlike tasselated tip –," but he included in *huebneri* specimens from Deosai Plains and northern Kashmir in addition to the ones from Spiti and Lahoul, and it is not known from which locality the specimen described was taken. Androconia on specimens from those localities diverge widely. Many of the, to us, bizarre relationships suggested by early writers were based largely upon a complete disregard of these structures.

With the exception of *cadesia, rohtanga* and the *pamira* varieties, all *Karanasa* found in and to the south of the Hindu Kush Mountain System have androconia. North of the Hindu Kush and west of a line running north-northwest along the western edge of the Pamirs there are also butterflies having androconia. Along the line they fly together with other *Karanasa* having none. East of that line, in northern and eastern Pamir, the Alai region and all of the *Karanasa* lands to the north and east, none have androconia.

The presence or absence of androconia is of great importance in the separation of major categories in the genus *Karanasa*. Lack of the scales reinforces genitalic and other indices in segregating the *pamira* group. On this basis, Grum's ochre division is split in two, the *huebneri* and *grumi-iskander* groups with androconia and the *dissoluta-intermedia-wilkinsi-leechi* complexes without them. Similarly, genitalic characters are reinforced in splitting Grum's black and white division into the *bolorica* group with, and the *regeli-abramovi* group without, these specialized scales. The finding of an androconia among the scales taken from the male of *roborovskyi* clinched the separation of that form from the black and white division, a separation tentatively made on the basis of minor genitalic differences and geographic distribution.

Along the southern edge of the distribution of *Karanasa* in India are two populations, both belonging to the *huebneri* genitalic complex, that lack completely the androconial scales. One might be tempted to

assume that these are merely sports on which the scales have failed to develop, but in each case, specimens have been captured over a period of many years and constitute too high a percentage of the total catch to be such. Besides, there are other unrelated characters such as wing shape and ocelli that help in the differentiation. The fact that they are found only on the fringe of the populations having androconia and flying with them poses the question — are they advanced varieties that have lost their androconia or ones that have not yet acquired them?

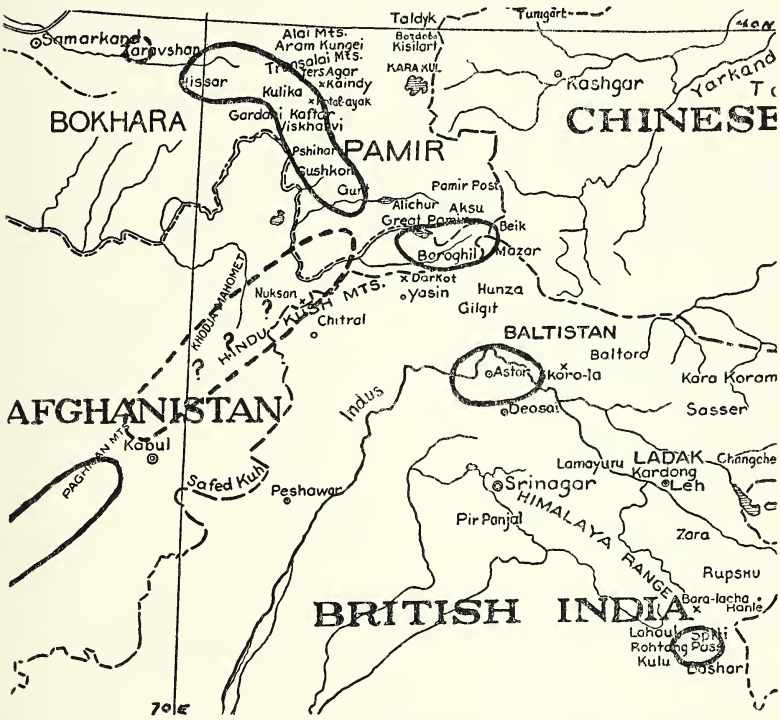


FIG. 6 Zones of overlap between the ranges of *Karanasa* species having androconia and those having none.

Within the group of species of *Karanasa* having androconia there is a distribution of the types of scales outlined on page 43 that shows some correlation with geography and with a few of the characters used to differentiate the populations. Type B, of medium length and thin

neck, is found in the Hindu Kush and those parts of the Karakoram and Himalaya ranges that are inhabited by *Karanasa,* being represented by *gemina, dubia, moorei, balti* and some *pallida* of the *huebneri* complex, and also by *bolorica, chitralica* and *nigrocellata.* At isolated points within the distribution of the B type scales are islands of the long necked type A. *Haarlovi* in Afghanistan near the western end and *gilgitica* in Gilgit at the eastern end of the Hindu Kush, *modesta* from the Deosai Plateau at the western end of the Himalayas, and some *pallida* from Chonking Valley on the border of Tibet make up this type. Along the upper reaches of the Indus River and its southern tributaries which cut in between the Karakoram and Himalayan ranges we find *expressa* of type C; *baltorensis* of the same type is found north of the river well within the range of the type B *balti*; *hodja* from the northern side of the Hindu Kush also fits into type C. Down river from the territory of *expressa,* on the flanks of the gorge of the Indus, the thick-necked type D is represented by *astorica* in Astor and *pupilata* in Chitral. At the extreme southern edge of the *Karanasa* distribution *huebneri* in Spiti and Lahoul and *safeda* in the Safed Koh on the border of Afghanistan both have androconia of the neckless type E. Type E is represented north of the Hindu Kush by *mushketovi* in southwest Pamir and by *maureri* and by some *iskander* in Zaravshan. The shortest and bluntest scale, type F, is found on the forms flying in Darwas, Bukhara and Zaravshan — the forms *grumi, decolorata, maidana, iskander* and *roborovskyi,* with those of *roborovskyi* the most extreme.

Plotted on a map (figure 7) the distribution of the types of androconia shows a central band of medium and long scales along the Hindu Kush-Karakoram system with an irregular gradation, both to the north and the south, towards short neckless types and eventually none at all. This appears to be a more or less orderly arrangement requiring some explanation. Several speculative solutions have been advanced. It has been suggested that here is an example of the "drying up" type of distribution. But surely a single structure does not disappear following such a pattern, like water evaporating from a puddle. The area occupied by a whole genus or species might shrink, but not that occupied by individuals having a certain nonselective inheritable character. Such a phenomenon would require graded changes in ecology that would elicit graded response from a common genetic pattern, or a graded

change in the genetic pattern itself. The first cannot hold because the distribution is geographical (in the map sense) and apparently independent of ecology. The second is unlikely because spontaneous genetic changes are usually random and would not be expected to show graded distribution geographically.

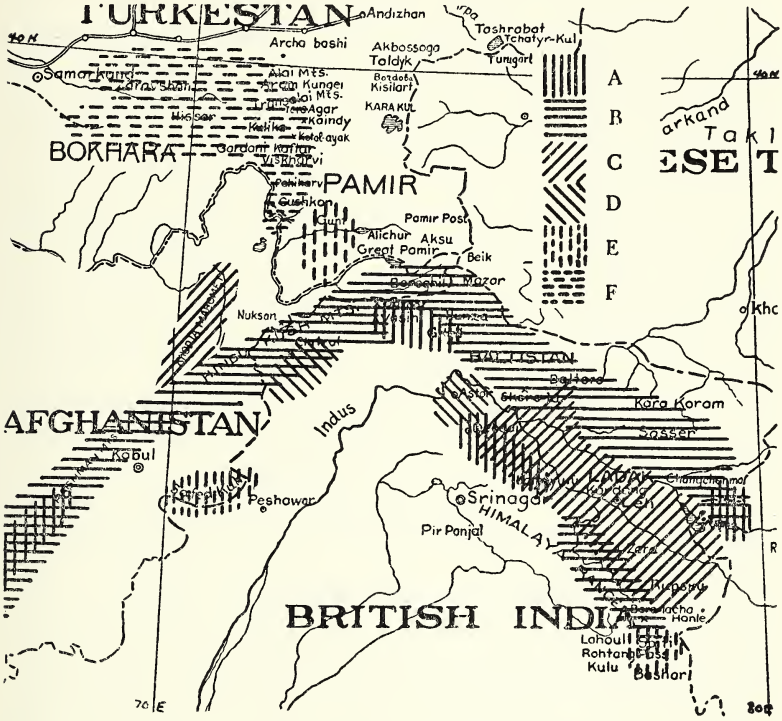


FIG. 7. Distribution of the types of androconial scales.

It has also been suggested that the region where the longest androconia are found is the area of greatest tendency to speciation — the center of origin — and that the older strains with less developed androconia have been pushed to the periphery. This classical interpretation of the distribution of species might be a reasonable explanation if the other characters of the butterflies were correlated with the androconia, but such is not the case.

A third possibility is that new (or modified) androconial determiners, not races or species, are pushing out from a center and that their distribution depends on the hybridization phenomena mentioned in the preceeding section. Such a method of spread would follow the geographic lines indicated by the distribution and be more or less independent of ecology, but would require that the androconia be developed *de novo* and progressively improved. This is highly improbable since it would imply the multiple origin of these structures which are found in many families of the butterflies. Thus there appears to be no logical general interpretation at the genus level and we will have to look for it in the relationships between lesser divisions not yet considered.

There are a number of cases where differences in the type of androconia serve to help differentiate coexisting kinds of butterflies. They give at least token support to the concept of the duality of the butterfly types in the *huebneri* group, a concept based principally on pattern and color characters. For instance, in Spiti and Lahoul, *huebneri* has shorter, blunter scales than its companion *gemina*; on the Deosai Plateau *expressa* has shorter scales than its companion *modesta*; *baltorensis* has thicker necks than *balti*; *pupilata* also has thicker necks than the coexisting *moorei*. Longer androconia serve to reinforce the separation on genitalic grounds of *hodja* from *grumi* and particularly to differentiate the Chodja Mahomet *hodja* from the Pshiharv butterflies now placed under *grumi*.

On the other hand, the apparently closely related *haarlovi, moorei, dubia* and *gilgitica* show a considerable difference between the long, thin necked type A scales of *haarlovi* and *gilgitica* at the geographic extremes and the shorter type B androconia of *moorei* and *dubia* from the middle. The discrepancy cannot even be explained on the basis of different altitudes because *dubia* is the high altitude phase of both *moorei* and *gilgitica*.

GROUPINGS BY COLOR AND PATTERN

The early writers dealing with *Karanasa* placed all of the forms under *huebneri* if ochre colored or under *regeli* if not. In the first attempt at monographing the group, that of Grum-Grshimailo in Romanoff's Memoirs de Lepidopterologie, this separation was still maintained in the form of two major divisions.

(Translation) "— As far as coloration is concerned all these [ten] forms are divided into two principal groups. To the first group belong three species with a more or less brown-black coloration, *boloricus, regeli* and *abramovi*; the second, a coloration of ochre of various tints and nuances, comprises all the other species. — What strikes us in the first place in this type are the two different hues of the predominant color. Since we possess in both cases series of forms spread all over the Pamirs we conclude that these two branches originally existed from very ancient times. The prototype of this group certainly could not have been divided immediately into two forms of such a diversity of coloration exemplified at present by *intermedius* or *abramovi*. There occurred a gradual adaptation to these two tendencies. The coloration of this prototype was doubtless intermediate between these two extremes."

A division based solely on the presence or absence of the reddish ochre color such as proposed by Grum is only partially valid in the light of the present day knowledge of this genus. Some ochre colored forms may be merely variants of the fuscous and ivory division, for instance, the yellow females of *abramovi* and *conradti,* or the partly ochreous *latifasciata*. Also some that are most closely related to the ochreous or russet division may lack that color, such as *roborovskyi* and some *grumi*.

Perhaps if we look into the basic composition of the color patterns of the Karanasa we may be able to form a clearer picture of their variations. The general base color, or prime coat to use an artist's terminology, is an all over dull white that shows through the superimposed tints and patterns only rarely. On it the markings are laid in at least three independently inherited patterns.

TINTING FROM CENTER

First there may be a general tinting of a russet color — pale yellow to fiery orange — appearing in about the center, or disc, of the wing and spreading in all directions, seldom, however, reaching the apex of the wing and sort of blocked or deflected by the discocellular vein. This pattern, usually obscured more or less by other patterns, shows

most clearly in some of the females such as *dubia* (Pl. 11, fig. 22) and *arasana* (Pl. 11, fig. 6). The specimen that shows the pattern best is a *balti,* unfortunately figured only in black and white (Pl. 2, fig. 17).

Tinting From the Edge

Second, there may be a suffusion of a russet tint inwards from the outer margin of the wing. This tint, which may vary from a pale pipe-clay color as in *korlana* (Pl. 10, fig. 29) to a bright orange red as in *kafir* (Pl. 10, fig. 41), often has the appearance of a stain that has run out from the marginal band when the wing got wet. This is particularly striking in some *grumi* (Pl. 10, fig. 31) and *hodja* (Pl. 10, fig. 33). This suffusion from the edge may also be combined with the first mentioned suffusion from the disc and may even be present in all the forms so colored. It is often demonstrable only by the lightening of the discal band inwardly as in *dublitzskyi* (Pl. 9, fig. 36).

The Dark Cross Bands

Third, there is a general overlay of a system of modified dark bands or lines which extend from the costa to the anal margin roughly parallel to the outer margin. These lines, so ably analysed by B. N. Schwanwitch and described on page 34, vary in degree of development from a narrow marginal band and a spot at the discocellular vein as in the *balti* ♀ (Pl. 11, fig. 11) or *centralis* ♂ (Pl. 9, fig. 3) to solid markings from base to margin excepting only the discal band as in *kafir* (Pl. 10, fig. 41) or *pupilata* (Pl. 9, fig. 10). On the upperside of the wing the bands are usually solidly colored, but on the underside, only their edges are accentuated, the body of the band being light or missing.

The Ocelli

The ocelli, or eyespots, are, as Schwanwitch and others have pointed out, a specialized part of the pattern of dark cross bands, but in the Karanasa they seem to vary independently of the bands. They may or may not have pupils and reach their maximum development in *regula* (Pl. 11, fig. 29) and their minimum in some *pallida* (Pl. 9, fig. 4).

Reticulation

On the underside, the same basic pattern elements predominate but in different aspects and to them is added in the cell of the forewing and on the base of the hindwing a reticulated pattern that is partly an atavistic archedycton and partially a breaking up of the cross band pattern (Pl. 7).

MULTIFACTOR VARIABILITY

The basic pattern elements are endlessly modified by genetic and environmental influences. Most important of the former is multifactor variability, the "random variation" of the early writers on evolution. Because of this no two specimens are alike. In *Karanasa,* the range of variability is fairly great, often greater than the difference between the means of the forms being compared. This makes the separation of individual specimens on the basis of color and pattern alone sometimes impossible, for, although two series when arranged side by side may be quite different, some of their extremes may be matched together. A very good example of this presents itself on Plate nine where *dublitzkyi* (fig. 36) and *safeda* (fig. 37) look enough alike to have come from the same brood, but belong to entirely different species groups coming from opposite ends of almost the longest diagonal that can be drawn through the map of the distribution of the genus. The similarity between examples of the two forms can be even greater because there are specimens of *dublitzkyi* that have the marginal band of the hindwings broken by orange veins as in *safeda.* It is scarcely necessary to point out that this universal law of biology applies not only to the color and pattern but also to all the other parts of the butterfly.

THE DARK AND LIGHT MORPHS

Throughout the genus *Karanasa* there is a greater variability in the amount of the markings developed from the dark cross band pattern than in any other character. The variations, however, do not appear to be strictly continuous, but to be concentrated towards the ends, there being in many species a light and a dark morph. In some localities the dark predominates, in others the light. In a few forms there are other characters associated with one or the other morph that suggest a specific or at least a racial segregation. Such is the case in *modesta* and *expressa* on the Deosai Plains, between *gemina* and *huebneri* in Lahoul and between *balti* and *baltorensis* in Baltistan. However *dissoluta* in the Trans-Alai may have both dark and light morphs unsupported by any other differences. We have described *angrena* and *arasana* as separate forms only because the few specimens known do not warrant their combination; it being much easier at a later date to sink one name into synonymy than to differentiate two

forms described under the same name. When more material becomes available from the Angren area, these two may prove to be the dark and light morphs of the same variety. The phenomenon of the dual morphs will be discussed more fully under the various species-group headings.

Other genetic modifications may be brought about by presumably single factor inheritance. Most of these are sports, but some have survived through isolation to form local populations.

Color Substitution

One of these single factor modifications is color substitution in which all of the scales expected to be a certain color are another. Albinism, which is the commonest example of this type, does not occur in *Karanasa,* but the aberration *fumigatus* of the form *alitchura* has the russet scaling colored brown and *hoffmani* has the russet scaling a reddish brown. The pale *roborovskyi* may also fit into this category, and *decolorata* as well, but these two may belong under the heading of multi-factor variation.

Diffusion of Lines

Occasionally there are found lepidoptera in which the dark pattern becomes fuzzy or diffused like a photograph taken with the lens out of focus. This type of marking occurs in *obscurior* (Pl. 10, fig. 11 and 12) and in *occidentalis* (Pl. 10, fig. 9), both of which are closely related to the clear cut *latifasciata* (Pl. 8, fig. 4-7).

Melanosuffusion

Finally there is a general suffusion of a dark color which appears to have crept out over the established pattern, engulfing it, but not disturbing its form or position. This is found in the *pamira* form *haslundi* on which the suffusing color is not the usual black or gray but a rich very dark brown.

The environmental influences are more difficult to pin down than the genetic, but one, at least, of them can be distinguished from the random variations sufficiently well to be demonstrated.

Altitudinal Forms

The first, and in this genus most important, of the environmental effects is that produced by differences in altitude. On the whole, *Karanasa* are found where the landscape is tilted on end, differences in

elevation of five thousand feet or more being found within a few miles. In the general latitude involved, a difference of a thousand feet vertically introduces climatic differences equivalent roughly to 175 miles[1] difference in a north and south direction. A form found five thousand feet higher, even though only a few miles away, could be expected to be as different as though it were 875 miles farther north. *Karanasa* vary with altitude both in size and in the development of the markings. The changes that occur in color are a lightening or "fading" of both the russet and the black-brown. This is quite noticeable in the Indian forms where both *balti* and *pallida* are paler than the lower altitude *expressa* and *modesta*. The form *dubia* is paler than either *moorei* or *gilgitica* which inhabit the lower slopes of the same mountains. All the high Pamir forms are pale, even those with an excess of dark markings. The forms *leechi* and *mihmana* from the higher slopes have the russet shades pale straw colored in comparison with the pale orange of *centralis* and *alitchura* from the elevated valleys. These in turn are much lighter than the bright reddish orange of *intermedia* and *jakobsoni* of the lower Trans-Alai and Darwas. We believe that all six forms are different manifestations of the same species, the principal isolating mechanism being altitude. Again, around Lake Tchatyr-Kul in the Tian Shan Mountains, *conradti* is found at lower altitudes on the same mountain as *arpensis* and *turugensis* which come from the two approaches to a high pass. Both of the latter forms are duller in the blackish crossmarkings and in the clay-white background than *conradti*. Again all are the same species. The small *pungeleri* is similarly a duller high altitude form allied to *aksuensis* and *korlana*. In the Kuldja district, *ruckbeili* from the flanks of the lower Ili Valley is a brighter variety of *regeli* which is found farther up along the headwaters of the same river. *Karanasa bolorica* is smaller and duller, but otherwise very much like its lower altitude form *chitralica*. The specimens which come from known high altitudes conform so closely to this principle that when a small dull colored specimen is presented, one automatically suspects that it came from a high pass.

Coupled with the faded colors is the relatively great reduction of the width, continuity and color density of the marginal band. In lowland

[1] Calculated from comparison of vertical and horizontal isotherms in Asia (177 miles) or on the rate of advance of Spring in the United States (171 miles).

(relatively speaking) forms, such as *pupilata, moorei, josephi, regula,* etc., the e_3 line which makes up the inner edge of the marginal band is scarcely ever distinguishable from the rest of the band, but in high altitude forms it is the most conspicuous part, the remainder fading almost to the shade of the discal band. This may be seen in *balti* (Pl. 9, fig. 6, 7), *arpensis* (Pl. 10, fig. 18, 19) and *turugensis* (Pl. 10, fig. 16, 17). In all of these and the other high forms, particularly *leechi,* the marginal band tends to become narrow and broken up.

CATEGORIES OF HIGHER ORDER

As was indicated in the discussion of the criteria for grouping into higher categories, the genus *Karanasa* may be broken up into the following major divisions. All of the Indian forms except *bolorica, chitralica* and *hunza* on the northern border may be grouped together with *haarlovi* from Afghanistan on the basis of the possession of androconia and the same type of genitalia. This first of the highest categories, a species-group, we will call the *huebneri,* or specialized branded, division. It includes sixteen subspecies. A second group, differentiated by unique genitalia, by the lack of androconia and by the wing shape, is the *pamira,* or specialized unbranded, division, a group of much greater compactness comprising six subspecies. A third, the *bolorica-iskander,* or primitive branded, division is loosely held together by the presence of androconia, thorn-like to cylindrical gnathi and similar patterns usually including a suffusion of russet from the edge. It includes eleven subspecies. The remainder of the russet forms, those lacking androconia and having only cylindrical gnathi form a fairly compact group of species, the *josephi* or unbranded russet, division. This group, which contains a minimum of three distinct species, comprises twenty-four subspecies. The fifth, the well established *regeli,* or black and white, division, separated on the basis of color and minor anatomical criteria, contains the remaining nineteen subspecies.

For purposes of a consecutive survey of a group, one naturally has to resort to a linear arrangement with all the recognized inadequacies of such a manner of representing the true relationships. While a phylogenetic tree branches off from some hypothetical center associated with the most primitive and generalized form, it might not be equally convenient to start with this at the head of the line since other ramifications which might be equally close will have to be resumed after other branches have been expounded. Such breaks are unavoidable but one might follow a procedure of compromise striving to inflict the least possible harm to the true picture which requires a multidimensional diagram rather than a simple consecutive chain.

Some of these groups contain forms doubtfully related but even excluding such forms, the divisions cannot be arranged in a linear series that preserves a picture of their interrelations. The arrangement that involves the least compromise is a ring made up as *bolorica-*

iskander to *josephi* to *regeli* to *pamira* to *huebneri* and back to *bolorica-iskander*. This fits well with the anatomical characters but has distinct breaks in color sequence. The weak places in the ring are at either end of the *pamira* division. If we follow Grum in considering *bolorica* as nearest to the ancestral stem and start our list with it, we must choose between breaking the trend in the relationship between the primitive branded division and the russet unbranded group, or separating the androconia bearing divisions. We originally followed the former course but now favor the latter. Our check list will follow the ring sequence stated above with the break coming between *huebneri* and *bolorica*. The order is arbitrary, but so would be any other linear arrangement.

The Primitive Branded Division

The common characters binding the *bolorica-iskander* division together are the combination of the presence of androconia and a cline in the male genitalia from a heavy thorn-like gnathos to a cylindrical one. The group also shows a more or less graded suppression of the ochre markings which appears in this case to be a primitive condition for there is a cline in the invasion of color from the margin into the uncolored areas rather than the fading of a color as would be expected if the forms were in the process of evolving a loss of color. The forms also have in common the well developed median band, which also may be considered a primitive pattern character. With the exception of some *bolorica* and *chitralica* and possibly *voigti* which spill over into the drainage basin of the Indus, all are found in the mountains rimming the drainage basin of the Amu Daria or Oxus River. The division can be subdivided into three discrete, more or less geographically isolated groups on the basis of differences in genitalia and androconia.

The first group in the southeastern part of the basin comprises *bolorica, chitralica* and *hodja*. These three share in common genitalia having very stout thornlike gnathi and a valve lacking a terminal tubercle. The moderately coarse teeth follow over the rounded tip of the valve like the teeth on the lower jaw of a dogfish shark. The form *hodja* has type C androconia with thicker necks than the type B of *bolorica* and *chitralica*. In pattern, all three share a well marked median band of dark brown, and a less dark basal area overlaid

slightly with pale scales, *bolorica* and *hodja* having the cell considerably lightened. In all three the anterior ocelli are moderate to small, usually minutely pupilled, the posterior ocelli reduced or absent. The discal bands are all crossed by dark scaling on the veins of which that on M_3 is particularly thick. Both *bolorica* and *chitralica* have a very

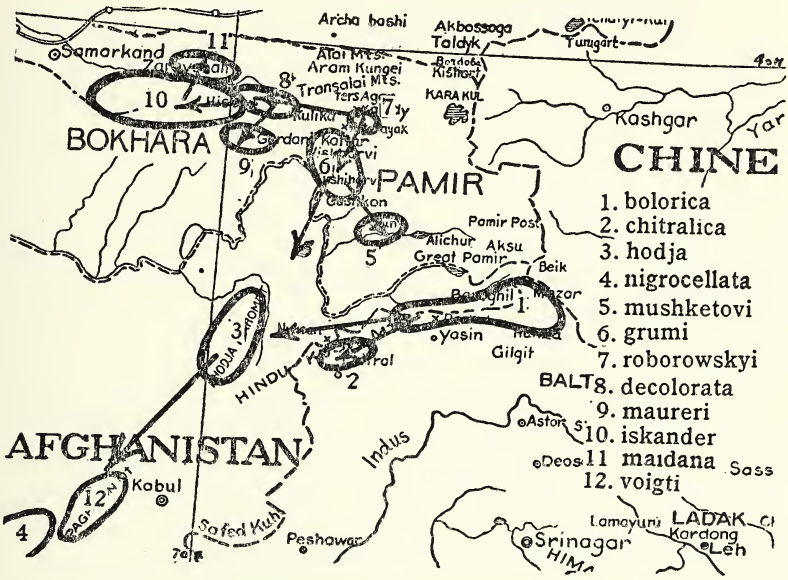


FIG. 8. Distribution of the Bolorica Division.

pale yellowish suffusion from the edge or none while *hodja* shows a similar but much brighter and more distinct suffusion. The undersides of *chitralica* and *hodja* are identical but *bolorica* shows the reduction characteristic of high altitude forms. We will place *chitralica* and *hodja* as discontinuously distributed races of the same species with *bolorica* as the high altitude form of the former. *Bolorica* has priority as the species name.

The second group occupies the mountains on the southwest of the basin in Afghanistan and consists of two populations, one of which is known at present only from a single pair from the Koh-I-Baba Mountains. This form, *nigrocellata,* differs from the rest of the division in the shape of the gnathos which while cylindrical is strongly

curved and also in the pupillation of the large ocelli. In other pattern characteristics it is an extension of the cline from *chitralica* to *hodja,* having heavier brown markings and more and deeper orange ground color, the differences being those of degree rather than type. The androconia match with those of *chitralica.* The other form, *voigti,* is provisionally placed here, no male of it having been taken.

The third group is a more or less intergrading complex of populations that have in common a short neckless androconia, a well developed median band, a light base, and a reduced second ocellus. The seven subspecies occupy a curved territory along the eastern, northern and northwestern sides of the Amu Daria drainage basin. There are four clines closely correlated with geography. First, the thickness and taper of the gnathos decreases northward from *mushketovi* and the Pshiharv *grumi.* Second the elbowing of the base of the gnathos decreases from west towards the east and south. Third, the terminal tubercle decreases from the west and center to east and south. Fourth, the amount of russet coloring increases from the center both ways. In attempting to break down this group we find that each of the sets of criteria usually used for diagnosis, color pattern, genitalia and androconia, gives a different alignment of the specimens. The form *roborovskyi* appears to be the key to the group. It comes in the middle of the opposed genitalic clines, its androconia are the fewest and most degenerate, it is the keystone of the arch of the geographical distribution and is the palest from which the others grade away in smooth clines of color. We will consider all to be the same species with two series of local races. To the south of *roborovskyi* are *grumi* with narrow divided discal bands, none to slight orange and an increase in the thickness of the gnathos, and *mushketovi* with more orange and thicker gnathi. The other line running towards the west has forms with wider discal bands, with *decolorata* having pale dull orange, *iskander* with deeper orange and with *maureri* and *maidana,* though represented only by single specimens, fitting into the cline. The double cline in the increase of orange is shown on the map, fig. 8 by the arrows. Priority requires that *decolorata* be the name applied to this species.

THE RUSSET UNBRANDED DIVISION

The distribution of the forms of the primitive branded division is overlapped in its eastern portion, in Pamir, Darwas, eastern Bukhara and Saravshan, by that of the russet unbranded division. This second division occupies the upper part of the drainage basin of the Amu Daria, the mountainous parts of the Syr Daria basin and the sources of the Talas and Tchou rivers to the north that lose themeslves in the deserts east of the Aral Sea. It spills over slightly into the drainage of the Indus at Hunza and into that of the Tarim at Beik Pass in the south.

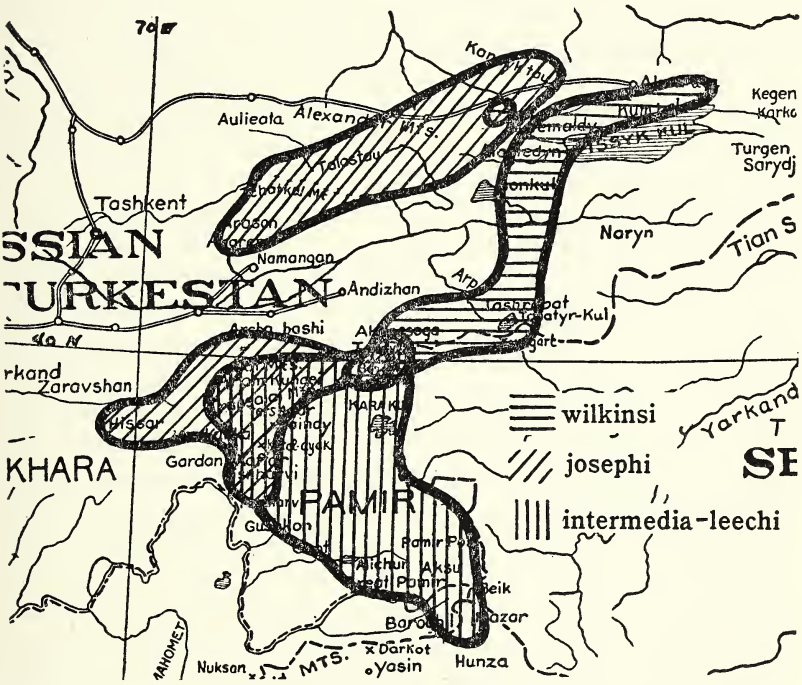


FIG. 9. Zones of overlap between the three species in the Josephi Division.

The twenty-four subspecies included in the russet unbranded division may be grouped in five more or less intergrading series — *josephi, dissoluta, wilkinsi, intermedia* and *leechi.* The first two have a contigu-

ous distribution and intergrade, so they may be lumped together; the last one gives evidence of being a high altitude segregate of the fourth. This leaves us with an irreducible minimum of three — *dissoluta, wilkinsi, intermedia* — which coexist over part of their ranges. The zones of overlap are as follows. In the eastern part of the Alai Valley and the Alai mountains around Taldyk Pass all three fly together. If we move due south to the eastern Trans-Alai *dissoluta* drops out and *wilkinsi* and *intermedia* tend to intergrade in spots and to merge with *leechi* in the higher parts. If we pass westward along the Alai Valley, *wilkinsi* soon drops out. North of the valley in the Alai mountains, *intermedia* also tends to drop out leaving only *josephi* as a representative of *dissoluta* on the north slope. The form *dissoluta* also extends farther down the Alai Valley than *intermedia* and reaches even into Bukhara in the form of *hissariensis*. In eastern Bukhara, western Pamir and Darwas, subspecies of both *dissoluta* and *intermedia* fly together with members of the primitive branded division. *Intermedia* and *leechi* intergrade in the Pamirs.

Because of the wide range in variability, there is no single character, either anatomical or pattern, which will serve to separate these three groups in all of their varieties, yet, wherever two or more fly together, they are easily distinguished. For instance, in any particular locality, *intermedia* has longer narrower wings, slightly paler color, less developed pupils in the ocelli and a less conspicuous white spot between the ocellus and the discocellular mark than *dissoluta*. *Karanasa wilkinsi* under the same conditions has rounder wings, better developed and pupilled ocelli, margins narrower with a marked tendency to be broken by russet veins, and a greater amount of yellowish color at the base of the forewings. On the underside, *intermedia* is readily distinguished by the fact that almost all of the pattern of the hindwing is suppressed except the e_3, m_1 and m_2 lines which stand out against a more or less uniform background. The *dissoluta* forms have the dark bands well marked with heavy reticulations against which the lines do not stand out. The *wilkinsi* forms have less marbled markings and the e_3 line is farther from the margin. With respect to the genitalia, the *wilkinsi* group have a tendency to possess an inflated tip to the valve while the teeth of the *intermedia* forms tend to be reduced to chitinized spots, but in general the differences lie within the spread in variation.

In the basic study of this division made by the senior author, more

than a thousand specimens of each of the groups were examined, including those in the collections of the British Museum and the Russian Academy and his own very large collection, since nationalized by the Soviet. The tabulations of all of these specimens on the basis of color and pattern alone shows that occasionally there is a specimen that cannot be put into any one of the three groups and that there are localities where two groups merge. For instance, in Eastern Trans-Alai, *dissoluta* gradually merges into *intermedia*; at Katylmysh Glacier, in northwestern Pamir, the specimen that we have described as *oshanini* has a mixture of the characters of *dissoluta, intermedia* and *leechi* and cannot be definitely placed in any. We tentatively include it with *dissoluta.* Grum recorded specimens of *dissoluta* from the Hindu Kush; we place them under *intermedia,* but not without some doubt. The modifying influences of high altitude mask any characters that might show a relationship of the northern *leechi* with *wilkinsi* rather than with *intermedia.*

The *dissoluta* group has the widest range and the greatest number of named local races. The typical race, which ranges throughout the Alai Valley and much of the flanking mountains, exists in two pattern morphs, one with a minimum of development of the dark median and basal markings and one in which they become more or less prominent. In the east, the former predominates, toward the west the latter increases. To the south, along the west flanks of the Pamirs, the dark morph becomes the dominant one and the appearance of the butterfly approaches that of *josephi* and the branded forms. This race is *darwasica.* The form *oshanini,* mentioned above, comes in between both in pattern and geographic position. Toward the northwest there is a similar trend to an accentuation of the dark band and base in *josephi* of the Alai Mountains and *hissariensis* from deep in Bukhara within the range of the branded *iskander.* Thus, if we consider *josephi* and *hissariensis* as *dissoluta* forms, there is a cline in the development of the brown markings from light to heavy, fanning out from the Alai valley to the north, west and south.

North of the Alai Mountains, the low valley of Fergana interrupts the distribution of the *dissoluta* group. Between this valley and the deserts of the north, there is a complex of mountain ranges west of Lake Issyk-kul, the Tschotkal, the Talastau, the Alexanders, the Djungaltau and the Kandyktau, that harbor a cline of forms most

closely related to the *dissoluta* of Alai, but having a more rounded outer border to the wings and a more contrasting combination of reddish orange and brown markings. The cline runs from the west-southwest to the east-northeast and involves an increase in the amount

FIG. 10. Distribution of *Karanasa josephi*.

of development in the dark median band and base in the direction indicated. Both *angrena* and *arasana* in the southwest have a minimum of the dark brown, *talastauna* some, *praestans* more and *kasak* at the extreme northeast has the most. The correlation between the amount of dark color and geographic position is almost perfect. Two possible doubtful points are the relation between the Djungaltau specimens and some of the *talastauana* cotypes discussed above on page 77 and the naming of *arasana* from a single specimen taken close to the type locality of *angrena*. In view of the tendencies of the former toward *wilkinsi* and the small number of specimens known, it was thought that the presence of the possibly extra name might stimulate further exploration in this group. The *dissoluta* group comes close to being a superspecies with northern (*talastauana*) and southern (*josephi*) semispecies. We will, however, consider it as a single species which

will have to be called *Karanasa josephi.*

The *wilkinsi* group forms a compact species, takes up where the *dissoluta* group leaves off, and except for the areas of overlap in the eastern Alai regions, occupies a north-south range from the Tchatyr-Kul region in the Tian Shan through the lower Naryn to the region

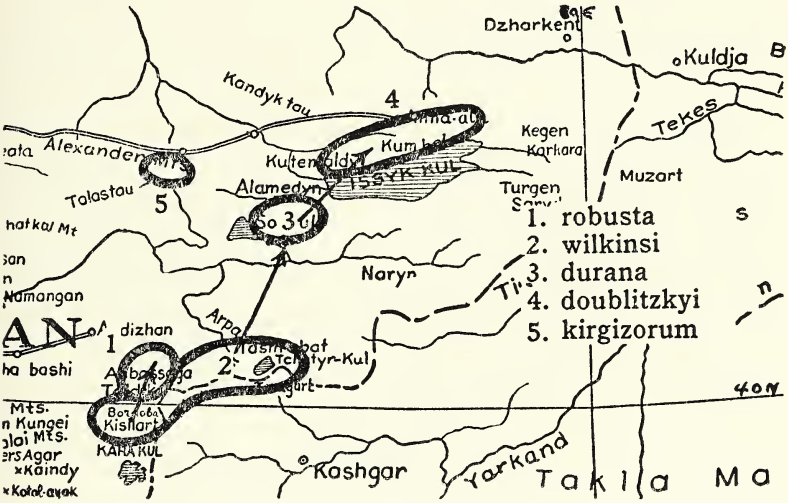


FIG. 11. Distribution of *Karanasa wilkinsi.*

around Lake Issyk-kul. There are four well integrated subspecies and one doubtfully included. They are characterized by well developed ocelli, a tendency for a discontinuity of the marginal band, and, in the forms without dark bases, the ground color at the base of the forewing is a pale brownish yellow with a greenish cast. The wings are broad and tend to be convex on the outer margin. The typical form is *wilkinsi* which ranges from the middle of the Alai Valley eastward over the Alai Mountains into the Tian Shan. On the south, it grades into the northern *leechi* in the high Pamirs. The variety in the passes of the Alai mountains is larger and brighter and has been named *robusta,* but the differences are most probably those due to differences in elevation. To the north, *durana* from southwest of Lake Issyk-kul lies in between *wilkinsi* and the dark *dublitzkyi* both geographically and in markings, forming another color cline that fits well with the

distribution. *Karanasa kirgizorum* represented by a single specimen is only tentatively included in this group because it shows the breaking of the hindwing marginal band by pale veins. It might fit better as a high altitude form of *latifasciata*.

The *intermedia* group is most easily segregated on the basis of the long wings, dull ocelli, and reduced pattern on the underside of the hindwings. According to Grum, it occupies a different ecological niche than that of the *dissoluta* group, but the senior author has taken both

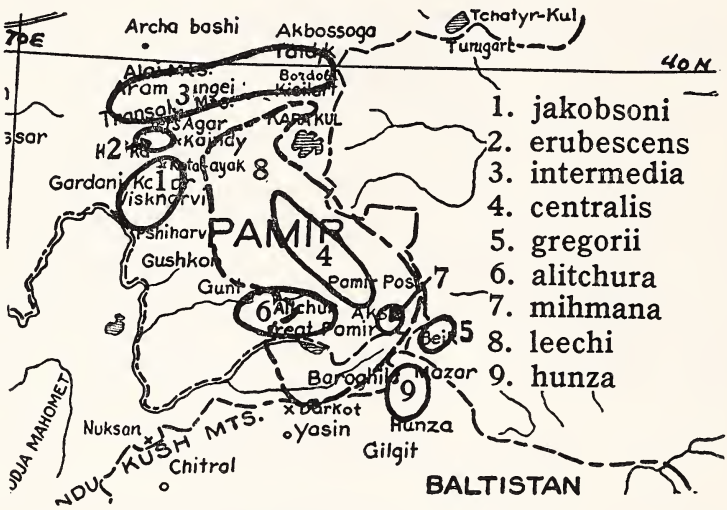


FIG. 12. Distribution of *Karanasa leechi*.

in the same gully. When specimens from all over the Pamir and surrounding areas are brought together, it is immediately apparent that there is a close connection between the *intermedia* of Trans-Alai and the *leechi* of the high passes. Both have the reduced pattern of the underside, both have elongated wings and dull ocelli, and intergrades exist. We will consider them as a unit. As such, the group occupies the high Pamirs and spills over into the Alai region to the north, into Darwas and eastern Bukhara to the west and into Hunza and Chinese Turkestan in the southeast. Taking the group as a whole and disregarding the differences due to altitude, there is a cline in the degree of development of the dark markings from the north and east.

The forms *intermedia* of the Alai and Trans-Alai and *centralis* of the eastern Pamir are the lightest; *erubescens* from northwest Pamir and *gregorii* of southeast Pamir are a little darker; *jakobsoni* from Darwas is still darker with *alitchura* from southwest Pamir and *mihmana* about the same; and *hunza* from the south slopes of the Hindu Kush is the darkest of all. Typical *leechi* varies irregularly in darkness, but averages between *centralis* and *alitchura*. The degree of development of the cross band pattern is a cline largely independent of topography, but the shade of russet is quite closely tied in with altitude. The relatively lowland forms, *intermedia, erubescens* and *jakobsoni,* have bright orange coloring shading to yellowish white on the tips of the wings. Within the Pamirs *centralis, alitchura* and *gregorii,* which fly in the high valleys at an elevation of about 13,000 feet, have paler yellowish orange backgrounds, while *leechi, mihmana* and *hunza* which inhabit the mountainsides and high passes up to 18,000 feet have their dark markings set over a ground that is pale straw to ivory in color. Page priority requires that *leechi* be the species name applied to the *intermedia* group. This is unfortunate for it means that the name now connected with a strictly high alpine segregate must be applied to the whole species.

The arrangement of the butterflies of the russet unbranded division as to taxonomic position is shown on the chart on page 190. On the distribution maps, figures 10, 11, we have indicated the directions of the clines in the development of the dark crossband pattern by means of arrows. The arrows point from less to greater development. It may be of some significance that the increase in the markings fans out in all directions from the eastern Alai Valley, the region in which all three species fly together.

THE REGELI OR FUSCOUS AND IVORY DIVISION

The third division, the *regeli,* or fuscous and ivory division is centered around the Tian Shan Mountain system and the spur ranges leading off to the northwest. The various populations are found in the drainage systems of the Ili River, the Tchou, the upper Syr Daria and the northern part of the Tarim and spill over into the Amu Daria drainage in the Alai Valley. The group as a whole is characterized by a pale color of the background caused by the absence entirely of the discal ochre shades and the absence or bleaching out of the marginal

ochre markings, by the outward displacement and strong development of the ocelli, and by the strong development of the dark transverse markings including, in some forms, the creation of an illusion of sculpturing on the basal area.

With the exception of the form *hoffmani* whose systematic position is indeterminate and whose place of origin is cloaked in mystery, the fuscous and ivory division can be broken down into three species, the *abramovi* forms, the *latifasciata* forms and the *regeli* forms.

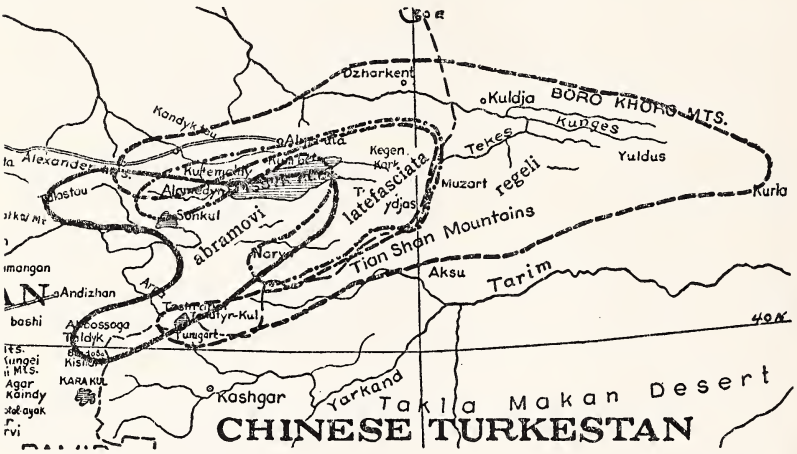


FIG. 13. Areas inhabited by the three species of the Regeli Division.

The westernmost of these is the *abramovi* group, distinguished from the others by the absence of a pale clay colored shade on the outer edge of the discal band and by the longer, shallower uncus in the male genitalia. It occupies a territory extending from about the middle of the Alai Valley eastward along the Tian Shan to the Tchatyr-Kul district and northward across the basin of the Naryn to Lake Issyk-kul and the Alexander mountains. The group is made up of four races and a possible fifth. The type form comes from Tchatyr-Kul in the Tian Shan Mountains along the headwaters of the Arpa River. It is smaller and duller than the other three major races and probably represents the most alpine form. Westward, the form *regula,* the best known of all the *Karanasa,* flies in the eastern half of the Alai Valley. It is the largest, has the largest and blackest ocelli and a complete

blackish median band contrasting with the paler base. In between these two forms geographically is a large pale race, *lactaea,* in which the median band is poorly developed. This race, tentatively set up on the basis of a single female, appears to be an extreme low altitude

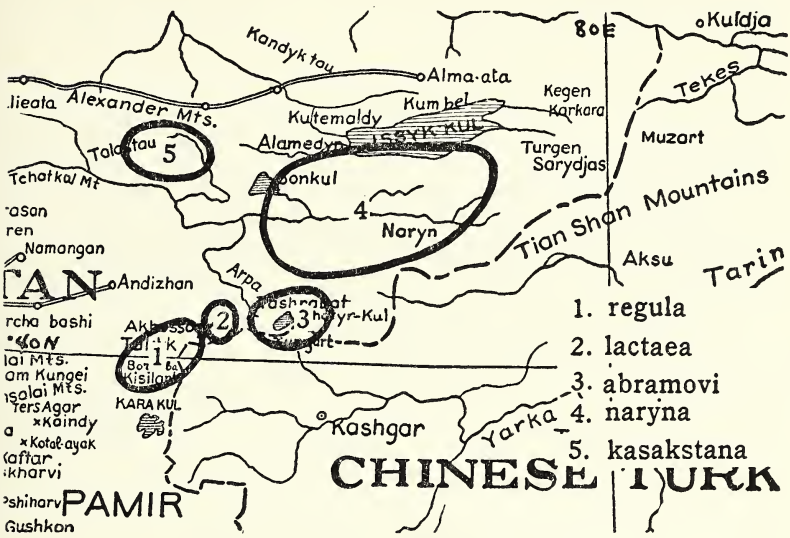


FIG. 14. Distribution of *Karanasa abramovi.*

form. In the Naryn region extending up to Lake Issyk-kul there is a race paler than *regula* with a wider discal band, smaller ocelli, less complete median band and a lighter base, the race *naryna.* In the Talastau district to the northwest there flies the darkest race of all, *kasakstana.* Occasionally a yellowish dimorphic female appears in the group. The *abramovi* group forms the westernmost and presumably the least alpine of three distributional arcs around the head of the drainage basin of the Syr Daria, the forms at the western tips of the arc having the darkest general tone.

The *latifasciata* group is a quite variable aggregation distinguished by the relatively broad discal band, ocelli that are not displaced outwardly as in the other two groups and by a pale yellowish coloring to parts of the discal band. It occupies the northwest slopes of the Tian Shan in an arc around the eastern limits of the distribution of

the *abramovi* group, overlapping the latter in the Issyk-kul and Alexander mountain districts. It appears to have a more alpine ecological niche than the *abramovi* group, whose members, according to Grum, do not fly above 10,000 feet. The type comes from the Sarydjas River up near the crests of the Tian Shan southeast of Lake

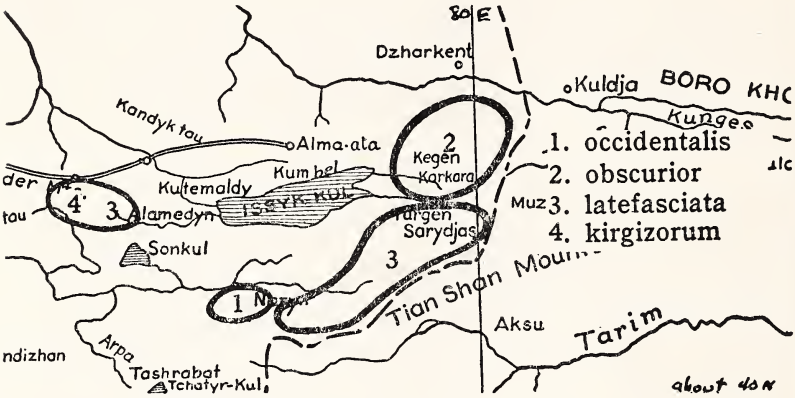


FIG. 15. Distribution of *Karanasa latifasciata.*

Issyk-kul and the race is found around the eastern edges of the Naryn district. To the north, along the streams flowing into the eastern end of Lake Issyk-kul, the fuscous markings become heavier and diffuse into the discal band. There is no break in distribution between this form, *obscurior,* and the typical *latifasciata.* At the southwestern end of the distribution an even darker and more blurred form, *occidentalis,* appears. The specimens from the Alexander Mountains were obtained from dealers and possibly do not come from there, since they match perfectly with those from the type locality, so the extension of the range of this group into the Alexander Mountains is only tentative. We have reason to believe that the name Alexander Mountains has often been applied to all of the ranges leading up to the Tian Shan. In the *latifasciata* group we again have an arc of intergrading forms which parallels that of the *abramovi* group geographically. The subspecies at the ends of the arc are darker than those in the middle as in the latter.

The third and largest group, the *regeli* group, extends still farther eastward and has two westward reaching arms that enclose the territory of the *latifasciata* group. The *regeli* complex may be distinguished by the presence of a light pipe-clay colored outer half to the discal band, by the short deep uncus and generally by the swollen tip of the valve of the male genitalia. *Karanasa regeli* proper inhabits the entire

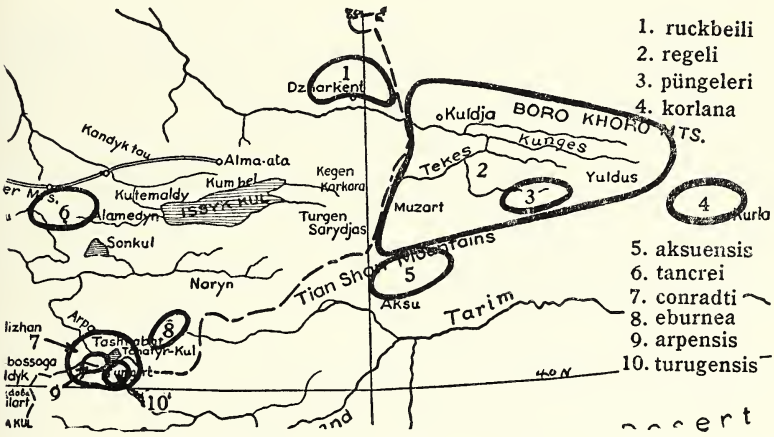


FIG. 16. Distribution of *Karanasa regeli.*

section of high rough country drained by the Ili River between the Tian Shan and the Boro Khoro Mountains. It is medium sized, dull blackish brown with the oyster-white and clay colored band divided on vein M_3; the ocelli, of which the second is the larger, are shifted toward the margin. On the mountains north of Dzarkent, farther down the valley of the Ili, there is a slightly larger, brighter, better ocellated form, *ruckbeili,* whose deviation from the type may be attributed to its coming from a lower altitude. On the southern edge of the *regeli* distribution, over the crest of the Tian Shan divide, north of Korla in the extreme east is found *korlana,* larger and with broader discal bands. North of Aksu, on the same side of the divide is *aksuensis* with still wider bands but smaller ocelli. Within this pattern of named races, but presumably at much higher altitudes, is the smaller duller alpine form *pungeleri.* A northern arm of the *regeli* group extends west into the Alexander Mountains where the form *tancrei,*

scarcely distinguishable from some *latifasciata,* flies. A southern arm extends down the divide of the Tian Shan to the Kashgar district where there flies an intermediate altitude form, *conradti,* with a poorly developed median band and a pale base. On the same mountain are found the two alpine forms *arpensis* and *turugensis* discussed on page 105. The specimen called *eburnea* is a very pale female from farther south along the Tian Shan.

In this division, *latifasciata* appears to be most clearly related to the butterflies of the russet unbranded division, not only because of the variable amount of the ochre coloring but also because of the size and position of the ocelli. It nearly intergrades with *tancrei* which leads to *regeli* to *korlana* and *aksuensis.* The *abramovi* forms which represent the culmination of the trends in this division appear to have turned back and reinvaded the territory of the russet forms. A pictorial representation of this trend is shown on plate 8 on which the specimens representing the two ends of the trend, *regula* and *wilkinsi,* were taken in the same place.

The Pamira or Specialized Unbranded Division

The three divisions discussed above are fairly closely related and one or more varieties in each division approaches a variety in the other, but the *pamira* or specialized unbranded division is separated from them morphologically by a quite considerable hiatus. The butterflies are significantly larger, the forewings are more triangular, the genitalia differ widely from those of the others, and although some forms have patches of enlarged brand-forming scales, there are no androconia. If one were to ignore the anatomical differences a small *pamira* specimen could be confused with a large *dissoluta.* Some of the larger *jakobsoni* have been considered *pamira*-like and Tytler used *pamira* as a point of departure in describing some of the Indian *Karanasa,* but actually, once one has become aware of the differences, the similarities fade away.

The *pamira* division occupies a "Y" shaped band at an intermediate elevation extending along the eastern and southern sides of the Amu Daria drainage basin. The lightest and best known race is *pamira* which is found in the western Alai and Trans-Alai. Due south of the western end of the Trans-Alai in eastern Bukhara, *pamira* is replaced by the more heavily marked *ornata,* and farther south in Darwas,

holbecki, still darker, is found. *Kafir* flies on the passes of the central Hindu Kush and has a dark cross band pattern that covers all the ground color except the normal sized discal band. At the southwestern end of the Hindu Kush the melano-suffused *haslundi* completes this cline. A specimen of *haslundi* on which the blanketing deep brownish-black shade is reduced to a minimum shows a maximum development

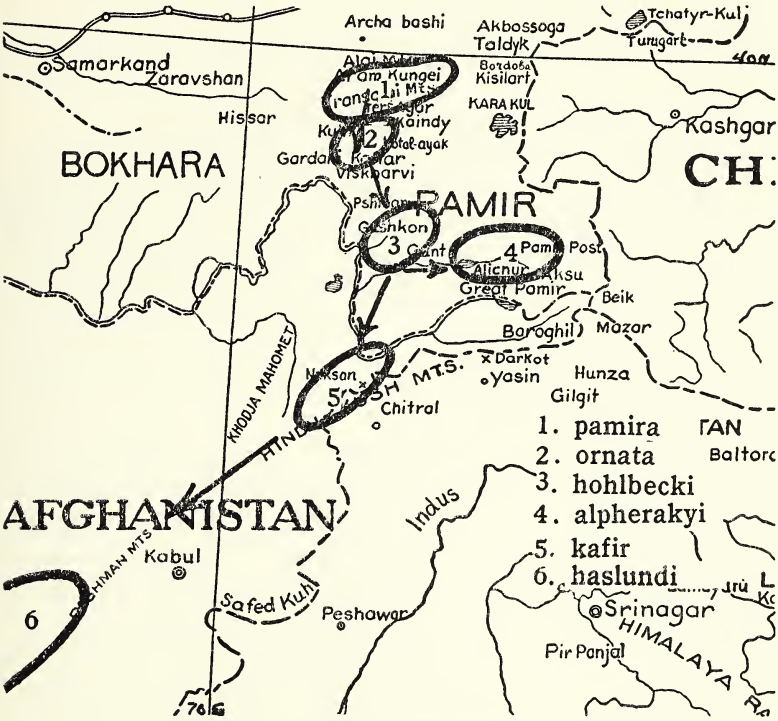


FIG. 17. Distribution of *Karanasa pamira.*

of the cross band pattern in which the discal band is much restricted. The race *alpherakyi* inhabits the valley of the Murgab at Pamir Post in the Pamirs on a line due east from between the ranges of *holbecki* and *kafir.* The development of the dark pattern of *alpherakyi* varies between that of these two, but the russet shades are much paler, possibly an alpine character since *alpherakyi* comes from the highest altitude of the whole division.

Here we have a division quite distinct from the other *Karanasa,* overlapping the distribution of three other divisions and *varying simultaneously with them in color and the development of the cross-band pattern.* We consider the six names as valid geographical subspecies of a single species. It is possible that *ornata* and *holbecki* may be combined when more material is made avilable from intervening localities. The discontinuous distribution of habitats suitable for *Karanasa,* though, makes the merging of local population forms difficult.

The Huebneri or Specialized Branded Division

The *huebneri* or specialized branded division of the genus *Karanasa,* like the *pamira* division, is sharply set off from the rest of the genus by the form of the male genitalia. Within the division there is even less variation in these structures than in those of the *pamira* division. Superficially, there is convergence between the colors and patterns of some of these and members of the other divisions, between *safeda* and *dublitzkyi, moorei* and *kafir, cadesia* and *angrena,* but the anatomical structures of these pairs are so different that the apparent relationships are entirely illusory.

The division occupies the southern slopes of the Hindu Kush and Karakoram Mountains reaching to the central passes in two places, *haarlovi* at Kotal Pass in the Koh-I-Baba, and *dubia* at Karambar Pass in Chitral. It also inhabits the high passes of the Punjab Himalayas but stops short of the Tibetan Plateau. A form is found in the Safed Koh, a range flanking the Hindu Kush on the southwest.

There is a certain amount of overlap between the forms of this division with respect to their differentiating characters because of their wide variability. As a result it is sometimes impossible to place a specimen stripped of its locality label in the proper subspecies, but such specimens are rare. If one arranges the specimens by regional series they may be divided on the basis of color and pattern into two major groups and several minor ones. The structure of the androconia are of considerable help in placing doubtful specimens. At one extreme, both geographically and in pattern, is the *moorei* group inhabiting the southern slopes of the Hindu Kush. This group is characterized by the strong development of the dark crossband pattern, the basal areas being entirely dark in the males and nearly so in the

females, the dark marginal band invading the narrow discal band along the veins. Further, the discal russet shade is poorly developed so that the discal band tends to be light. Sometimes the pale orange is restricted to the area around the lower ocellus. *Haarlovi,* in Afghanistan, is the westernmost and has the narrowest discal bands which are a rosy orange and contrasting white that characterizes all the *Karanasa*

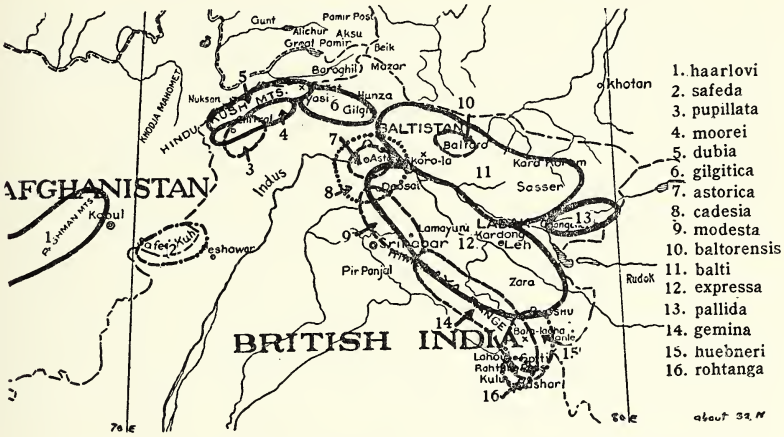


FIG. 18. Distribution of the subspecies of the Huebneri Division.

species in that region. Eastward, after a considerable entomologically unexplored interval, three contiguous forms extend through Chitral and Gilgit. *Moorei,* with the deepest orange, occupies the smallest range at intermediate elevations in Chitral; the lighter *gilgitica* has a much more extended range at the same elevations in Gilgit; while the smaller, duller, darker *dubia* is found in a higher zone on the same mountains as the other two and intergrades with them. All have type A or B androconia. In pattern and the development of the tinting from the edge, these subspecies form a cline with the *pamira* and *bolorica* groups that fly with or near them. On the southern slopes of the Karakoram, on the mountains separating the tributaries of the Indus and on the northern side of the Punjab Himalayas there is a second group of forms characterized by a tendency toward a great reduction in the development of the dark cross band pattern, a paler, more uniformly distributed russet coloring and a slightly different wing

shape. These forms also have androconia of types A or B. The group is divided into three intergrading races, *expressa,* the deepest in color, along the Himalayas and the southern ridges, *balti,* a little paler, occupying the north or Karakoram side of the basin and *pallida,* the palest of all, from the headwaters on the border of Tibet. Flying with *expressa* and *balti* along the western and southern boundaries of their range are forms of a third group that appear to be continuations of the first. In them the dark crossband pattern is normally developed, the basal areas dark, the russet shades deeper, and the androconia different. In any one locality they are fairly easily separated from their lighter neighbors, but when the light or dark forms from all of the stations are placed in series, the ranges of variation overlap. Lumped together, however, the variation from darkest to lightest shows a bimodal distribution. These light and dark morphs, while similar to those of *dissoluta,* differ in that they involve not only pattern but color and androconia as well. The dark segregates, *modesta* and *gemina* along the south side of the *expressa* distribution and *baltorensis* among the *balti,* may be considered incipient species, genetic segregates or ecological variants, but the bimodality of the variation and their proportions in the total population seem to warrant their consideration as separate subspecies, *modesta* and *gemina* have longer androconia than their companions, while *baltorensis* has ones with thicker necks, being in this respect closest to the form *astorica,* a dark form intermediate between the *expressa* group and these dark morphs. *Karanasa astorica* is a more reddish, presumably lower altitude form from the tip of the Punjab Himalayas corresponding to *pupilata* from across the Indus in Chitral. Both have about the same shade of russet and degree of development of the dark markings, but *astorica* has a reduction of the second ocellus while *pupilata* has both equally developed. At the southeastern end of the division, *huebneri* is a pale form generally merging in color and pattern with *expressa* forms to the north of it, but it has entirely different (neckless) androconia. Similarly, *safeda,* the southernmost population west of the Indus has color and pattern tending toward *moorei* and *pupilata* to the north and *haarlovi* to the west of it but the same neckless androconia as *huebneri.* There can be no contact between the two since they are widely separated by the very low valley of the middle part of the Indus. Flying with *huebneri* at Rohtang Pass is a species,

rohtanga, near to it in color and pattern, but having no androconia. Similarly, among *astorica* there is a species, *cadesia,* also having no androconia, which, while it has the same color as *astorica,* differs constantly in other characters.

Here is a very variable, intergrading complex of butterflies sharing almost identical male genitalia, a complex whose extremes are strikingly different, a complex made up of many more or less isolated populations, most of them confined to the upper reaches of "nullahs" or high valleys near the mountain tops, unable to cross the intervening barren ridges or to pass down to the junction of the valleys at much lower altitudes, a condition similar to that encountered by Crampton in his studies of the snails of the genus *Partula* in Tahiti. The complex shows clines in the development of many characters, clines whose directions and rates of change do not necessarily coincide. There are many explanations and we have arrived at our present hypothesis after long study. There appear to be two influences moving counter to each other from the east and from the west and others moving independently from north to south. The western populations have a strong development of the dark crossband pattern similar to that of their *pamira* group neighbors to the north. Those from the east have an equal lack of such development. Both *pallida* and *rohtanga* from the east show as great pattern differences from *moorei* and *haarlovi* of the west as do the extreme populations in any of the other divisions. As we pass toward the center the dark forms get a little lighter and the light forms a little darker and where they meet at the end of the Punjab Himalayas they do not merge, but intermingle; they do not retain their sharp distinctions, but neither do they lose their identities in a general fusion. In the zone of meeting there is a partial exchange of characters. The amount of exchange appears to be about that realized when two species hybridize producing offspring that are only partly fertile, or when two coexisting species breed at different times so that there is only an occasional crossing. The abruptness of the change and the overlapping of the distributions preclude an explanation on the basis of graded geographical subspecies. The hypothesis, to which we held for a long time, that *astorica, modesta, gemina* and *baltorensis* constitute a third group does not explain the intergrading specimens. We believe that *astorica* belongs to the eastern and the other three to the western complex, all having been modified by hybridization.

In addition to the east-west meeting there is a cline from north to south, or rather from the rim of the arc of distribution toward the center, in which there is a change in the type of androconia. All along the rim of the segment the androconia are of types A and B, differing almost only in size, but the forms toward the center, *pupilata, astorica* and *expressa* have the thicker necked types C and D. *Baltorensis* which seems to be a western type segregate that has been deflected up into the range of *balti* is also of this type. Although the first three are lower altitude forms, *baltorensis* comes from the foot of the glaciers. Thus, the change in the form of the androconia is not necessarily one involving a lower altitude. Closer to the center of the segment, *safeda* and *huebneri* have no-necked androconia, while *cadesia* and *rohtanga* have no androconia at all. While *safeda* and *huebneri* share the same type of androconia each is more closely related to their neighbors in other characters than to the other. The same may be said of *cadesia* and *rohtanga,* so it is not logical to assume that they are fringe forms pushed to the edge of the usable habitat by more successful forms having as diagnostic characters the longer androconia. The whole division behaves as though it were one plastic superspecies through which by a slow process, possibly hybridization, individual traits have spread in various directions independently of each other. Many of these traits would serve to delimit acceptable species if there were no intergrades and *if there were some correlation between them.*

SYSTEMATIC SEQUENCE – THE TAXONOMIC CHART

An arrangement of the named forms of the genus *Karanasa* that would place each one in its correct relationship to all of the others, if the relative values of these relationships could be computed, would require more than the three dimensions of space. If we flatten such an arrangement down to a plane, we have the choice between two types of diagrams; one, a sort of tree of life which attempts to show relationships through common ancestry, and the other, a synoptic chart, to show degrees of differentiation at any one particular point in time. The first is the ideal towards which the Linnean taxonomic system is oriented. In practice, however, many compromises are necessary, in fact, in the genus *Karanasa,* so many anomalous interrelations must be taken into account that we had decided to discard the species concept and start with a clean slate. For instance, we must show multiple origins for local populations; we must account for continuous intermediate populations between valid species; we must provide for parallel variations where two or more kinds of butterflies are distinct in each locality, yet more or less overlap when considered as a whole; hybridization must be recognized as a normal factor, not a rare illegitimate phenomenon; and our analysis requires five categories below the genus instead of two. We had even decided to leave to each reader which of our categories he would call species.

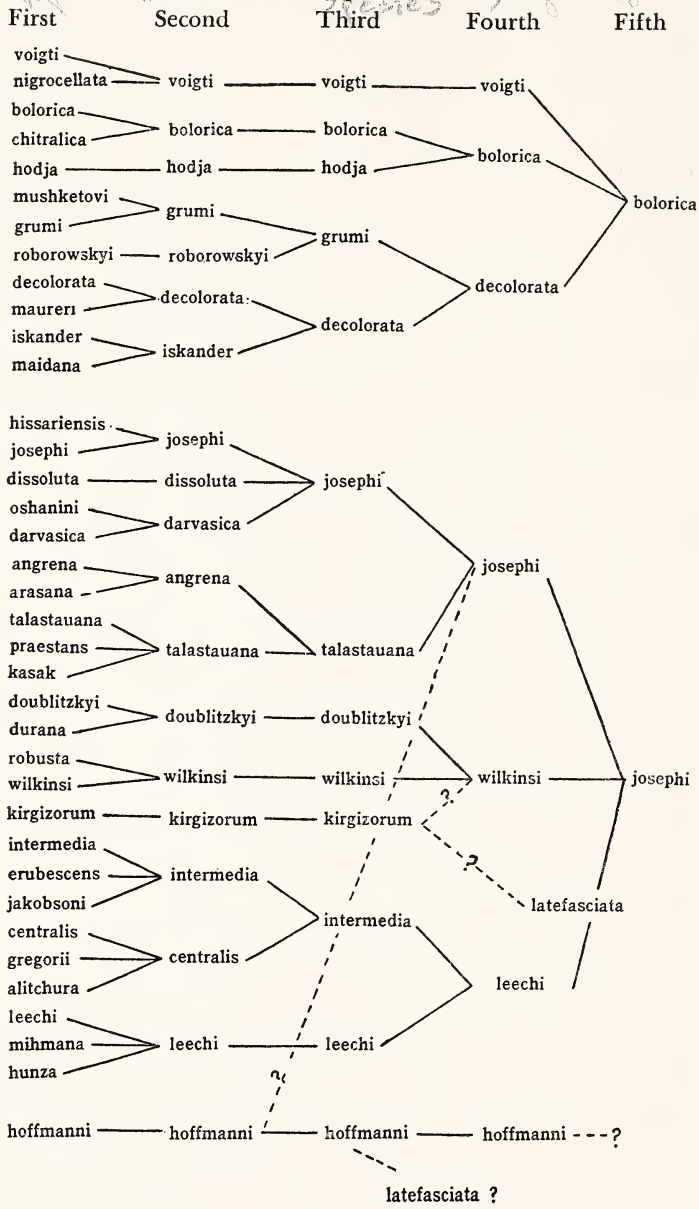
Because of severe criticism of this line of approach by colleagues to whom the first draft of this paper was submitted, the junior author takes the responsibility for trying to fit the work into the more or less rigid straight-jacket of standard nomenclature. We ask the reader to be somewhat liberal in his interpretation of the requirements of the concept of species.

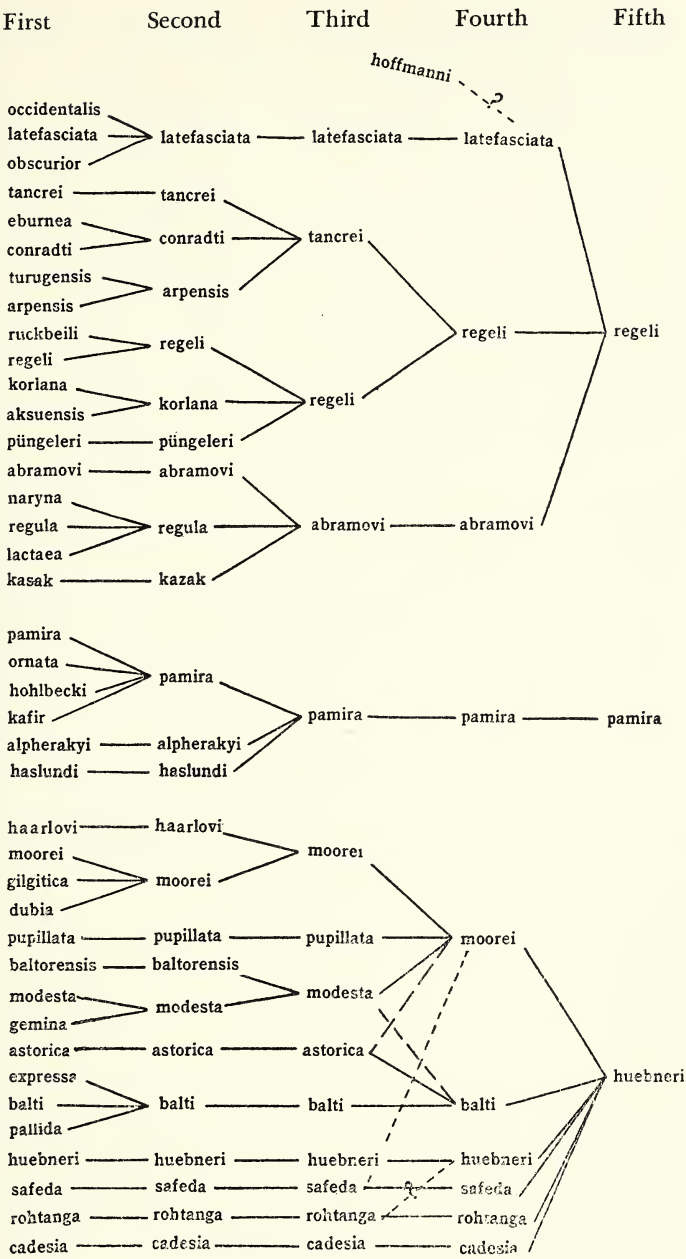
In the accompanying chart we show the various categories in which we combine the various subspecies of the genus *Karanasa* into a taxonomic system.

The lowest category, containing seventy-seven names, represents the known local populations that differ from each other with sufficient constancy to be recognizable as separate entities. Comparisons between such populations show the trends in the development of the entire genus and are the basis for the recognition of clines in various characters. The forms of the first category, then, are *subspecies* in the

THE SYSTEMATIC CHART

Categories




First
Second
Third
Fourth
Fifth
hoffmanni
?
occidentalis
latefasciata
obscurior
latefasciata
latefasciata
latefasciata
tancrei
tancrei
eburnea
conradti
conradti
tancrei
turugensis
arpensis
arpensis
ruckbeili
regeli
regeli
regeli
regeli
korlana
aksuensis
korlana
regeli
püngeleri
püngeleri
abramovi
abramovi
naryna
regula
lactaea
regula
abramovi
abramovi
kasak
kazak
pamira
ornata
hohlbecki
kafir
pamira
pamira
pamira
pamira
alpherakyi
alpherakyi
haslundi
haslundi
haarlovi
haarlovi
moorei
moorei
gilgitica
dubia
moorei
pupillata
pupillata
pupillata
moorei
baltorensis
baltorensis
modesta
gemina
modesta
modesta
astorica
astorica
astorica
expressa
balti
pallida
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huebneri
huebneri
huebneri
huebneri
huebneri
safeda
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rohtanga
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sense of geographic races. We include as subspecies the altitudinal forms for they constitute, to us, valid geographic races, climate being one of the most effective barriers to intermingling.

The second category contains combinations of the first category forms that have been differentiated on the basis of minor characters. Light races are combined with dark ones; the various members of short clines have been combined; some high altitude forms have been coupled with low altitude ones where they occupy contiguous territories. In general, those so combined differ in only a few characters. The second category forms could be called subspecies and the first given quadrinomial status, but that would serve no useful purpose. The second category forms cannot be justified as species and as subspecies in most cases would submerge differences that would otherwise give a better picture of the group as a whole. We let this category go nameless, it merely serves to show relative relationships between subspecies.

The third category represents combinations of forms in which color and pattern similarities are reinforced by similarities in anatomical structures such as genitalia, wing shape and androconial types. These are the species as recognized by many lepidopterists today, the species of the "check list." There are a few names of forms of uncertain position that must be retained in this category, such forms as *kirgizorum* and *hoffmani* which eventually may be combined with one of the others.

The fourth category reduces the number of combinations to a few groups, groups that come closest to the present day biological concept of species. For instance, while the small black *hunza* from Hindu Kush appears to have little in common with the large red *intermedia* from Aram Kungei, they are connected by intermediates and can be considered as extreme forms of what is almost a superspecies.

The fifth and last category, that of the five divisions, obviously combines forms that are specifically distinct. If we adhere to the concept that two subspecies of the same species cannot inhabit the same place at the same time, this category is well above the species level. The races *wilkinsi, dissoluta* and *intermedia,* which are combined at this level, fly together. So do *abramovi* and *conradti, modesta* and *expressa* as well as *huebneri, gemina* and *rohtanga.* We do not wish to designate these divisions as subgenera, they are just combinations for convenience in study, perhaps species-groups.

One of these groups, the *huebneri* complex, does not yield to so simple an analysis. Here the subspecies do not combine into species. The third category groups are not sufficiently distinct to be called species and the fourth category combinations include co-existing subspecies. Since all have almost identical male genitalia, one could sidestep the issue by calling them all one species and ignoring the internal organization, but that would be equivalent to calling all things made with wheat, bread. If we consider the western group, *moorei-gilgitica-dubia-haarlovi* and the eastern group, *pallida-balti-expressa-astorica,* as superspecies, then *pupilata* becomes a semispecies of the former while the *modesta-gemina-baltorensis* group becomes another, but with ties to the eastern superspecies. *Astorica* of the eastern superspecies also has ties to the western one. *Huebneri, rohtanga, cadesia* and *safeda* remain as separate species with cross connections to their neighbors. In all cases these cross connections represent the results of hybrid infusions.

In putting names to the groups in categories of higher order we have adhered to the practice of using the oldest name entering into the combination. This sometimes leads to using the name of an obscure form to head a species, most of the specimens of which do not come near to the original description of that form. For instance, the *dissoluta* species must be called *josephi,* and the *iskander* species, formerly called *josephi,* must now be called *decolorata.* Even more annoying is the fact that mere page priority requires the use of the unsuitable name of *leechi* for the *intermedia* species and *astorica* for the eastern *huebneri*-complex superspecies.

THE CHECK LIST

In revisional work, it is customary to provide a check list of the names used. We will not attempt to give a synonymy because, in many cases, it is not known for certain what insect was being discussed under this or that name. We have reduced the number of species recognized to the minimum possible; not all of the subspecies are of equal taxonomic value. The name of the genus is omitted.

			Page
1.	voigti voigti O. Bang-Haas	Paghman Mts., Afghanistan	47
2.	voigti nigrocellata nov.	W. Hindu Kush, Afghanistan	47
3.	bolorica bolorica Gr.-Gr.	E. Hindu Kush	49
4.	bolorica chitralica Tytler	Chitral, N. W. India	51
5.	bolorica hodja nov.	Badachschan, N.E. Afghanistan	52
6.	decolorata mushketovi nov.	S. W. Pamir	55
7.	decolorata grumi nov.	Darwas	53
8.	decolorata roborovskyi nov.	N. W. Pamir	56
9.	decolorata decolorata Staudinger	E. Bukhara	57
10.	decolorata maureri nov.	E. Bukhara	61
11.	decolorata iskander nov.	N. Bukhara	62
12.	decolorata maidana nov.	Zaravshan	64
13.	josephi hissariensis nov.	E. Bukhara	64
14.	josephi josephi Stgr.	Alai Mountains	65
15.	josephi dissoluta Stgr.	Alai region	69
16.	josephi oshanini nov.	N. W. Pamir	73
17.	josephi darwasica nov.	Darwas	72
18.	josephi angrena nov.	Angren Dist., Russian Turkestan	74
19.	josephi arasana nov.	Angren Dist., Russian Turkestan	75
20.	josephi talastauana O. B-H.	Talas Dist., Russian Turkestan	75
21.	josephi praestans nov.	Djungaltau Dist., Rus. Turkestan	77
22.	josephi kasak nov.	Kasakstan	78
23.	kirgizorum nov.	Alexander Mountains ?	84
24.	wilkinsi dublitzkyi O. B-H.	N. Issyk-kul Dist.	82
25.	wilkinsi durana nov.	S. Issyk-kul Dist.	83
26.	wilkinsi robusta nov.	Alai Mountains	82
27.	wilkinsi wilkinsi Erschov.	Tian Shan, Alai, Trans-Alai	79
28.	leechi intermedia Gr-Gr.	Alai, Trans-Alai	85
29.	leechi erubescens nov.	N. W. Pamir	87
30.	leechi jakobsoni nov.	Darwas	88
31.	leechi centralis nov.	E. Pamir	89

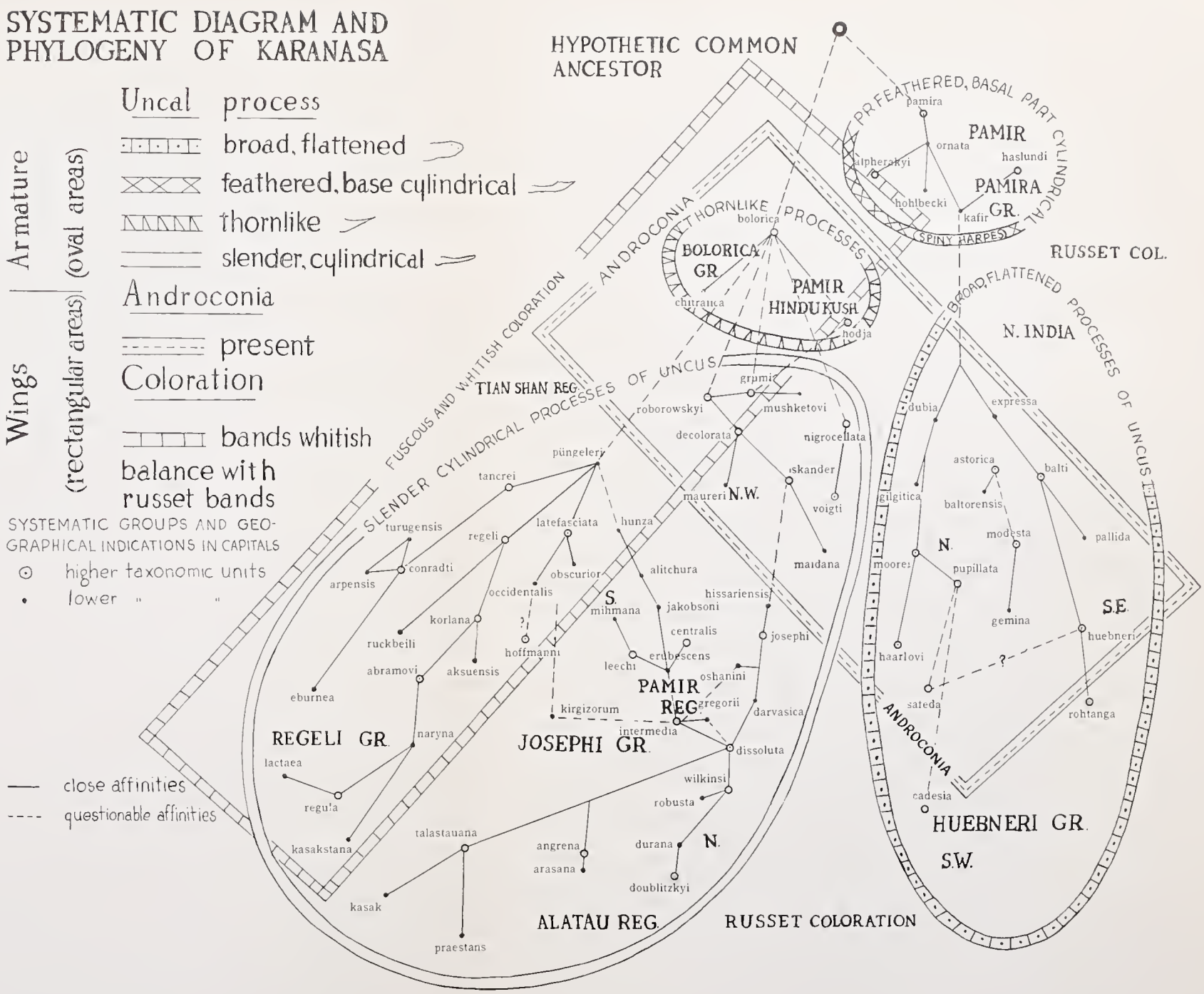
32.	leechi gregorii nov.	S. W. Chinese Turkestan	90
33.	leechi alitchura nov.	S. Pamir	88
	ab. fumigata Avinoff	S. Pamir	89
34.	leechi leechi Gr.-Gr.	Pamir	91
35.	leechi mihmana nov.	S. E. Pamir	93
36.	leechi hunza nov.	Hunza, N. W. India	93
37.	hoffmani Stgr.	Turkestan ?	94
38.	latifasciata occidentalis nov.	Naryn	98
39.	latifasciata latifasciata Gr.-Gr.	N. Tian Shan	96
40.	latifasciata obscurior nov.	Issyk-kul, N. Tian Shan	97
41.	regeli tancrei Gr.-Gr.	Alexander Mountains ?	103
42.	regeli eburnea nov.	Tian Shan	105
43.	regeli conradti Alph.	Tchatyr-Kul, Tian Shan	104
	ab. erschovi Avin. (part)	Tian Shan	112
44.	regeli turugensis nov.	Tchatyr-Kul, Tian Shan	105
45.	regeli arpensis nov.	Tchatyr-Kul, Tian Shan	105
46.	regeli ruckbeili nov.	Djarkent, Semirjetschensk	100
47.	regeli regeli Alph.	Kuldja, Chinese Turkestan	98
48.	regeli korlana Stgr.	Korla, Chinese Turkestan	101
49.	regeli aksuensis nov.	Aksu, Chinese Turkestan	102
50.	regeli pungeleri O. B-H.	Yuldus, Chinese Turkestan	107
51.	abramovi abramovi Erschov	Tchatyr-Kul, Tian Shan	108
52.	abramovi naryna nov.	Naryn	113
53.	abramovi regula Stgr.	Alai	109
	syn. minutianus Fruhst.	Alai	111
	ab. erschovi Avin. (part)	Tian Shan	112
54.	abramovi lactaea nov.	Tian Shan	114
55.	abramovi kasakstana O. B-H.	Talas Dist., Russian Turkestan	113
56.	pamira pamira Gr.-Gr.	Alai, Trans-Alai	114
57.	pamira ornata nov.	N. W. Pamir	117
58.	pamira holbecki nov.	Darwas	118
59.	pamira kafir nov.	Central Hindu Kush	121
60.	pamira alpherakyi Avinoff	S. Pamir	119
61.	pamira haslundi nov.	W. Hindu Kush, Afghanistan	122
Super-species moorei tytler			
62.	moorei haarlovi nov.	W. Hindu Kush, Afghanistan	124
63.	moorei moorei Tytler	Chitral, N. W. India	125
64.	moorei gilgitica Tytler	Gilgit, N. W. India	126
65.	moorei dubia nov.	Chitral, Gilgit	127
66.	pupilata Tytler	Chitral	141
67.	modesta baltorensis nov.	Baltistan, N. W. India	132

THE SYNOPTIC CHART

The standard branching or family tree type of diagram from which the check list was derived is a poor compromise for showing the intricate and not necessarily monophyletic relationships within the genus *Karanasa*. The senior author experimented with a series of two dimensional diagrams to illustrate these relationships. The latest diagram together with his explanation of it follows. As would be expected, it has been necessary to make a couple of minor changes in order to fit in some more recently acquired information.

An attempt is made of tracing a synoptic chart which would comply with the following qualifications: to show the mutual relationship of groups, species, and races in terms of a chain of all the known forms with occasional ramifications of either more obvious or conjectural nature; 2) to indicate the associations in accordance with a) structure of the armature — in particular the gnathi (four divisions) b) the presence or absence of androconia and c) type of coloration: russet or fuscous and whitish. The purpose is to portray each division as a solid and unique block, without breaking the pertaining forms into several separate groups and at the same time to maintain the character of a phylogenetic tree, not making claims of actual descent, of course, of one contemporary form from another. While the linkage of the *huebneri, josephi* and *regeli* cycles has been indicated, it appears that the points of approximation and hypothetical blood relationship are multiple. Thus the kinship may be traced by several paths of interrelated forms. Whether this relationship, if valid, would suggest a phylogenetic origin in the whole group is a matter of opinion, but it seems to me to be not improbable. One should mention, however, that two groups *bolorica* and in particular — *pamira* are left somewhat hanging in the air. The true systematic position of *bolorica* is not quite clear; superficially it seems somehow simultaneously related to the *dubia* section of *huebneri,* to *leechi* of the general *josephi* division, and also to *pungeleri* of the *regeli* group. Since all of these are high alpine forms, the similarity may be an altitudinal convergence. Furthemore, *bolorica* seems to be connected with the *grumi* branch of the *decolorata* section and this connection is probably the closest on grounds of androconia, coloration, and pattern. Also, to a certain

CYLINDR
RUSSET COL.
PROCESSES OF UNCUS
DIA
alti
pallida
S.E.
huebneri
rohtanga
GR.


SYSTEMATIC DIAGRAM AND PHYLOGENY OF KARANASA
Armature (oval areas)
Uncal process
broad, flattened
feathered, base cylindrical
thornlike
slender, cylindrical
Androconia
present
Wings (rectangular areas)
Coloration
bands whitish
balance with russet bands
SYSTEMATIC GROUPS AND GEOGRAPHICAL INDICATIONS IN CAPITALS
higher taxonomic units
lower " "
close affinities
questionable affinities
HYPOTHETIC COMMON ANCESTOR
PREFEATHERED, BASAL PART CYLINDRICAL
PAMIR
PAMIRA GR.
SPINY HARPES
RUSSET COL.
THORNLIKE PROCESSES
BOLORICA GR.
PAMIR HINDUKUSH
ANDROCONIA
FUSCOUS AND WHITISH COLORATION
SLENDER CYLINDRICAL PROCESSES OF UNCUS
BROAD, FLATTENED PROCESSES OF UNCUS
TIAN SHAN REG.
N. INDIA
N.W.
N.
S.
S.E.
S.W.
REGELI GR.
JOSEPHI GR.
PAMIR REG.
ALATAU REG.
RUSSET COLORATION
HUEBNERI GR.
pamira
ornata
haslundi
alpherakyi
hohlbecki
kafir
bolorica
chitranica
hodja
grumi
roborowskyi
mushketovi
decolorata
nigrocellata
iskander
maureri
voigti
maidana
püngeleri
tancrei
turugensis
regeli
latefasciata
hunza
conradti
arpensis
obscurior
alitchura
occidentalis
hissariensis
korlana
mihmana
jakobsoni
ruckbeili
centralis
josephi
hoffmanni
aksuensis
abramovi
leechi
erubescens
oshanini
eburnea
kirgizorum
gregorii
darvasica
naryna
intermedia
dissoluta
lactaea
wilkinsi
regula
robusta
kasakstana
talastauana
angrena
durana
arasana
doublitzkyi
kasak
praestans
dubia
expressa
astorica
balti
gilgitica
baltorensis
modesta
pallida
moorei
pupillata
gemina
huebneri
haarlovi
sateda
rohtanga
cadesia

extent the structure of the armature is perhaps the most similar. Accordingly this chart brings all these groups into proximity, preserving at the same time the diagrammatic single boundary for each group. The *pamira* group is not connected at all in a direct way with any other group. Whether it emerged out of some hypothetical *bolorica-turugensis-leechi* prototype, or is a kind of a modified off-shoot of the *huebneri* complex with which it has a certain remote similarity of armature — is a matter of speculation. Anyhow it is shown in its natural systematic isolation and is only coordinated with the colorational divisions, being an all inclusive complex with every possible variety of ground colors. (AVINOFF MSS.)

The chart strives to express the dual nature of the combination of the *huebneri* complex with the rest of the species. One is suggested by the similarity of the *moorei* branch with *iskander*. The sequence of forms within the *huebneri* cycle is a relatively simple system but some of the branches are traced in dotted lines to express a degree of doubt in regard to the position of the more specialized and isolated members of the clan. (AVINOFF MSS.)

The *josephi* and *regeli* groups — the unbranded, slender-process forms — have a more complex branching. They constitute together the main bulk of the *Karanasa* forms and it might be considered reasonable that they derive origin from the *iskander* and *grumi* stocks correspondingly. At least the line of phylogenetic affinity is sufficiently clear for deducing *josephi* from the *iskander* type. The only substantial difference being the absence of androconia in the first. The close blood relationship between *pungeleri* and *grumi* is highly improbable. It may well be that *intermedia* through *leechi, hunza,* and relatives — is the real connecting link — in accordance with the views of Grum-Grshimailo, who ascribes to *leechi* a central position in the evolution of the various ramifications of *Karanasa*. The diagram makes a point to indicate both lines of affinity and even suggests the rather paradoxical analogy of the *talastauana* and *abramovi* cycles. Whether the close likeness of armature reflects some genuine affiliations or is merely a case of convergence, the diagram takes account of this fact and also alludes to the peculiar proximity of *kirgizorum* to the *latifasciata* branch. Some of the ramifications of the *regeli* group at large are not fully satisfactory and there may be alternatives in shifting some of the links. The position of *hoffmanni* may be considered questionable. (AVINOFF MSS.)

The most involved and somewhat unsettled is the family tree of the *josephi* group. The branching of the *intermedia* cycle may not fully express all the peculiarities of affiliations, like for instance the fact that both *gregorii* and *erubescens* have some traits in common with *dissoluta.* Nevertheless it was considered desirable not to break the immediate association of *dissoluta* and *intermedia* which really reaches the point of fusion. Also *wilkinsi* in certain ways is particularly close to *intermedia,* so that the main gist of the reading of the chart should be consideration of the direct connection of *wilkinsi, dissoluta,* and *intermedia,* which outweighs the fact of the branching of the Alatau cycle (*angrena-talastauana*), between *wilkinsi* and *intermedia,* which should be considered of equal phylogenetic value as the ramifications of the northern relatives of *wilkinsi, durana,* and *dublitzkyi.* The upright direction of the *intermedia* branch suggests the ambiguous position of this group as a possible bridge to the *pungeleri* branch as it was already stated before, but the upward or downward direction in the evolution is not postulated. In fact it should be made clear that the suggested "tree of life" is really not a pedigree, but merely a presentation of closest neighbors and probable blood relatives in the intersection of this evolutionary tree of multiple development by the present instant of time. No true living ancestors are implied and only a closer preservation of more primitive traits is suggested. The fusion of several recurring branches and the multiple bridges between groups should not be interpreted necessarily as a matter of actual derivations, although instances of polyphyletic origin, as intimated before, could not be ruled out. Analogies, whatever be their biological significance, have been everywhere emphasized in this synoptic chart, calling for a bird's eye view of the group from every possible aspect. (AVINOFF MSS.)

While this diagram entailed considerable preliminary trials in adjusting six overlapping areas over a tracing of systematic sequence of forms, it has turned out to be a matter of certain surprise and satisfaction that a good deal of unexpected unity has been brought to light in this way. In addition to this integration of many elements into one picture, it happened that the distributional principle was kept in good accord as it can be noticed by some generalized geographical indications. Also the position of forms recognized to enjoy a specific status gives a clear conception of their distribution and disposition on the family tree. The race or subspecies not necessarily placed below the

species to which it belongs. The relative position was dictated by the best ways of indicating natural affinities but not taxonomic subordination. (AVINOFF MSS.)

The position of the *pamira* cycle was a matter of several experiments in order to allocate to it the most plausible place in a systematic sense. No immediate ties through definite forms can be established for this relatively isolated section of Karanasa. Structural marks indicate its affinity with the *huebneri* cycle of which it might be considered a specialized offshoot, peculiarly recapitulating the diversity of types in the whole genus. The underside so strongly suggesting both the *regeli* and the *decolorata* types only serves to complicate the natural position of the group in question. While it could be taken as a disconnected side excrescence of the *regeli* group it was placed on the diagram above the *huebneri* group on grounds of structural affinities. (AVINOFF MSS.)

The interrelationship of forms eludes all possibilities of expressing the connection as a family tree as some of the more advanced links of the chain show some connections with other ramifications which could not be expressed in an arrangement on a flat surface. It would require some weird, fancy working of the chart to bring certain forms into proximity after they have radiated from a common origin through many steps. In fact, this is one of the most interesting features in such an attempt to show a phylogenetic tree, the stereometric properties of which are wholly defeated. Systematics do not belong to a realm of two dimensions; a flat surface, as it has been stated repeatedly in this essay, does not lend itself for an accurate projection of mutual relationship. One should really have some curved fourth dimensional space postulated by the theory of relativity to work out a model of theoretical inter-linkage. The present chart is but an imperfect compromise which only tends to show how perfectly futile it is to try to present logically and naturally a linear sequence, which has to be adopted in an expository and consecutive treatment, like in this paper. In this sense, one should correlate the main diagram figure and the chart of consecutive enumeration of forms (Pages 194-196) with a diagrammatic branching on various taxonomic levels (Pages 190-191). While a consecutive enumeration possesses obvious practical merits of simplicity in revising any group the diagrammatic chart in two dimensional projection has the advantages of an all-embracing geometrical compromise like a Mercator's projection of geographical maps. (AVINOFF MSS.)

The relative value of various characteristics may be appreciated by comparing the superposition of different areas of uniform properties on certain portions of the family tree of *Karanasa*. The similarity of apparently related groups, diverging from each other on the ground of a particular structural or chromatic trait, indicates the importance of taking into account the totality of properties and distinguishing marks for a correct systematic diagnosis. The interplay of certain diacritical marks is made graphically clear by such a procedure of simultaneous projections of overlapping areas over a network of linked forms. Even such an unstable character as coloration assumes a well defined place in the systematic picture and appears as a sufficiently well circumscribed element of evolutionary variations or mutations.

(AVINOFF MSS.)

No claim is made that every derivation and association is an accurate statement of irrefutable systematic truths. If these diagrams will serve to clarify the conception of the taxonomic and systematic mosaic of *Karanasa* the purpose would be achieved, especially if it would stimulate trials to represent in a similar way other biological groups. Problems are in every group of living forms basically the same and auxiliary methods might be considered practicable to integrate into one picture different systematic coordinates. (AVINOFF MSS.)

SIMULTANEOUS OCCURRENCE

One of the requisites for the maintenance of a stable uniform population of any kind of animal is freedom of movement of the individual and a lack of barriers to interbreeding. The most stable species of butterflies are the wide ranging ones that indulge in periodic or sporadic migrations, *Danaus plexippus* L. or *Vanessa cardui* L., for instance. Conversely, the more restricted the range of activity of the individual for any reason, the greater the differentiation of geographic races. This applies particularly well to alpine species and to insular species, and the genus *Karanasa* may be cited as an extreme example. Most alpine species of butterflies have very restricted flight because the prevailing high winds snatch up the more venturesome and carry them away, usually to places where they cannot survive. The resulting inbreeding preserves the recessive traits and produces widely varying series of local populations even within a limited range. This is quite in evidence among the *Karanasa.*

The *Karanasa* populations are separated by two types of barriers. In the entire southern and western portions of their range, the butterflies live in infrequent pockets of vegetation in a generally barren rocky land. These pockets are at the headwaters of small mountain streams where the seepage from melting snows supports a sparse alpine growth. Above is perpetual snow, on either side wide stretches of barren rock, below, an inhospitable lower altitude ecology. Even in the northern portions of the distribution, where alpine valleys such as the Alai provide a more continuous range, the ruggedness of the mountains maintains this isolation to a lesser degree. Here, though, according to Grum-Grshimailo, the second barrier becomes effective, the barrier of ecological segregation. Even in the Alai valley, only *pamira* and *regula* are regularly found on the open slopes, the others preferring the "sais" or side canyons. The food habits of the *Karanasa* larvae are not known, but they must be quite specific, for *dissoluta, wilkinsi* and *intermedia,* part of whose ranges coincide, normally are each found in its particular niche and each niche ordinarily does not harbor more than one kind.

These butterflies do fly together under certain circumstances as witnessed by the senior author. Also, natural agencies, particularly high winds, may carry individual butterflies across inhospitable intervening space to the next population center. Therefore, unless the various populations are sterile *inter se,* there must be an exchange of characters

between them, a gene flow, the amount and rate of exchange being determined by the frequency of cross mating and the degree of cross fertility. If such were the only factors involved, one would expect a more or less continuous cline of geographical forms such as Crampton found in the land snails of Tahiti and Moraea.

The picture with respect to *Karanasa* is not so simple. Here is no single system of replacement forms but an overlapping of many such systems. In the contacts so established all gradations of interbreeding exist, from *wilkinsi* and *regula* at Bordoba where there is none to the form called *oshanini* in northern Pamir that is a complete blend between *dissoluta* and *intermedia*. In order to get a picture of the amount of overlapping, let us consider the numbers of forms at particular collecting stations. Starting from the south, at Rohtang Pass there are three (*huebneri, gemina, rohtanga*); at Deosai Plateau, two (*modesta, expressa*); at Astor, two (*astorica, cadesia*); at Mizgar, Hunza, two (*bolorica, hunza*); at Gilgit, two (*gilgitica, dubia*); at Chitral, four (*moorei, dubia, pupilata, chitralica*); at Kotal Pass, Koh-I-Baba, three (*haarlovi, nigrocellata, haslundi*); at Alitchura, four (*kafir, alitchura, leechi, bolorica*); at Pamir Post, three (*alpherakyi, centralis, leechi*); at Vis-harvi, four (*ornata, jakobsoni, darwasica, grumi*); at Gursy Tash, three (*ornata, erubescens, dissoluta*); at Hissar, two (*iskander, hissariensis*); at Aram Kungei, three (*pamira, dissoluta, intermedia*); at Kisel Art, three (*wilkinsi, leechi, regula*); at Akbossoga, three (*wilkinsi, intermedia, regula*); at Taldyk Pass, three (*wilkinsi, intermedia, dissoluta*); at Tchatyr-Kul, three (*abramovi, conradti, wilkinsi*); at Yuldus, two (*regeli, pungeleri*); at the Alexander Mountains, three (*tancrei, latifasciata, kirgizorum*); at Talastau, two (*talastauana, kasakstana*); *at* Naryn, two (*naryna, occidentalis*). With the exception of the Alexander Mountain locality which is vague and probably erroneous, all of the places cited harbor the butterflies listed in such close proximity that they may be taken flying together. In addition, there are isolated spots within the distribution of some of the more widely ranging forms that hold still others. For instance, *roborovskyi* is found near Gursy Tash, and *hoffmanni* is found somewhere within the territory of either *iskander* or *maidana*. If complete collections could be obtained from most of the regions of overlap, the list of simultaneously occurring forms could be expanded. Dr. John Clark, for instance, reports seeing a *balti* in Hunza, but did not catch it. The distribution data, of which

the above list is a sample, is combined in the map, figure 20. A study of this map shows that the maximum of joint occurrences extends from Chitral through western and northern Pamir toward the Trans-Alai and Alai mountains. On either side of this line there is a gradual

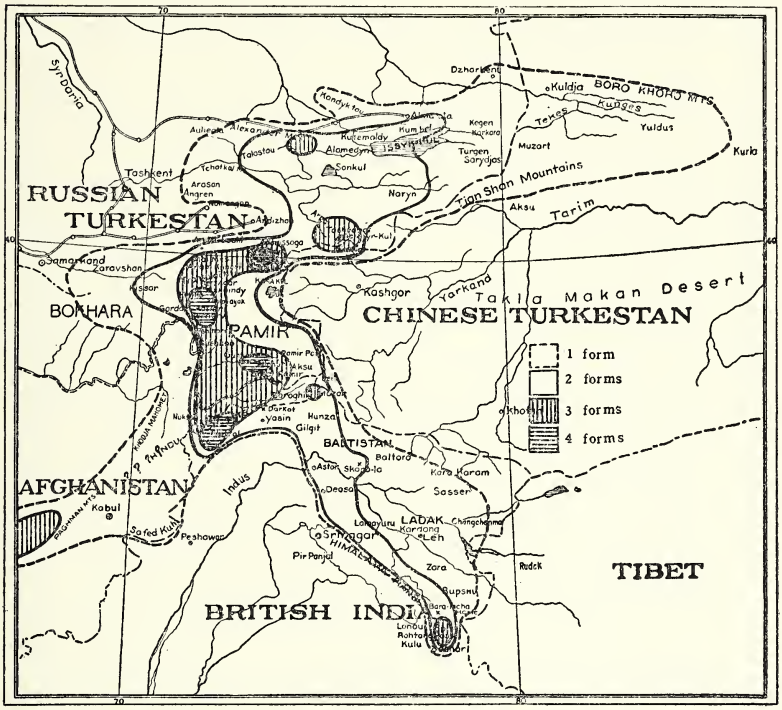


FIG. 20. Map showing the number of species of *Karanasa* living together.

decrease in the number of forms appearing together, from a maximum of four to one on the periphery. It will be noted that the area of maximum number of simultaneously occurring forms coincides with the zones of overlapping of those having androconia and those lacking them and includes at its ends zones of overlapping between the russet and dark forms. There is also an overlapping of forms having fundamentally different genitalia in this same area. This coincidence of the number of forms found in a given area with the assumed zones of overlap gives support to the reality and independence of the postulated divisions within the *Karanasa*.

COINCIDENT VARIATION AND INTERGRADATION

In many localities where two or more species of *Karanasa* fly together there is a tendency for all to assume the same general tone in color. In India, *huebneri* and *rohtanga* share the same shade of pale russet color and the same brown; *cadesia* and *astorica* share a brighter russet; *moorei* and *pupilata* share a darker brown. In the Koh-I-Baba Mountains of Afghanistan *haarlovi* and *nigrocellata,* belonging to two different species groups, have the same rosy tint to the orange color and the same olivaceous brown in similar "grainy" markings. In Hunza at the western end of the Karakoram *bolorica* and *hunza,* belonging to two other species groups, are so similar in general tone that the latter, known only from the female, could easily pass for the female belonging with the males of the former. The triumvirate of *dissoluta, intermedia* and *wilkinsi* vary simultaneously from place to place and where they fly with the *pamira* forms, blend even with them. In Darwas, *jakobsoni* of the *K. leechi* complex and *darwasica* of the *K. josephi* group both have the same dark markings developed to the same extent, having the median band accentuated but the base not solidly dark. Both have almost the same orange tint. In these characters they are also approached by *holbecki,* the *pamira* representative in that district. At Gursy Tash, *erubescens, dissoluta* and *ornata,* representatives of the same three complexes, all have the dark markings developed to a lesser degree and a deeper reddish ground color. A little farther to the northeast, at Aram Kungei in the Alai region, *intermedia, dissoluta* and *pamira* all have a less bright orange color becoming paler toward the base and all three have a minimum of dark markings. At Taldyk Pass at the eastern end of the Alai valley, *pamira* has dropped out but *dissoluta, intermedia* and now, *robusta* a variety of *K. wilkinsi* have in common a pale yellowish orange color with a heavy dark brown border and very little development of the other dark pattern elements, though *intermedia* has narrower margins in keeping with its group characteristics. At Akbossoga and at Bordoba, *wilkinsi* and *intermedia* share overall colors that differ slightly from those of other localities. In the few places where the members of the fuscous and ivory group fly together they have the same general tones.

This type of convergence has been noted by various workers among

many kinds of butterflies in widely separated parts of the world. Sometimes, particularly in connection with the South American Heliconiinae and Ithomidae, it has been attributed to Batesian mimicry. In the *Karanasa,* however, the colors of the upperside can have no survival value so there can be no mimicry. Other explanations, that it is the result of the balance in trace minerals in the soil of the foodplants, or the result of the interaction between the microecological niche and certain common genetic determiners are purely speculative. We have no new hypothesis, but the general ecological setup seems to favor the last named explanation. The traits that converge are the russet and the brown colors. These are pigments derived from uric acid and are laid down in the scales during a relatively brief stage in the development of the pupa. It has been demonstrated experimentally many times that the intensity of the pigment can be influenced by external factors such as temperature and moisture. In countries having both wet and dry season forms of butterflies, one of the principal differences is that the dry season form is lighter and duller in color than the wet season form. *Karanasa* has but one generation a year, so there can be no such comparison, but its whole habitat is a semidesert varying widely in dryness from place to place. Two different degrees of dryness should produce similar effects whether at different times at the same place as in India or East Africa, or at two different places at the same time, as in the Alai. We have no comparative weather data for the stations where the *Karanasa* were caught, so we will have to be satisfied with this speculation.

If we carefully analyse one of these groups of forms from a particular place, say, *dissoluta, intermedia* and *wilkinsi* from Taldyk Pass, we find that *dissoluta* has traits a, b, c, d, e while *intermedia* has traits f, g, h, i, j and *wilkinsi* has k, l, m, n, o. If we make a collection at another station we now find that *dissoluta* and *intermedia* have exchanged a character or two or both may have acquired one from *wilkinsi.* At a third station there is still another assortment and so on. If a *dissoluta* from pass X is compared with the series caught in valley A, it may come half way between the *dissoluta* and the *intermedia* of valley A. We have such a specimen, an *intermedia* from Taldyk Pass that is between the *intermedia* and the *dissoluta* of Aram Kungei. As additional instances of the exchange of characters, the *wilkinsi* of the Eastern Alai valley and mountains sometimes lack the light veins on

the marginal band and *dissoluta* in the same area may occasionally have them; outside the range of *wilkinsi, dissoluta* always has a solid marginal band. At the top of the pass Kisel-Art, leading from the Alai to the Pamirs, only *leechi* is found; this *leechi* has characters usually associated with the *wilkinsi* found a few miles away, these *wilkinsi* characters appearing sporadically also in *leechi* from farther south in the Pamirs.[1] In the region of Dzarkent along the northern slope of the Tian Shan some of the *latifasciata* specimens tend towards *regeli,* some having the band shape of *regeli* but not the color and others just the reverse. Along the passes of the Hindu Kush, *kafiir* of the *pamira* complex on the north slopes approaches in pattern *dubia* of the *huebneri* complex on the south slope. Strangely some of these *dubia* have terminal tubercles on the valve of the male genitalia, a character found in *kafir* but in none of the relatives of *dubia.* In other than color and pattern traits, both *mushketovi* and *roborovskyi* along the edge of the distribution of the androconia bearing forms have very few of these scales. We have already discussed the sharing by different species of certain genitalic traits with variation correlated with geography. The variation from place to place in the combination of characters differentiating species sometimes reaches the point where it is difficult to identify accurately a single specimen from a given locality; long series are easy but short ones are often difficult. This shift in differentiating characters is not to be confused with the shift in characters that separates geographical races; in the present case, two or more SPECIES are simultaneously involved and the difficulties appear when we try to separate the specimens without regard to their places of origin.

The picture is still more confused by the occasional appearance of an exact intermediate, a specimen having the characters of two of the local species but not fitting into either. We have such a specimen from Gursy Tash that could be either *dissoluta* or *erubescens* (*intermedia*) among a long series of the two species. The type specimen of *oshanini* from the edge of the joint distribution of *dissoluta* and *intermedia* is not assignable to either and tends toward *leechi.* This phenomenon, of which the two cases cited are only samples, is quite logically a matter of hybridization.

[1] A. Avinoff "Horae Societis Entomologicae Rossicae" vol. 39, pp. 237-240, 1910.

For the most part, the local populations are not in contact with each other. The two phenomena, the appearance of intergrades between species, and the geographically correlated shift in differentiating characters while the simultaneously existing species remain distinct, can be explained if we assume that there is infrequent crossbreeding. By infrequent, we mean that a few new genetic determiners are introduced into a population from outside not oftener than once in a decade or possibly less often. Bars restricting the introduction of such determiners might be different times of breeding, the mating of a female before her first flight, rejection of strange males, physical bars to the mixing of populations, or hybridization such as explained elsewhere in this paper. The first and third of these are unlikely; mating before flight, while common among some of the moth families and in the Heliconiinae of the butterflies, has not been reported in the Satyridae.

SUMMARY AND GENERAL CONCLUSIONS

In the genus *Karanasa* we have a group of related forms of butterflies which, on the surface, appear to be a variable, heterogeneous aggregation, crudely divisible into three or four species, but which, when carefully analysed, actually consists of a number of overlapping species groups whose variations conform closely to the general laws governing geographical distribution. The genus occupies a territory which extends a thousand miles from east to west, twelve hundred and fifty from south to north and the equivalent of seventeen hundred miles from bottom to top. This last measurement is predicated on the climatic relationship between differences in altitude and latitude being expressed as one thousand feet of the former equivalent to one hundred and seventy-five miles of the latter (page 164). The distribution is not continuous; the local populations are small and isolated (page 203) so that it is possible to demonstrate clines and intergradations that would be swamped in a more continuous distribution.

We have divided the complex into seventy-seven discrete local populations, some restricted to a single gully, others spreading over hundreds of square miles. Some we name only because they show stages in a cline (*mushketovi, arasana, praestans,* etc.), others are well established in the literature. The local populations as used by us are equivalent to the accepted geographical subspecies, and are grouped into sixteen species (plus two of doubtful standing) based on anatomical and distributional differentiation (page 194).

There are three anatomically distinct major groups, each illustrating a different step in the differentiation of kinds of organisms. First, the *pamira* group contains one species composed of six subspecies that form a perfect cline in color, pattern and anatomical characters, well correlated with geography. This is a simple group that illustrates the classical species perfectly (page 182). Its distribution is superimposed on that of the other groups.

The second group, the *huebneri* group, occupying a single drainage basin, goes several steps farther in complexity. Here the basic clines in distinguishable characters do not spread evenly over the distribution, but some appear to be reflected back toward the center from the edges, producing an overlapping of two forms that are neither completely distinct nor merged together. Here also appear clines that progress in

different directions and develop independently of the others (page 184). On the basis of genitalia alone, there is but a single species; on the basis of kinds of androconia, three; on the basis of androconia, color patterns and simultaneous distribution, there are eight. As many as three of these fly together (*huebneri, rohtanga, gemina*) and the group shows overlapping variations.

The third group is increased geometrically in complexity over the other two. The *bolorica-josephi-regeli* complex is anatomically distinct from the *pamira* and *huebneri* complexes, but within itself shows almost continuous intergradation in *all* characters, intergradations that are not correlated with each other, intergradations that must cross species lines, for as many as four of the forms may fly together. If we discriminate on the basis of genitalic structures alone, we have the choice of two or three classification schemes depending on which character we consider diagnostic. If we consider androconia alone, we get an entirely different classification; color gives another and pattern still another, and THERE IS NO CORRELATION BETWEEN ANY OF THEM. The employment of any single kind of diagnostic character results in the grouping of unlikes with regard to the others. The use of combinations results in situations where one character gives a clear-cut differentiation while others intergrade. In another section this is reversed.

A breakdown of this group that fits most closely the interrelationships, that cuts across the fewest clines and that fits best with the geographical distribution, involves roughly the following sequence in diagnosis: (1) androconia or none, (2) color type, (3) pattern and genitalic characters taking into account sympatric forms, and finally geographic distribution. On this basis the complex breaks down into three geographically overlapping species groups, the *bolorica, josephi* and *regeli groups*. The *bolorica* group contains a minimum of three allopatric species, all three of which are connected by uncorrelated clines in color, pattern and genitalic structures. The *josephi* group contains three partially sympatric species whose subspecies cover a wide range in color and pattern and whose local populations vary simultaneously and, rarely, even intergrade. The *regeli* group also contains three slightly overlapping species and appears to have reversed the direction of its dispersal, the clines in color and pattern, at least, producing almost a circle on the map. These nine species together with

two unclassified populations divide up into fifty-three discrete subspecies within which the various populations vary from place to place. For the most part, each of the nine species corresponds in complexity to the whole *pamira* group. The degree of morphological differentiation between the three species of the *bolorica* group, which MAY be called one biological species, and those of the other two groups, which CANNOT, is slight, if any.

The genus *Karanasa* appears to have had a quite recent origin in comparison with the other butterfly genera. The present distribution indicates that before the last major glaciation of the high mountains of Central Asia or before the final uplift—some time between early Pliocene and Pleistocene — there existed in the areas of the Pamirs a butterfly adapted to feeding on some arctic-alpine plant. It is possible that it had already split into two, one of which was the ancestor of the *pamira* group. With the glaciation (or uplift) the food plant was driven from the higher ranges into the fringing drainage areas and carried the butterflies with it. This isolated the butterflies until the food plant was able to reinvade the highlands. Counting clockwise from the Tibetan barrier, the *huebneri* group developed in the Indus drainage district; the *bolorica* group, in the valley of the Amu Daria (Oxus); the *josephi* group differentiated in the district drained by the Syr Daria (Jaxartes); while the Tchou and Ili drainages to the north held the *regeli* group. Either no *Karanasa* went into the Jarkand Daria (Tarim) basin or they were exterminated, because the only members of this genus found there now are three advanced subspecies of *K. regeli* (*korlana, aksuensis* and *turugensis*) that are obviously derived from forms to the north, and a single subspecies of *K. leechi* (*gregorii*) that spills over Beik Pass from the southeast Pamirs; all the tributaries of the Jarkand Daria on the west and south sides of the basin do not harbor any *Karanasa*. The *pamira* group is sufficiently distinct to have been differentiated before the exodus and could have gone into the Amu Daria area or into the drainage of the lesser rivers at the end of the Hindu Kush, such as the Helmand or the Murgab (of Afghanistan not Pamir.)

Since the Pleistocene, there has been a warming and a fluctuating drying up of the entire region, apparently accelerated within historic time. As the higher regions again became hospitable to the food plant, it and its butterfly converged on the Pamirs with the encroaching

deserts pushing from the rear. This produced the sympatric populations indicated in figure 20. This speculative history of the genus, while not ironclad, fits the present distributional facts. The various species did not attain full reproductive isolation because there are numerous evidences of hybridization among them.

The problem of the distribution of the androconia, left unsolved on page 160 can be explained on the basis of the above assumptions. If the parent strains that gave rise to the *josephi, regeli* and *pamira* groups lost their androconia while geographically isolated, it is not necessary to include these groups in the clines of androconial shapes. It will be noted (figure 7) that the long-necked androconia are found centered along the Hindu Kush-Karakoram mountain chain, the zone of overlap between the Indus drainage *huebneri* and the Amu Daria drainage *bolorica* groups. It is possible that during their isolation, these two groups acquired inhibitors that reduced the androconia to the degenerate shapes now found farthest from the zone of overlap, and that introgressive hybridization, by mixing these presumably unlike inhibitors, has restored the primitive types in the zone of contact. Gene flow from the same cause will then account for the gradation to the north and to the south.

There are a number of other phenomena that require some type of gene flow to explain them: (1) the graded dispersion of the terminal tubercle, centering in Bukhara, that involves five species in four species groups (page 152); (2) the cline in the thornlike form of the gnathos that involves four species in three groups (page 153); (3) the elbowed gnathos cline involving four species in two groups (page 154). There is no correlation between these or with any other character. (4) There are other clines in the degree of development of the crossband pattern with the least development centering in the Alai Valley and gradual increases in all directions from it. This involves all species except those in the *huebneri* and *regeli* complexes. (Page 177, figures 10, 11, 17). (5) Within the *bolorica* group there are two centers of pale ground color, *K. bolorica bolorica* and *K. decolorata roborovskyi,* from which there are gradations to orange within the species group (figure 8). (6) The subspecies of *K. moorei* of the *huebneri* complex continue the color and pattern clines of their northern unrelated neighbors (page 185) and even may have a contaminating genitalic character (page 153). (7) The *modesta-gemina-baltorensis* section of *K. moorei* merges incom-

pletely with *K. astorica balti* where the two species overlap (page 187). (8) There is coincidental variation and irregular exchange of characters between the partially sympatric *K. josephi dissoluta, K. leechi intermedia* and *K. wilkinsi,* including the occasional breaking of the marginal band of *K. josephi dissoluta* by yellow veins ONLY where that subspecies is sympatric with *K. wilkinsi.* The yellow veins through the marginal band are characteristic of the latter species (page 207-208). (9) Along the Trans-Alai, *Karanasa josephi dissoluta, K. wilkinsi wilkinsi* and *K. leechi intermedia* merge into the dull, high alpine race *K. leechi leechi,* the presumed hybrid *K. josephi oshanini* being an example (page 208). None of the above phenomena shows significant correlation with any other traits and only the last ties in with ecology, the effects of very high altitude bringing about a convergence of the characters separating the three species.

All of these phenomena represent a dispersal, by contact, of hereditary determiners — gene flow — from population to population along geographical lines; differences between subspecies offer no effective barrier; even differences between species or species groups fail to stop the apparent spread. Inherited characters show up in distinct species (sympatric and allopatric) following definite geographic patterns, patterns that are not satisfactorily explained by parallel evolution. If we assume, however, that there is occasional successful hybridization (introgressive hybridization), all of these phenomena become logical. The extreme variability found in most of the *Karanasa* is supporting evidence to the probability of introgressive hybridization.

Reproductive isolation need not be complete for two species to live together and maintain each its own identity. A hybrid capable of producing only a single, partially fertile offspring when back-crossed to one of the parent species can initiate a flow of new genes into that parent stock. Since only those F_2 or back-cross offspring that are closest to the non-hybrid parent could be expected to survive, there is little probability of the intergrades bridging the gap between the species. The phenomena of secondary hybrid intergradation and gene flow, generally admitted as being normal where SUBSPECIES come into contact, can also function between valid SYMPATRIC SPECIES. There is no natural dividing line.

The above conclusions, if true, have a side effect on the concept of phylogeny. If *Karanasa moorei dubia* has pattern determiners and

terminal tubercle determiners derived from *K. pamira kafir* through hybrid introgression, or if some *Karanasa josephi dissoluta* populations have the marginal band cut by yellow veins because of some past irregular mating with *K. wilkinsi wilkinsi,* then the diagram of the phylogeny of these forms would have a reticulate pattern, rather than the standard branching pattern. It is even conceivable that a whole subspecies could be built up that would come close to the F_1 hybrid between two species and thus be referable to either of them. Strict monophyletic origin is not true where any degree of hybridization is involved.

This brings us back to where we started, namely, that while we glibly write of species, subspecies, etc., these terms really have no fixed meanings, no boundaries. The concept of species — any concept —is largely an abstraction, a special case of a generalized "orderly anarchy." The mere fact that new terms for intermediate grades (subspecies, semispecies, superspecies, formenkreis, artenkreis, vicespecies) are constantly being proposed (and misinterpreted) is supporting evidence to the non-existence of a "species." None of the accepted concepts fits the relationship of the genus *Karanasa.* FIRST, the genitico-physiological concept — applying the term to all the individuals capable of maintaining their stock by interbreeding — leads to absurdities in this genus. Introgressive hybridization operates at all levels and there is no fundamental difference between the process by which fertile offspring are produced from the mating of a melanic sport *fumigata* of *Karanasa leechi alitchura* with its own normal sister and that producing the presumable largely sterile offspring of the mating between a female of the border population of *Karanasa moorei dubia* and a male of the very distantly related *K. pamira kafir* which had been blown across the pass. Both result in the perpetuation of the stock. There are all gradations between these extremes and one can only arbitrarily choose a point before which the matings are intra-specific and beyond which they are inter-specific. SECOND, the replacement race concept is also proven arbitrary. In the Alai Valley, *Karanasa josephi dissoluta* and *K. leechi intermedia* represent two distinct "sympatric species," but in northern Pamir they merge into one. One does not drop out, the intergrade has the characters of both. THIRD, the morphological concept of species suffers most in the *Karanasa.* Size, wing shape, androconia, genitalic characters, pattern and color, for the most part,

vary in orderly clines according to plan, but the plans are all different, there is no correlation between any of them. We think that our taxonomic setup is the best compromise, but there are many others equally logical.

Other observations and conclusions that support or supplement these two major points are:

1. The study of variation divorced from geographical distribution is futile. Where two or more kinds exist together they are usually easily separated on the basis of certain combinations of characters, but in other places, the combinations may change, so that taken as a whole, the two or more species form parallel bands of variation, the means of which are different but the ends overlap. The *dissoluta-intermedia-wilkinsi* complex presents almost a hopeless mess when taken as a whole, but resolves itself into three parallel chains when considered by local populations (page 206-207). Similarly the double nature of the populations in the *huebneri* complex is not apparent until the specimens are arranged geographically.

A corollary of this is that in the variation of any group, the changes are tied in with geography and local climate, and that if a specimen does not fit into the pattern when all of these things are taken into consideration, then either the locality data are wrong or the pattern is imperfect. For example, the form *hoffmanni,* presumably a sport, can be fitted into several places in the *Karanasa* pattern of distribution, but it lacks accurate data. The type specimen of *K. decolorata grumi* supposedly comes from the Alai where it could not fit in (page 54). The junior author doubts that the "Alexander Mountains" locality of the older collections is the same limited mountain range known by that name today; the specimens fit better into the north slope of the Tian Shan part of the distribution pattern.

2. The distribution pattern of the Karanasa shows interesting tie ins with ecology. Where there is a continuous satisfactory habitat from relatively low altitude to high, there is a cline from large, intensely colored, bright individuals to small, pale, dull ones. There are characteristic impoverishments in the pattern at high altitudes. Where there is no such continuous distribution, the same differences, proportional to altitude, occur (page 165). This purely environmental reaction serves to complicate the other variations and misled Grum-Grshimailo and later writers into considering this high altitude convergence to be an

evidence of primitiveness (page 18, 19).

There is a convergence in color tones in which the tints of several sympatric species vary simultaneously from place to place, a convergence that can have no selective basis, but which is possibly a reaction to the dryness of the particular area (page 206-207).

Probably of interest only to lepidopterists are the following observations: 1. We have found that the male genitalic characters, so universally used as the ultimate diagnosis for morphological species, vary as irregularly as do the color and pattern characters and we have found no way to tie in their variations with ecology. 2. We have been able to demonstrate a "sport," presumably genetic, of male genitalic characters (page 123, 150, plate 12, figs. 2, 3). 3. We report a whole population having melano-suffusion, not of the usual black or gray, but of a rich deep brown (page 122, plate 12).

We present these findings as a progress report of a study that is far from complete. The passing of the senior author and the isolation by political factors of the major part of the territory involved have dictated that we pause and take stock. The most serious deficiency is the complete lack of information concerning the immature stages of the butterfly and the paucity of facts regarding the ecology of the breeding ranges. A more accurate measure of the distances between the colonies would help, as would more exact climatic data. We have, at the present time, a trained biologist in Hunza, and we expect to obtain more material from Afghanistan.

EXPLANATION OF PLATE 1

Reproductions of illustrations accompanying original descriptions of *Karanasa.*

FIG. 1. *huebneri* Fld. ♀ type, Novarra R. Pl. LXIX, fig. 8.

FIG. 2. *huebneri* Fld. ♀ type, underside, Novarra R. Pl. LXIX, fig. 9.

FIG. 3. *modesta* Moore ♂ type, Lep. Ind., Pl. 101, fig. 1.

FIG. 4. *modesta* Moore ♀ allotype, Lep. Ind., Pl. 101 fig. 1a (figured by mistake, a male — confirmed by N. D. Riley).

FIG. 5. *leechi* Moore ♂ type, Lep. Ind., Pl. 101, fig. 4.

FIG. 6. *leechi* Moore ♀ allotype, Lep. Ind., Pl. 101, fig. 4a.

FIG. 7. *huebneri* Moore ♂, Lep. Ind., Pl. 101, fig. 3.

FIG. 8. *huebneri* Moore ♀, Lep. Ind., Pl. 101, fig. 3a.

FIG. 9. *cadesia* Moore ♂ type, Pr. Zool. Soc. Lond. 1874, Pl. LXVI, fig. 7.

FIG. 10. *boloricus* Gr-Gr. ♂ type, Rom. Mem. Lep., Pl. XIV, fig. 6a.

FIG. 11. *boloricus* Gr-Gr. ♀ allotype, Rom. Mem. Lep., Pl. XIV, fig. 6c.

FIG. 12. *leechi* Gr-Gr. ♂ type (*huebneri* on plate), Rom. Mem. Lep., Pl. XV, fig. 3a.

FIG. 13. *leechi* Gr-Gr. ♀ allotype (*huebneri* on plate), Rom. Mem. Lep., Pl. XV, fig. 3c.

FIG. 14. *wilkinsi* Ersch. ♂ (*intermedius* on plate), Rom. Mem. Lep., Pl. XV, fig. 5a.

FIG. 15. *wilkinsi* Ersch. ♀ (*intermedius* on plate), Rom. Mem. Lep., Pl. XV, fig. 5c.

FIG. 16. *intermedius* Gr-Gr. ♀ type (*pamirus* on plate), Rom. Mem. Lep., Pl. XV, fig. 7.

FIG. 17. *josephi* Gr-Gr. (see Stgr.) ♂, Rom. Mem. Lep., Pl. XV, fig. 4a.

FIG. 18. *josephi* Gr-Gr. (see Stgr.) ♀, Rom. Mem. Lep., Pl. XV, fig. 4c.

FIG. 19. *pamirus* Stgr. "♂", (a ♀ and not *intermedius* as on plate), *Rom.* Mem. Lep., Pl. XV, fig. 6.

FIG. 20. *abramovi* Gr-Gr. (see Ersch.) ♂, Rom. Mem. Lep., Pl. XVII, fig. 2c.

FIG. 21. *abramovi* Gr-Gr. (see Ersch.) ♀, Rom. Mem. Lep., Pl. XVII, fig. 2a.

FIG. 22. *regeli* (Ersch.) Alph., Horae S. E. R. 1881, Pl. 15, fig. 23.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EXPLANATION OF PLATE 2

Typical subspecies of *Karanasa*

FIG. 1. *bolorica* Gr-Gr. ♂, Beik, Eastern Hindu Kush.
FIG. 2. *bolorica* Gr-Gr. ♀, Beik, Eastern Hindu Kush.
FIG. 3. *bolorica* Gr-Gr. ♂, Mizgar, Hunza, ex coll. Tytler.
FIG. 4. *bolorica* Gr-Gr. ♀, Mizgar, Hunza, ex coll. Tytler.
FIG. 5. *chitralica* Tytler ♂ cotype, Ghizer, Gilgit, ex coll. Tytler.
FIG. 6. *chitralica* Tytler ♂ type, Chitral, in British Museum.
FIG. 7. *chitralica* Tytler ♀ allotype, Chitral, in British Museum.
FIG. 8. *hodja* nov. ♂ paratype, Chodja Mahomet Mts., Afghanistan.
FIG. 9. *hodja* nov. ♂ paratype, Chodja Mahomet Mts., Afghanistan.
FIG. 10. *hodja* nov. ♂ paratype, Chodja Mahomet Mts., Afghanistan.
FIG. 11. *pallida* Tytler ♀ cotype, Chonging Valley, ex coll. Tytler.
FIG. 12. *balti* Tytler ♀ cotype, Skoro-la, Baltistan, in coll. British Museum.
FIG. 13. *gemina* nov. ♀ allotype, Bara-lacha, in coll. British Museum.
FIG. 14. *balti* Tytler ♂, Skoro-la, Baltistan.
FIG. 15. *balti* Tytler ♀, Skoro-la, Baltistan.
FIG. 16. *balti* Tytler ♂, Kardong Pass, Ladakh.
FIG. 17. *balti* Tytler ♀, Kardong Pass, Ladakh.
FIG. 18. *expressa* nov. ♀ paratype, Skarda, Baltistan.
FIG. 19. *expressa* nov. ♀ paratype, Skarda, Baltistan.
FIG. 20. *expressa* nov. ♀ paratype, Foto-la, Ladakh.
FIG. 21. *expressa* nov. ♂ paratype, Tchang Tchen Mo, Ladakh.
FIG. 22. *expressa* nov. ♀ paratype, Tchang Tchen Mo, Ladakh.
FIG. 23. *expressa* nov. ♂ paratype, Peang, Ladakh.
FIG. 24. *expressa* nov. ♀ paratype, Lama-yuru, Ladakh.
FIG. 25. *expressa* nov. ♂ paratype, Nya, Ladakh.
FIG. 26. *astorica* Tytler ♂ cotype, Rupal, Astor, ex coll. Tytler.
FIG. 27. *astorica* Tytler ♀, Rupal, Astor, ex coll. Tytler.
FIG. 28. *astorica* Tytler ♂ ab., Rupal, Astor, ex coll. Tytler.
FIG. 29. *cadesia* Moore ♂, Kalapani, Astor, ex coll. Tytler.
FIG. 30. *cadesia* Moore ♂, Rupal, Astor, ex coll. Tytler.
FIG. 31. *rohtanga* nov. ♂, Rohtang Pass, Kangra, India.
FIG. 32. *gemina* nov. ♀, Rohtang Pass, Kangra, India. (*problematica*, see page 140.)
FIG. 33. *astorica* Tytler ♂, underside of figure 28.
FIG. 34. *cadesia* Moore ♂, underside of figure 29.
FIG. 35. *pupilata* Tytler ♀, Shandur Pass, Chitral, ex coll. British Museum.


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EXPLANATION OF PLATE 3

Typical subspecies of *Karanasa*

FIG. 1. *gilgitica* Tytler ♂, Ghizer, Gilgit, ex coll. Tytler.
FIG. 2. *gilgitica* Tytler ♂, underside, Gilgit, 3,000 m.
FIG. 3. *gilgitica* Tytler ♀, Yasin, Gilgit allotype, ex Tytler coll. (negative reversed).
FIG. 4. *moorei* Tytler ♂, Chitral (Evans) ex coll. Tytler.
FIG. 5. *moorei* Tytler ♀, Darkot Pass, Chitral, ex coll. Tytler.
FIG. 6. *moorei* Tytler, ♂ Chitral, ex coll. Tytler.
FIG. 7. *dubia* nov. ♀ allotype, Punial, Gilgit, ex coll. Tytler.
FIG. 8. *modesta* Moore ♀, Deosai Plains, ex coll. British Museum.
FIG. 9. *dubia* nov. ♂ paratype, Gilgit.
FIG. 10. *dubia* nov. ♀ paratype, Gilgit.
FIG. 11. *iskander* nov. ♂, Mountains in Samarkand region.
FIG. 12. *iskander* nov. ♂, Mt. Hazret-Sultan, Saravshan.
FIG. 13. *decolorata* Staudinger ♂, Kara Sagin, Eastern Bukhara.
FIG. 14. *decolorata* Staudinger ♀, "Samarkand."
FIG. 15. *iskander* nov. ♂, Mt. Hazret-Sultan, Saravshan.
FIG. 16. *voigti* O. Bang-Haas ♀ type, Paghman Mountains, Afghanistan.
FIG. 17. *gilgitica* Tytler ♂ underside, Gilgit.
FIG. 18. *darwasica* nov. ♂ paratype, (dark) Visharvi, Eastern Bukhara.
FIG. 19. *darwasica* nov. ♂ paratype, (medium) Visharvi, Eastern Bukhara.
FIG. 20. *darwasica* nov. ♂ paratype, (light) Visharvi, Eastern Bukhara.
FIG. 21. *darwasica* nov. ♀ paratype, Visharvi, Eastern Bukhara.
FIG. 22. *darwasica* nov. ♀ ab., Visharvi, Eastern Bukhara.
FIG. 23. *josephi* Staudinger ♀, Alai Mountains, ex coll. Maurer.
FIG. 24. *dissoluta* Staudinger ♂ (dark), Gursy Tash, northern Pamir.
FIG. 25. *dissoluta* Staudinger ♂ (light), Gursy Tash, northern Pamir.
FIG. 26. *dissoluta* Staudinger ♂, Ters-Agar, Western Trans-Alai.
FIG. 27. *dissoluta* Staudinger ♀, Gursy Tash, northern Pamir.
FIG. 28. *dissoluta* Staudinger ♂, Aram Kungei, Western Trans-Alai.
FIG. 29. *dissoluta* Staudinger ♂, Taldyk Pass, Eastern Alai Mountains.
FIG. 30. *dissoluta* Staudinger ♀, Atchik-su, Trans-Alai.
FIG. 31. *josephi* Staudinger ♂, Kara-beles, Eastern Bukhara.
FIG. 32. *josephi* Staudinger ♀, Kara-beles, Eastern Bukhara.
FIG. 33. *josephi* Staudinger ♂, Alai Mountains.
FIG. 34. *josephi* Staudinger ♀, Alai Mountains.
FIG. 35. *josephi* Staudinger ♀, underside of figure 34.


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EXPLANATION OF PLATE 4

Typical subspecies of *Karanasa*

FIG. 1. *angrena* nov. ♂ holotype, Angren, Tchotkal Mts.
FIG. 2. *angrena* nov. ♀ allotype, Angren, Tchotkal Mts.
FIG. 3. *talastauana* O. Bang-Haas ♂ type, Talastau, near Aulie Ata (Hor. Macr. Pl. 7).
FIG. 4. *talastauana* O. Bang-Haas ♂ cotype, Talastau, near Aulie Ata.
FIG. 5. *talastauana* O. Bang-Haas ♀ cotype, Talastau, near Aulie Ata.
FIG. 6. *praestans* nov. ♂ paratype, Aulie Ata, Syr Daria (a cotype of *talastauana*).
FIG. 7. *praestans* nov. ♂ paratype, Djungaltau.
FIG. 8. *praestans* nov. ♀ paratype, Djungaltau.
FIG. 9. *kasak* nov. ♂ paratype, Kandyk-tau, Kasakstan.
FIG. 10. *kasak* nov. ♂ paratype, Kandyk-tau, Kasakstan.
FIG. 11. *dublitzkyi* O. Bang-Haas ♂, Kum-bel Mountains, near Aulie Ata.
FIG. 12. *dublitzkyi* O. Bang-Haas ♀, Kum-bel Mountains, near Aulie Ata.
FIG. 13. *dublitzkyi* O. Bang-Haas ♂ type, Kum-bel Mountains (Hor. Macr. Pl. 7, fig. 13).
FIG. 14. *robusta* nov. ♂ paratype, Taldyk Pass, Alai Mountains.
FIG. 15. *robusta* nov. ♀ allotype, Taldyk Pass, Alai Mountains.
F.G. 16. *wilkinsi* Ersch. ♂ ab., Bordoba, Alai region.
FIG. 17. *wilkinsi* Ersch. ♂, Aravan, Alai region.
FIG. 18. *wilkinsi* Ersch. ♀, Akbossoga, Alai Mountains.
FIG. 19. *wilkinsi* Ersch. ♀, Bordoba, Alai region.
FIG. 20. *kirgizorum* nov. ♂ type, underside, Alexander Mountains near Issyk-kul.
FIG. 21. *intermedia* Gr-Gr. ♂, Aram Kungei, western Trans-Alai.
FIG. 22. *intermedia* Gr-Gr. ♀, Aram Kungei, western Trans-Alai.
FIG. 23. *intermedia* Gr-Gr. ♂, Aram Kungei, western Trans-Alai.
FIG. 24. *intermedia* Gr-Gr. ♀, Aram Kungei, western Trans-Alai.
FIG. 25. *intermedia* Gr-Gr. ♂ ab., (trans. to *wilkinsi* Ersch.), Bordoba, Alai region.
FIG. 26. *intermedia* Gr-Gr. ♂, Taldyk Pass, Alai Mountains.
FIG. 27. *intermedia* Gr-Gr. ♀, Taldyk Pass, Alai Mountains.
FIG. 28. *intermedia* Gr-Gr. ♀, Aram Kungei, western Trans-Alai.
FIG. 29. *intermedia* Gr-Gr. ♀, Atchik-su, central Trans-Alai.
FIG. 30. *jakobsoni* nov. ♂ paratype, Gursy Tash, northwest Pamir.
FIG. 31. *jakobsoni* nov. ♀ allotype, Gursy Tash, northwest Pamir.
FIG. 32. *jakobsoni* nov. ♀ paratype, Gursy Tash, northwest Pamir.
FIG. 33. *jakobsoni* nov. ♂ paratype, Visharvi, Darwas, Bukhara.
FIG. 34. *alitchura* nov. ♂ paratype, Great Pamir, in coll. British Museum.
FIG. 35. *mihmana* nov. ♂ paratype, Mihman-yuli, eastern Hindu Kush.
FIG. 36. *leechi* Gr-Gr. ♂, Beik Pass, eastern Hindu Kush.
FIG. 37. *centralis* nov. ♂ paratype, Pamir Post, Pamir.
FIG. 38. *centralis* nov. ♀ paratype, Aksu, Pamir.


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EXPLANATION OF PLATE 5

Typical subspecies of *Karanasa*

FIG. 1. *leechi* Gr-Gr. ♀, Beik Pass, eastern Hindu Kush (maximum ocellation.

FIG. 2. *leechi* Gr-Gr. ♀, Beik Pass, eastern Hindu Kush (minimum ocellation.

FIG. 3. *arpensis* nov. ♂ paratype, Tash Rabat, Kashgar District.

FIG. 4. *turugensis* nov. ♂ paratype, Turug-art, Kashgar District.

FIG. 5. *turugensis* nov. ♂ paratype, Turug-art, Kashgar District.

FIG. 6. *arpensis* nov. ♀ paratype, Tash Rabat, Kashgar District.

FIG. 7. *arpensis* nov. ♂ paratype, Tash Rabat, Kashgar District.

FIG. 8. *arpensis* nov. ♀ paratype, Tash Rabat, Kashgar District.

FIG. 9. *arpensis* nov. ♀ paratype, Tash Rabat, Kashgar District.

FIG. 10. *eburnea* nov. ♀ type, Utchinunak, Kashgar Region, in coll. British Museum.

FIG. 11. *turugensis* nov. ♀ ab., Turug-art, Kashgar District.

FIG. 12. *pungeleri* O. Bang-Haas ♂ type, Yuldus, Tian Shan (Iris, Vol. 24, Pl. 3, fig. 2).

FIG. 13. *tancrei* Gr-Gr. ♂ type, Alexander Mountains, in coll. British Museum.

FIG. 14. *tancrei* Gr-Gr. ♂ cotype, Alexander Mountains, in coll. British Museum.

FIG. 15. *ruckbeili* nov. ♂ ab., Burkhan near Djarkent, Semirjetschensk.

FIG. 16. *latifasciata* Gr-Gr. ♂, Oldjabai, Sarydjas, central Tian Shan.

FIG. 17. *latifasciata* Gr-Gr. ♀, Oldjabai, Sarydjas, central Tian Shan.

FIG. 18. *tancrei* Gr-Gr. ♀, Alexander Mountains, ex coll. Tancré.

FIG. 19. *obscurior* nov. ♀ allotype, Kara Kara, north slope Tian Shan.

FIG. 20. *obscurior* nov. ♂ (trans. to *latifasciata*), Kara Kara, north slope Tian Shan.

FIG. 21. *grumi* nov. ♂ (trans. to *mushketovi*), Psiharv, eastern Bukhara.

FIG. 22. *hoffmanni* Staudinger ♀, Samarkand Region, in coll. British Museum.

FIG. 23. *ruckbeili* nov. ♀ ab., Burkhan, near Djarkent, Semirjetschensk.

FIG. 24. *obscurior* nov. ♂ paratype, Kara Kara, north slope Tian Shan.

FIG. 25. *naryna* nov. ♂ paratype, Karagaitau, Naryn.

FIG. 26. *naryna* nov. ♂ paratype, Issyk-kul.

FIG. 27. *regula* Staudinger ♂, Akbossoga, Alai Mountains.

FIG. 28. *kasakstana* O. Bang-Haas ♂ cotype, Talas Alatau, Kasakstan.

FIG. 29. *regula* Staudinger ♂, Kisel-art slopes, eastern Trans-Alai.

FIG. 30. *regula* Staudinger ♂, Bordoba, eastern Alai Region.

FIG. 31. *lactaea* nov. ♀ type, Yagatchart, Alai Mountains, ex coll. Grum-Grshimailo.

FIG. 32. *regula* Staudinger ♀ ab., Akbossoga, eastern Alai Mountains.

FIG. 33. *naryna* nov. ♀, Alexander Mountains ?, ex coll. Tancré.

FIG. 34. *regula* Staudinger ♀, underside, Akbossoga, eastern Alai Mountains.


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EXPLANATION OF PLATE 6

Typical subspecies of *Karanasa*

FIG. 1. *pamira* Staudinger ♂, Darant Kurgan, western Alai Mountains.

FIG. 2. *pamira* Staudinger ♂, underside of figure 1.

FIG. 3. *pamira* Staudinger ♂, Aram Kungei, western Trans-Alai.

FIG. 4. *pamira* Staudinger ♀, Aram Kungei, western Trans-Alai (compare with fig. 20, Pl. 1).

FIG. 5. *ornata* nov. ♂ paratype, Gursy Tash, northwest Pamir.

FIG. 6. *ornata* nov. ♂ paratype, Gursy Tash, northwest Pamir.

FIG. 7. *ornata* nov. ♂ underside, paratype, Gursy Tash, northwest Pamir.

FIG. 8. *ornata* nov. ♀ paratype, Kulika Pass, eastern Bukhara.

FIG. 9. *alpherakyi* Avinoff ♂ type, Pamir Post, east-central Pamir.

FIG. 10. *alpherakyi* Avinoff ♀ allotype, Pamir Post, east-central Pamir.

FIG. 11. *alpherakyi* Avinoff ♂ underside, Pamir Post, east-central Pamir.

FIG. 12. *alpherakyi* Avinoff ♂ ab., Pamir Post, east-central Pamir.

FIG. 13. *alpherakyi* Avinoff ♂, underside of figure 12.

FIG. 14. *alpherakyi* Avinoff ♀ underside, Pamir Post, east-central Pamir.

FIG. 15. *alpherakyi* Avinoff ♀, Pamir Post, east-central Pamir.

FIG. 16. *alpherakyi* Avinoff ♀, Nestijilga, east-central Pamir.

FIG. 17. *holbecki* nov. ♂ holotype, Gushkon Pass, Darwas.

FIG. 18. *kafir* nov. ♂, locality unknown, from illustration by Schwanwitch.

FIG. 19. *kafir* nov. ♂, underside of figure 18.

FIG. 20. *kafir* nov. ♂ type, Nuksan Pass, Hindu Kush, Kafirstan.

FIG. 21. *kafir* nov. ♂ paratype, Nuksan Pass, Hindu Kush, Kafirstan.

FIG. 22. *kafir* nov. ♀ allotype, Nuksan Pass, Hindu Kush, Kafirstan.

FIG. 23. *hoffmanni* Staudinger ♀ ?, from illustration by Schwanwitch.

FIG. 24. *hoffmanni* Staudinger ♀, underside of figure 23.

FIG. 25. *roborovskyi* nov. ♀ allotype, underside, Koshalayak Glacier, Darwas.

FIG. 26. *roborovskyi* nov. ♂ type, underside, Koshalayak Glacier, Darwas.

FIG. 27. *chitralica* Tytler ♂ cotype, underside, Shandur Pass, Chitral, ex coll. Tytler.


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EXPLANATION OF PLATE 7

Typical subspecies of *Karanasa*

FIG. 1. *leechi* Gr-Gr. ♂ underside, Beik Pass, Eastern Hindu Kush.
FIG. 2. *aksuensis* nov. ♂ underside, Aksu region, Tian Shan Mountains.
FIG. 3. *regeli* Alpherakyi ♂ underside, Karagaitash, Tekkes, Tian Shan.
FIG. 4. *dissoluta* Staudinger ♂ underside, Gursy Tash, northwest Pamir.
FIG. 5. *praestans* nov. ♂ underside, "Aulie Ata, Syr Daria."
FIG. 6. *dubia* nov. ♂ underside, Gilgit.
FIG. 7. *angrena* nov. ♂ type underside, Angren, Tchotkal Mountains.
FIG. 8. *dissoluta* Staudinger ♂ underside, Aram Kungei, western Trans-Alai.
FIG. 9. *intermedia* Gr-Gr. ♂ underside, Aram Kungei, western Trans-Alai.
FIG. 10. *dissoluta* Staudinger ♂ underside, Gursy Tash, northwestern Pamir.
FIG. 11. *erubescens* nov. ♂ holotype, underside, Gursy Tash, northwestern Pamir.
FIG. 12. *jakobsoni* nov. ♂ underside, Gursy Tash, northwestern Pamir.
FIG. 13. *intermedia* Gr-Gr. ♀ underside, Atchik-su, Trans-Alai.
FIG. 14. *intermedia* Gr-Gr. ♀ underside, Aram Kungei, western Trans-Alai.
FIG. 15. *dissoluta* Staudinger ♂ underside, Taldyk Pass, eastern Alai Mountains.
FIG. 16. *dissoluta* Staudinger ♂ underside, Atchik-su, Trans-Alai.
FIG. 17. *intermedia* Gr-Gr. ♂ underside, Atchik-su, Trans-Alai
FIG. 18. *intermedia* Gr-Gr. ♂ underside, Atchik-su, Trans-Alai.
FIG. 19. *arpensis* nov. ♂ underside, Tash Rabat, Kashgar District.
FIG. 20. *arpensis* nov. ♂ underside, Tash Rabat, Kashgar District.
FIG. 21. *bolorica* Gr-Gr. ♀ underside, eastern Hindu Kush.
FIG. 22. *Neominois ridingsii* Edw. ♂, Converse County, Wyoming.
FIG. 23. *Neominois ridingsii* Edw. ♂, Converse County, Wyoming.
FIG. 24. *Neominois ridingsii* Edw. ♀, Colorado.
FIG. 25. *Neominois ridingsii* Edw. ♂ underside, Colorado.
FIG. 26. *Neominois ridingsii* Edw. ♂ underside, spring form, Colorado.
FIG. 27. *Neominois ridingsii* Edw. ♂ underside, Upper Cliff, Colorado.
FIG. 28. *Neominois ridingsii* Edw. ♂ underside, Upper Cliff, Colorado.
FIG. 29. *Neominois ridingsii* Edw. ♂ underside, Madison, Montana.
FIG. 30. *Neominois dionysus* Edw. ♂ underside, Glenwood, Colorado.
FIG. 31. *Neominois ridingsii* Edw. ♂ underside, Converse, Wyoming (late form).
FIG. 32. *Neominois ridingsii* Edw. ♂ underside, Converse, Wyoming (late form).
FIG. 33. *Neominois ridingsii* Edw. ♂ underside, Converse, Wyoming (early form).
FIG. 34. *Neominois dionysus* Edw. ♂ underside, Glenwood, Colorado.
FIG. 35. *Neominois dionysus* Edw. ♂ underside, Glenwood, Colorado.
FIG. 36. *Neominois dionysus* Edw. ♀ underside, Glenwood, Colorado.
FIG. 37. *Satyrus geyeri* H.-S. ♂ underside, Armenia.


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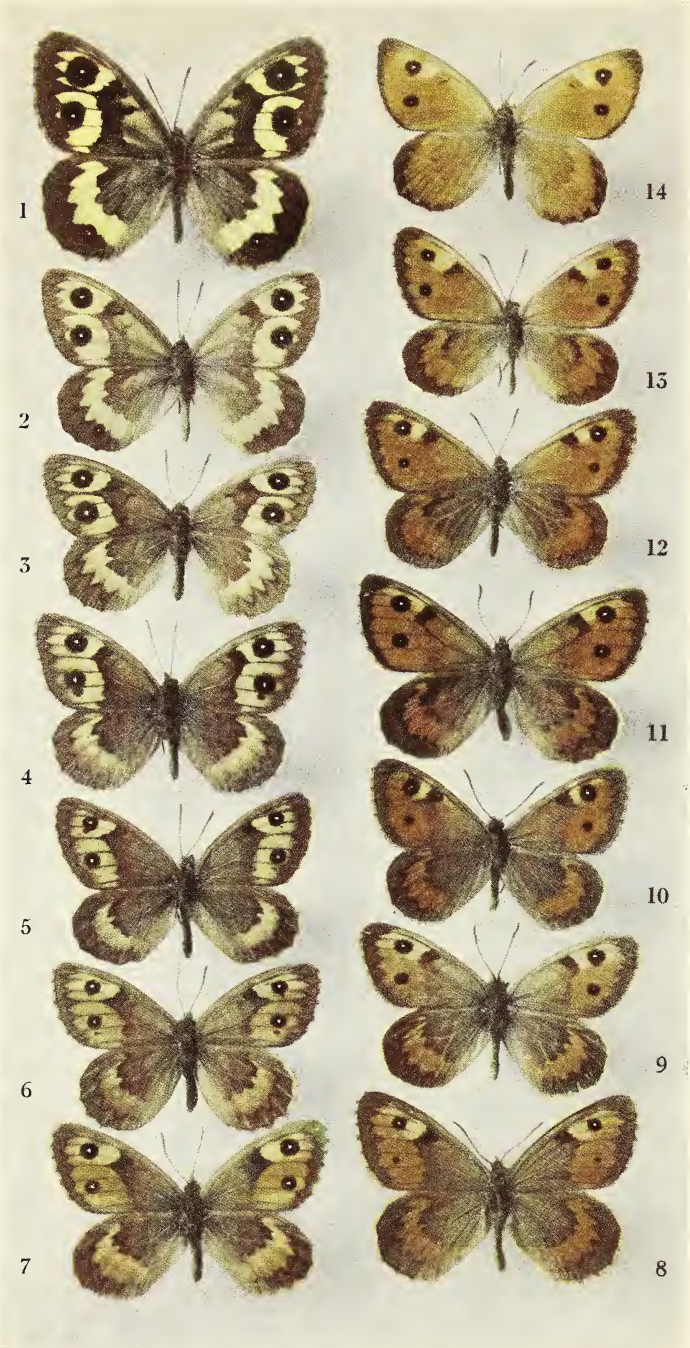
EXPLANATION OF PLATE 8

Typical subspecies of *Karanasa*

A ring of *Karanasa*. Specimens arranged to show gradual transition from one species to another. The two species at the top of the plate fly together. *(The color plate was printed ten years ago and the etchings destroyed. There are only enough for half of the issue. Copies with the color plate have been distributed mostly to libraries; the remainder have a black and white reproduction. Ed.)*

FIG. 1. *regula* Staudinger ♂, Bordoba, eastern Alai District.
FIG. 2. *naryna* nov. ♂, Karagaitau, Naryn.
FIG. 3. *regeli* Alpherakyi ♂, Kuldja District, Tian Shan.
FIG. 4. *latifasciata* Gr-Gr. ♂, Oldjabai, Sarydjas, Tian Shan.
FIG. 5. *latifasciata* Gr-Gr. ♂, Oldjabai, Sarydjas, Tian Shan.
FIG. 6. *latifasciata* Gr-Gr. ♂, Oldjabai, Sarydjas, Tian Shan.
FIG. 7. *latifasciata* Gr-Gr. ♂, Oldjabai, Sarydjas, Tian Shan.
FIG. 8. *hissariensis* nov. ♂, Hissar Mountain, eastern Bukhara.
FIG. 9. *jakobsoni* nov. ♂ type, Kaindy, northwestern Pamir.
FIG. 10. *dissoluta* Staudinger ♂, Kaindy, northwestern Pamir.
FIG. 11. *erubescens* nov. ♂, Gursy Tash, northwestern Pamir.
FIG. 12. *dissoluta* Staudinger ♂, Kaindy, northwestern Pamir.
FIG. 13. *intermedia* Gr-Gr. ♂, Aram Kungei, western Trans-Alai.
FIG. 14. *wilkinsi* Ersch. ♂, Bordoba, eastern Alai District.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EXPLANATION OF PLATE 9

Typical subspecies of *Karanasa*

FIG. 1. *huebneri* Felder vera ♂, Shigri, Lahoul, Elwes coll., ex coll. British Museum.
FIG. 2. *huebneri* Felder ♂, Rohtang Pass, Lahoul, India.
FIG. 3. *rohtanga* nov. ♂ holotype, Rohtang Pass, Lahoul, India.
FIG. 4. *pallida* Tytler ♂ cotype, Chonging Valley, Ladak, ex Tytler coll.
FIG. 5. *pallida* Tytler ♂, Chonging Valley, ex coll. British Museum.
FIG. 6. *balti* Tytler ♂, eastern Pamir (locality uncertain).
FIG. 7. *balti* Tytler ♂ cotype, Skoro-la, Baltistan, ex coll. Tytler, Leech.
FIG. 8. *astorica* Tytler ♂, Rupal, Astor, ex coll. Tytler.
FIG. 9. *modesta* Moore ♂, Deosai Plains, ex coll. British Museum.
FIG. 10. *pupilata* Tytler ♂ cotype, Chitral, ex coll. Tytler.
FIG. 11. *pupilata* Tytler ♂, Shandur Pass, Chitral, ex coll. British Museum.
FIG. 12. *dubia* nov. ♂ holotype, Baroghil Pass, Chitral.
FIG. 13. *dubia* nov. ♂ paratype, Karambar Pass, Chitral.
FIG. 14. *expressa* nov. ♂ holotype, Bura Deosai, Baltistan.
FIG. 15. *baltorensis* nov. ♂ holotype, Baltoro Glacier, Karakoram Mountains.
FIG. 16. *expressa* nov. ♂ paratype, Skardu, Baltistan.
FIG. 17. *wilkinsi* Ersch. ♂, Kisil-art, eastern Trans-Alai, ex coll. Grum-Grshimailo.
FIG. 18. *robusta* nov. ♂ holotype, Taldyk Pass, eastern Alai Mountains.
FIG. 19. *cadesia* Moore ♂, Deosai Plains, ex coll. British Museum.
FIG. 20. *moorei* Tytler ♂, Utzen Nallah, Chitral, ex coll. British Museum.
FIG. 21. *gilgitica* Tytler ♂ type, Ghizer, Gilgit, ex coll. Tytler.
FIG. 22. *dubia* nov. ♂ paratype (Tytler's type), Gilgit, ex coll. Tytler.
FIG. 23. *dubia* nov. ♂ ab., Gilgit.
FIG. 24. *gemina* nov. ♂ holotype, Bara-lacha Pass, Lahoul, India.
FIG. 25. *kirgizorum* nov. ♂ holotype, Alexander Mountains, ex coll. Tancré.
FIG. 26. *angrena* nov. ♂ paratype, Angren, Arasan Region.
FIG. 27. *oshanini* nov. ♂ holotype, Katelmysh Glacier, northern Pamir.
FIG. 28. *maureri* nov. ♂ holotype, eastern Bukhara.
FIG. 29. *voigti* O. Bang-Haas ♀ type, Paghman Mountains, Afghanistan.
FIG. 30. *maidana* nov. ♂ holotype, Maidan Pass, Zaravshan Mountains.
FIG. 31. *decolorata* Staudinger ♂, Kara Sagin, Hissar.
FIG. 32. *iskander* nov. ♂ holotype, Hazret Sultan, Samarkand Region.
FIG. 33. *josephi* Staudinger ♂, Archa Bashi, northwest Alai Mountains.
FIG. 34. *darwasica* nov. ♂ paratype, Visharvi Pass, Darwas.
FIG. 35. *darwasica* nov. ♂ holotype, Visharvi Pass, Darwas.
FIG. 36. *dublitzkyi* O. Bang-Haas ♂ cotype, Kum-bel Mountains, Alma Ata Region.
FIG. 37. *safeda* Tytler ♂ type, Safed Kuh, Afghanistan-India Border, ex coll. Tytler.
FIG. 38. *kasak* nov. ♂ holotype, Kandyk-tau, near Turgaisk.
FIG. 39. *talastauana* O. Bang-Haas ♂, Talastau Mountains, near Aulie Ata.
FIG. 40. *praestans* nov. ♂ holotype, "Aulie Ata, Syr Daria."


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EXPLANATION OF PLATE 10

Typical subspecies of *Karanasa*

FIG. 1. *durana* nov. ♀ allotype, Dura Pass, Syr Daria District near Issyk-kul.
FIG. 2. *gregorii* nov. ♂ holotype, Chinese slopes of Beik Pass, eastern Hindu Kush.
FIG. 3. *centralis* nov. ♂ holotype, Pamir Post, central Pamir.
FIG. 4. *leechi* Gr-Gr. ♂, Beik Pass, 17,000 feet, eastern Hindu Kush.
FIG. 5. *mihmana* nov. ♂ holotype, Mihman-yuli Pass, 18,000 feet, eastern Hindu Kush.
FIG. 6. *hunza* nov. ♀ type, Mizgar, Hunza, ex coll. Tytler.
FIG. 7. *alitchura* nov. ♂ holotype, Alitchur, south-central Pamir.
FIG. 8. *alitchura* ab. *fumigata* Avinoff ♂ type, Alitchur, south-central Pamir.
FIG. 9. *occidentalis* nov. ♂ holotype, Karagaitau Mountains, Naryn.
FIG. 10. *leechi* Gr-Gr. ♂, Beik Pass, eastern Hindu Kush.
FIG. 11. *obscurior* nov. ♂ paratype, Kensu, central Tian Shan.
FIG. 12. *obscurior* nov. ♂ holotype, Turgan, central Tian Shan.
FIG. 13. *regeli* Alpherakyi ♂, Yuldus, Tian Shan.
FIG. 14. *tancrei* Gr-Gr. ♂, Alexander Mountains, ex coll. Tancré.
FIG. 15. *conradti* Alpherakyi ♂, Nia, Kashgar Region.
FIG. 16. *turugensis* nov. ♂ holotype, Turug-art, Tchatyr-Kul Region.
FIG. 17. *turugensis* nov. ♀ allotype, Turug-art, Tchatyr-Kul Region.
FIG. 18. *arpensis* nov. ♂ holotype, Tash Rabat, 11,000 feet, Tchatyr-Kul Region.
FIG. 19. *arpensis* nov. ♀ allotype, Tash Rabat, 11,000 feet, Tchatyr-Kul Region.
FIG. 20. *pungeleri* O. Bang-Haas ♂ cotype, Yuldus, Tian Shan.
FIG. 21. *ruckbeili* nov. ♂ holotype, Burkhan Mountain, near Djarkent.
FIG. 22. *lactaea* nov. ♀ type, Yagatch-art, Alai Mountains, ex coll. Grum-Grshimailo.
FIG. 23. *ruckbeili* nov. ♂ ab., Burkhan Mountain, near Djarkent.
FIG. 24. *kasakstana,* O. Bang-Haas ♂ cotype, Talastau Mountains, near Aulie Ata.
FIG. 25. *regula* Staudinger ♀ ab., *ershovi* Avinoff (original description), Akbossoga, Alai Mountains.
FIG. 26. *conradti* Alpherakyi ♀ ab., *ershovi* Avinoff (original figure), ex coll. Maurer.
FIG. 27. *aksuensis* nov. ♂ holotype, Aksu, south slope, central Tian Shan.
FIG. 28. *abramovi* Ersch. (vera) ♂, Tchatyr-Kul Region, central Tian Shan.
FIG. 29. *korlana* O. Bang-Haas ♂, Korla Mountains, eastern Tian Shan.
FIG. 30. *roborovskyi* nov. ♂ holotype, Koshalayak Glacier, central Pamir.
FIG. 31. *grumi* nov. ♂ paratype, Visharvi Pass, Darwas.
FIG. 32. *grumi* nov. ♂ holotype, Alai Region (false) probably Visharvi, ex coll. Tancré.
FIG. 33. *hodja* nov. ♂ holotype, Chodja Mahomet Mountains, Afghanistan.
FIG. 34. *hoffmanni* Staudinger ♂, Samarkand Region?, ex coll. Maurer.
FIG. 35. *bolorica* Gr-Gr. ♂, Mizgar, Hunza.
FIG. 36. *chitralica* Tytler ♂ cotype, Shandur Pass, Chitral, ex coll. Tytler.
FIG. 37. *pamira* Staudinger ♂, Aram Kungei, western Trans-Alai.
FIG. 38. *ornata* nov. ♂ holotype, Gursy Tash, northwestern Pamir.
FIG. 39. *alpherakyi* Avinoff ♂ holotype, Pamir Post, central Pamir.
FIG. 40. *holbecki* nov. ♂ holotype, Gushkon Pass, Darwas.
FIG. 41. *kafir* nov. ♂ holotype, Nuksan Pass, central Hindu Kush.


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EXPLANATION OF PLATE 11

Typical subspecies of *Karanasa*

FIG. 1. *wilkinsi* Ersch. ♀, Bordoba, eastern Alai Region.
FIG. 2. *darwasica* nov. ♀ allotype, Visharvi Pass, Darwas, eastern Bukhara.
FIG. 3. *praestans* nov. ♀ allotype, Aulie Ata, Syr Daria?
FIG. 4. *centralis* nov. ♀ allotype, Pamir Post, central Pamir.
FIG. 5. *dissoluta* Staudinger ♀, Taldyk Pass, eastern Alai Mountains.
FIG. 6. *arasana* nov. ♀ type, Arasan Bulak.
FIG. 7. *cadesia* Moore ♀ Deosai Plains, Kashmir.
FIG. 8. *safeda* Tytler ♀ allotype, Safed Kuh, India-Afghanistan border, in coll. British Museum.
FIG. 9. *eburnea* nov. ♀ type, Utchianunak, Kashgar Region, in coll. British Museum.
FIG. 10. *intermedia* Gr-Gr. ♀, Aram Kungei, western Trans-Alai.
FIG. 11. *balti* Tytler ♀ cotype, Skoro-la, 15,000 feet, Leech coll., ex Tytler coll.
FIG. 12. *astorica* Tytler ♀ allotype, Rupal, Astor, ex coll. Tytler.
FIG. 13. *rohtanga* nov. ♀ allotype, Rohtang Pass, Lahoul.
FIG. 14. *pamira* Staudinger ♀, Aram Kungei, western Trans-Alai.
FIG. 15. *ornata* nov. ♀ allotype, Gursy Tash, northwestern Pamir.
FIG. 16. *alpherakyi* Avinoff ♀ allotype, Pamir Post, central Pamir.
FIG. 17. *holbecki* nov. ♀ allotype, Gushkon Pass, Darwas.
FIG. 18. *conradti* Alpherakyi ♂ var., Kashgar Region.
FIG. 19. *regeli* Alpherakyi ♀, Yuldus, Kuldja District.
FIG. 20. *ruckbeili* nov. ♀ allotype, Burkhan Mountain, Djarkent Region.
FIG. 21. *pupilata* Tytler ♀ allotype, Tarben Nallah, 8,000 feet, Chitral.
FIG. 22. *dubia* nov. ♀ paratype, Yasin, Chitral (Tytler's allotype).
FIG. 23. *gilgitica* Tytler ♀, Gilgit.
FIG. 24. *moorei* Evans ♀, Chitral.
FIG. 25. *iskander* nov. ♀ allotype, Dukdon, Samarkand Region.
FIG. 26. *dublitzkyi* O. Bang-Haas ♀ cotype, Kum-bel Mountains, near Alma Ata.
FIG. 27. *kafir* nov. ♀ allotype, Nuksan Pass, central Hindu Kush.
FIG. 28. *naryna* nov. ♀ allotype, Karagaitau, Naryn.
FIG. 29. *regula* Staudinger ♀, Akbossoga, eastern Alai Mountains.
FIG. 30. *obscurior* nov. ♀, Kara Kara, northern Tian Shan.
FIG. 31. *latifasciata* Gr-Gr. ♀, Oldjabai, Sarydjas, Tian Shan.
FIG. 32. *josephi* Staudinger ♀, western Alai Mountains, south of Margellan.
FIG. 33. *leechi* Gr-Gr. ♀, Beik Pass, eastern Hindu Kush.
FIG. 34. *roborovskyi* nov. ♀ allotype, Koshalayak Glacier, north central Pamir.
FIG. 35. *conradti* Alpherakyi ♀, Nia, Kashgar Region.
FIG. 36. *tancrei* Gr-Gr. ♀, (vera) Alexander Mountains, ex coll. Tancré.
FIG. 37. *pungeleri* O. Bang-Haas ♀, Yuldus, Tian Shan.
FIG. 38. *chitralica* Tytler ♀ cotype, Chitral, ex coll. Tytler.
FIG. 39. *bolorica* Gr-Gr. ♀, Hindu Kush, ex coll. Grum-Grshimailo.
FIG. 40. *mushketovi* nov. ♂ type, Muzkulak, west-central Pamir.
FIG. 41. *huebneri* Felder ♀ (vera), Shigri, Lahoul, Elwes Coll., ex coll. British Museum.


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EXPLANATION OF PLATE 12

Typical subspecies of *Karanasa*

FIG. 1. *nigrocellata* male genitalia.

FIG. 2. *haslundi* male genitalia, normal form.

FIG. 3. *haslundi* male genitalia, attentuated form.

FIG. 4. *haarlovi* male genitalia.

FIG. 5. *haslundi* ♂ holotype, Marak, Koh-I-Baba, Afghanistan.

FIG. 6. *haslundi* ♀ allotype, Marak, Koh-I-Baba, Afghanistan.

FIG. 7. *voigti* O. Bang-Haas ♀ underside of forewing, Paghman Mountains, Afghanistan.

FIG. 8. *nigrocellata* ♀ allotype, Surta, Koh-I-Baba, Afghanistan.

FIG. 9. *nigrocellata* ♂ holotype, Puistagoli, Koh-I-Baba, Afghanistan.

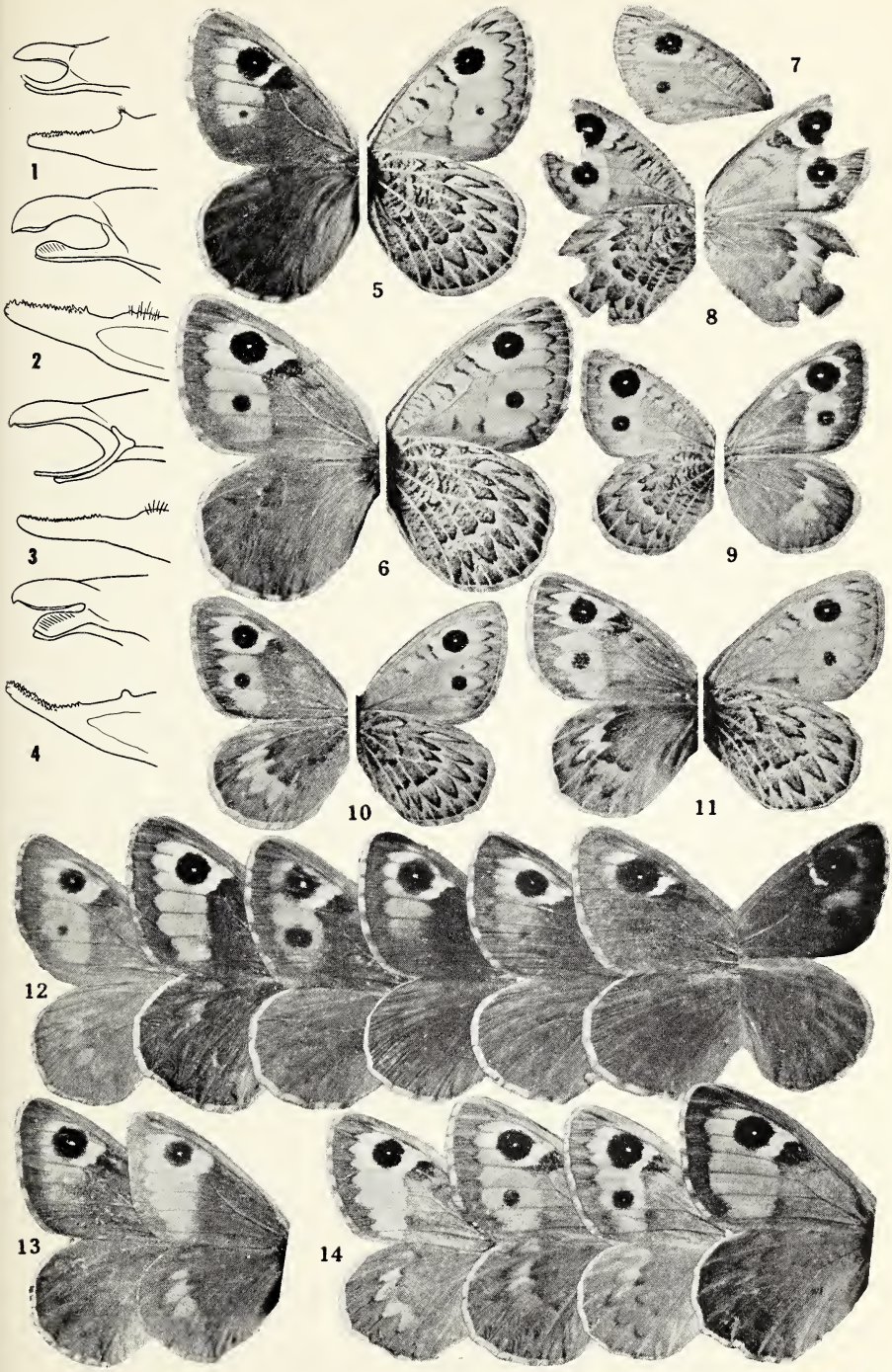
FIG. 10. *haarlovi* ♂ holotype, Kotal Pass, Koh-I-Baba, Afghanistan.

FIG. 11. *haarlovi* ♀ allotype, Surta, Koh-I-Baba, Afghanistan.

FIG. 12. *haslundi*. Variation in the extent of the melano-suffusion in the males.

FIG. 13. *haslundi*. Males having the type of genitalia shown in figure 3.

FIG. 14. *haslundi*. Variation in the extent of the melano-suffusion in the females.


1
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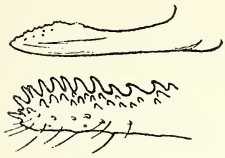
EXPLANATION OF PLATE 13

Diagrams of the gnathos and tip of valve of the male genitalia of various *Karanasa*.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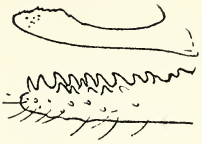
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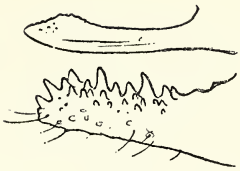
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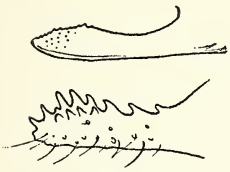
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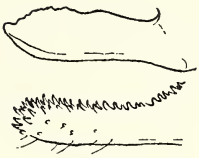
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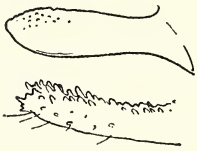
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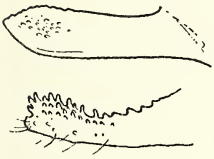
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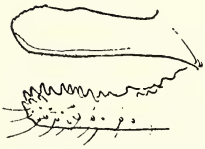
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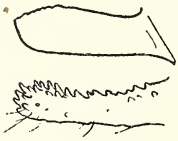
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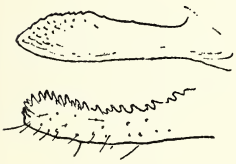
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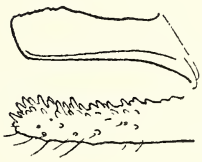
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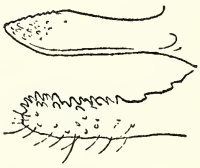
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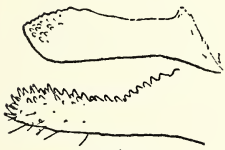
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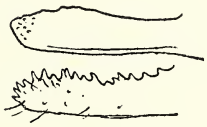
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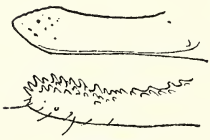
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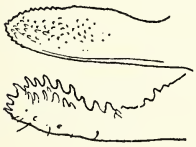
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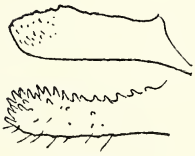
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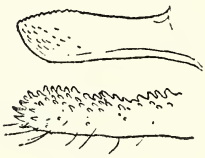
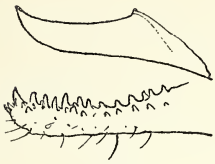

pupillata

EXPLANATION OF PLATE 14

Diagrams of the gnathos and tip of valve of the male genitalia of various *Karanasa*.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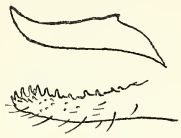
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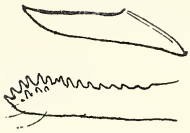
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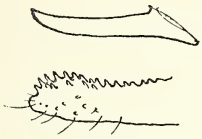
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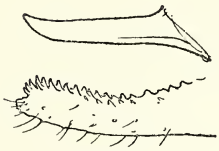
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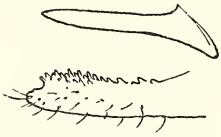
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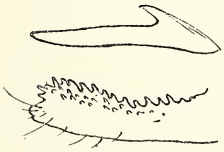
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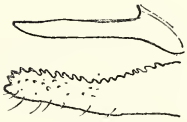
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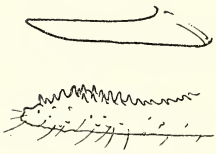
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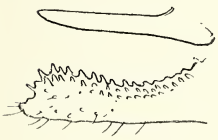
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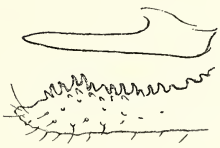
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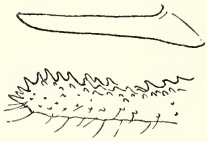
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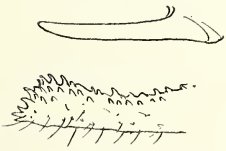
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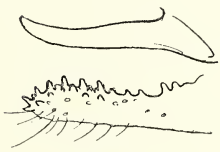
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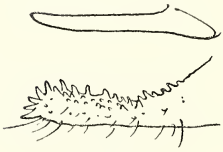
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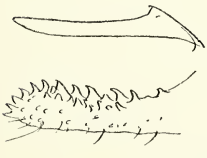
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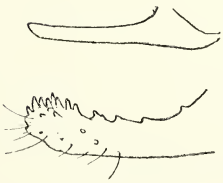
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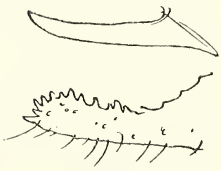
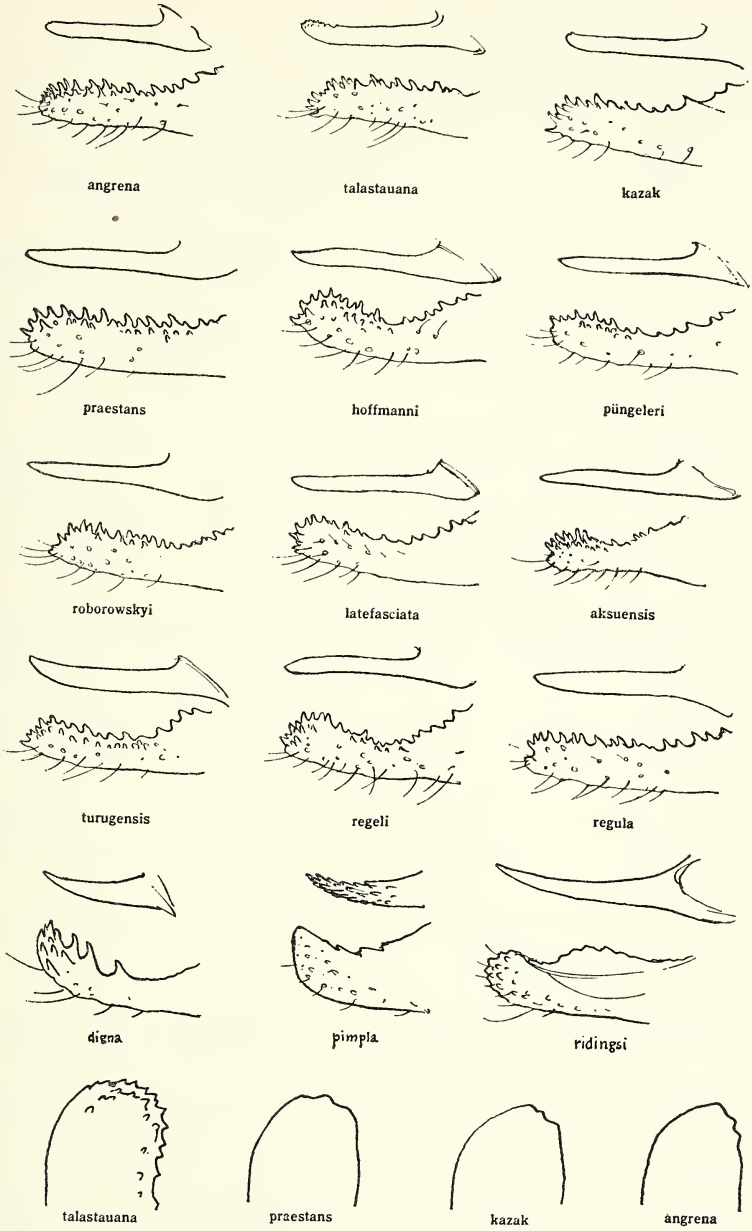

kirgizorum

EXPLANATION OF PLATE 15

Diagrams of the gnathos and tip of valve of the male genitalia of various *Karanasa*.

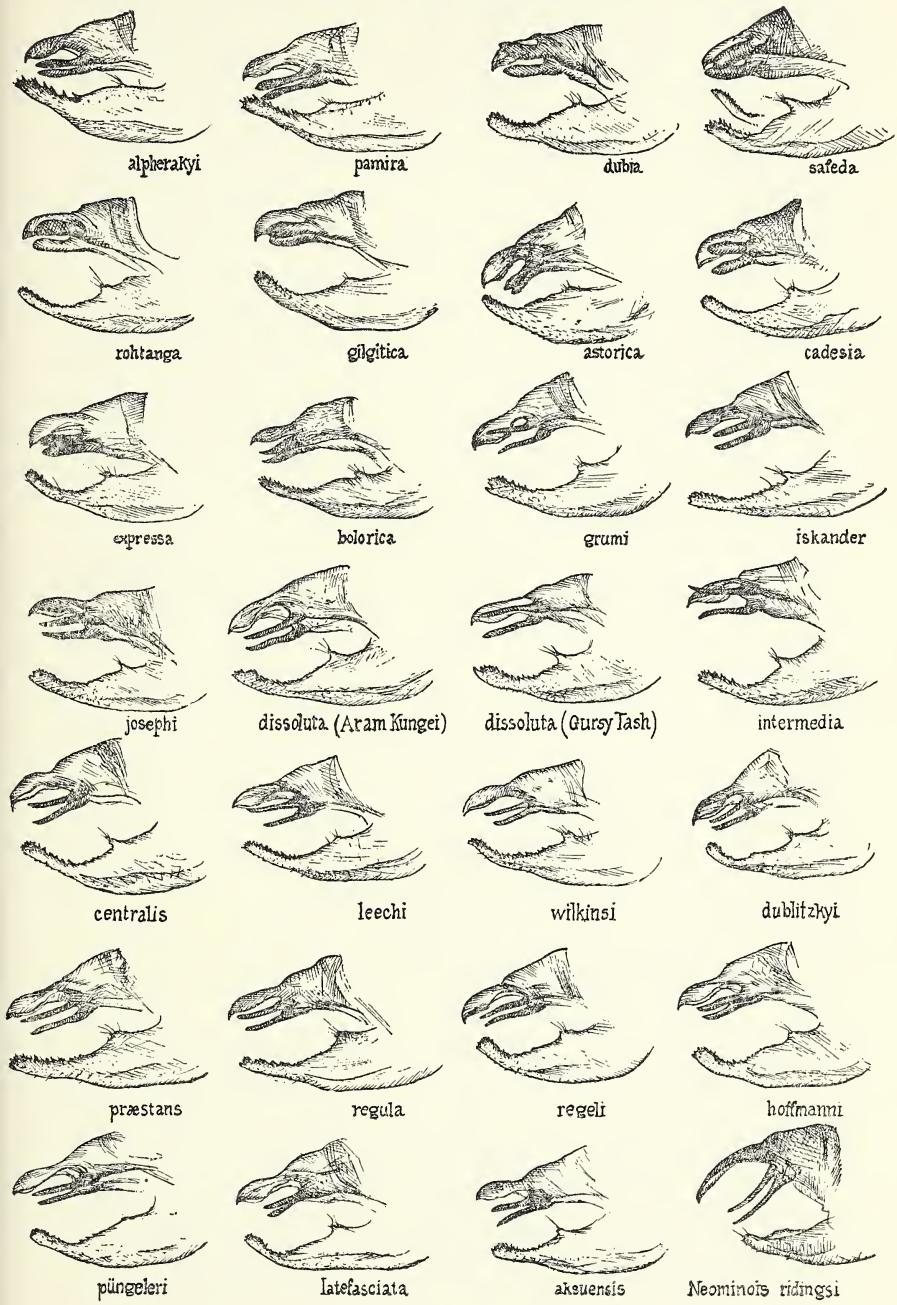


DETAIL OF THE STRUCTURE OF THE TIP OF THE PPOCESS

EXPLANATION OF PLATE 16

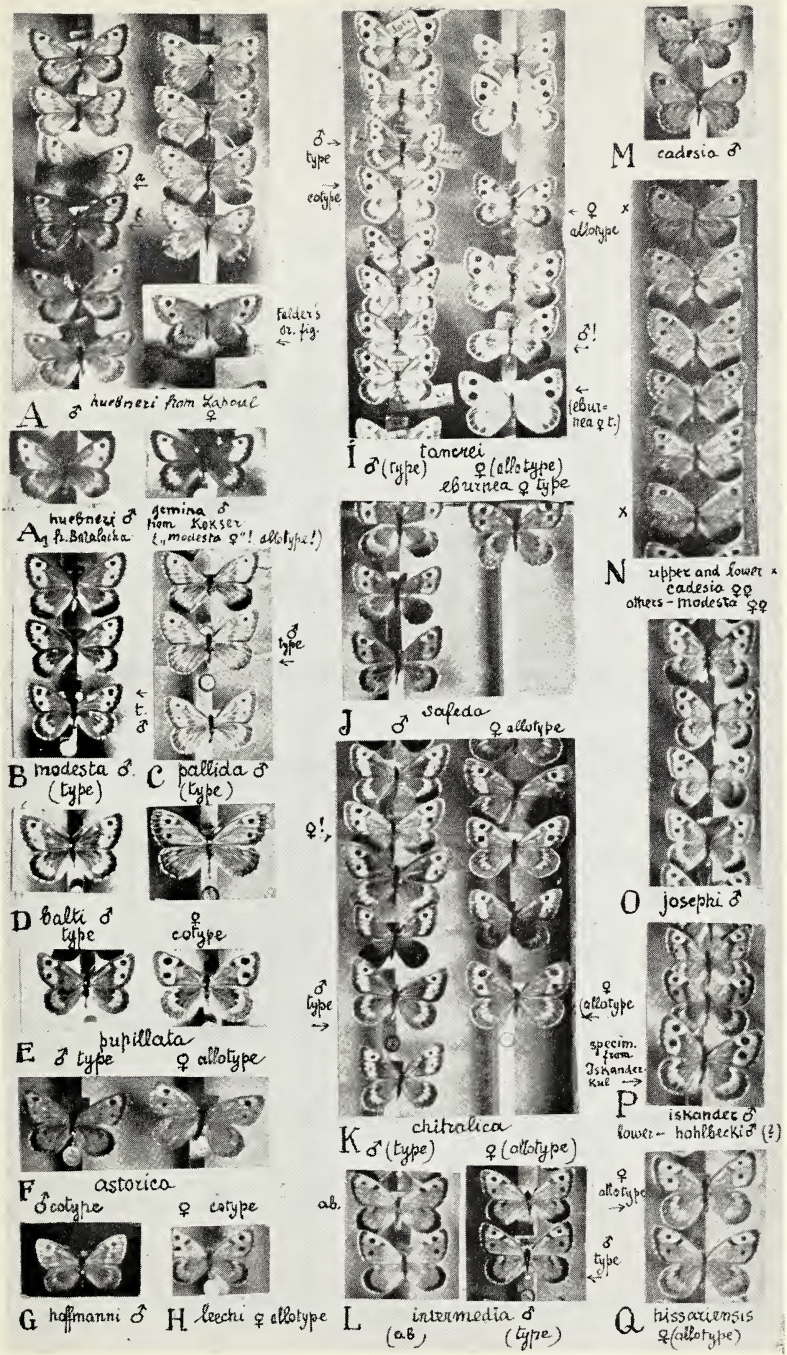
Diagrams of the complete male genitalia of various species of *Karanasa* and related genera. Side view.

MALE ARMATURE OF KARANASA



EXPLANATION OF PLATE 17

Reproductions of some *Karanasa* as arranged in the cabinets of the British Museum prior to the year 1938.


A ♂ huebneri from Zaboul ♀
Felder's or. fig.
huebneri ♂ A, fr. Batalacka
gemina ♂ from Kokser („modesta ♀"! allotype!)
B modesta ♂ (type)
C pallida ♂ (type)
D balti ♂ type
♀ cotype
E pupillata ♂ type ♀ allotype
F astorica ♂ cotype
♀ cotype
G hoffmanni ♂
H leechi ♀ allotype
♂ type
cotype
I tamerlei ♂ (type) ♀ (allotype)
eburnea ♀ type
♀ allotype
♂!
(eburnea ♀ t.)
J ♂ safeda ♀ allotype
♀!
♂ type
K ♂ (type) chitralica ♀ (allotype)
♀ (allotype)
specim. from Iskander Kul
L intermedia ♂ (type)
ab.
♀ allotype
♂ type
M cadesia ♂
N upper and lower cadesia ♀♀ others - modesta ♀♀
O josephi ♂
P iskander ♂ lower - hohlbecki ♂ (½)
Q hissariensis ♀ (allotype)

ART. 2 NOTES ON THE EGGS AND EARLY LARVAE OF THREE MORE FLORIDA SALAMANDERS

By Coleman J. Goin

University of Florida
and
Research Associate, Carnegie Museum

(Plate 18)

This paper is essentially a companion to one published recently (Goin: 1947 a) under a similar title.

Since the published descriptions of the larvae of many species and subspecies of salamanders are based on stages not at all comparable, and since both the form and color of the larval stages are known to be affected by the environment, I believe that the presentation of adequate descriptions and figures of the newly hatched larvae can serve two functions: first, to permit a comparison of two or more forms on the basis of determinable life history stage; and second, to record the features of the free living larva before local environmental factors have had an opportunity to modify them. So far as I know, the newly hatched larvae of the three following forms have not heretofore been described; therefore I take this opportunity to present descriptions and figures of them.

I am indebted to Messrs. Julian Baumel, John Decker, Edwin H. McConkey, John S. Mecham, and Gideon E. Nelson, all graduate students at the University of Florida, for spending many hours helping me hunt for the natural nests of our local salamanders. I am also indebted to Miss Esther Coogle, artist and research assistant of the University of Florida, for the drawings which accompany this paper.

Triturus viridescens louisianensis

A single egg of *Triturus viridescens louisianensis* was taken under a dead pine log in about two inches of water in a pond about five miles west of Gainesville, Alachua County, Florida, on January 8, 1951. This egg was at hatching stage when found and the larva

emerged shortly after it was picked up. Except for details of color pattern, this larva does not seem to differ essentially from the newly hatched young of *T. v. viridescens* from New York as described and illustrated by Bishop (1941: 65, fig. 14 b). The specimen is 7.5 mm. in total length. It has a well-developed balancer about half way between the eye and the base of the first gill. The front legs are present only as rounded blunt buds. A well-developed dorsal keel is continued anteriorly to a point above the base of the third gill. Bishop describes the New York specimens as having the pigment concentrated more or less into two rather broad bands which extend nearly the whole length of the body whereas in this specimen the dorsolateral bands are broken to give the appearance of blotches along the back. The tail keels are essentially unpigmented.

This specimen is identified as *louisianensis* on the basis of a number of adult individuals of this species which were found in the same general vicinity at the time and on the personal experience of both Dr. A. F. Carr and myself that *louisianensis* and *perstriatus* are not normally found associated in the same ponds.

Desmognathus fuscus auriculatus

The eggs and natural nests of *Desmognathus fuscus auriculatus* have been twice before recorded. Neill and Rose (1949: 234) describe a single clutch of eggs found on June 16, 1948, in Richmond County, Georgia, as follows: "The nest was a shallow depression beneath a scrap of bark at the edge of a sandy spring run. The female, a small specimen of 40 mm. snout-vent length, was coiled about the eggs. The eggs, six in number, averaged 7.7 mm. in diameter. Four of the eggs were held together by thread-like extensions of the outer envelope; the other two were separate."

Robertson and Tyson (1950: 132) record six nests taken near Grimesland, Pitt County, North Carolina, but do not give the exact dates on which the eggs were collected. They state that all of the nests found by them were within well-rotted cypress logs and stumps and that the individual clutches ranged in number from fourteen to twenty eggs. They further state that a female was associated with five of the six nests.

We have taken the eggs of *D. f. auriculatus* near a small spring run about three miles north of Gainesville, Alachua County, Florida. Ten

clutches of eggs in various stages of development were found on October 28, 1950, by the author and his students, and Mr. John S. Mecham collected one set on October 29. A few of the nests mentioned above had adult females apparently associated with them but in several cases so many *Desmognathus* were found in the vicinity of the nest that it was impossible to determine whether any one individual was associated with it.

Each of these nests was found on the side of a small natural hillock twelve to eighteen inches high and from one to three feet from the water's edge. In each case the eggs were deposited on the dirt under a layer of undisturbed sphagnum. They were generally attached to some small rootlet or similar organic structure.

Since some of the eggs were at hatching stage and the larvae emerged as they were disturbed, it was impossible to obtain exact counts in each case, but in five complete clutches in which the eggs were counted they numbered 9, 11, 14, 15, and 19 respectively. The eggs were approximately 5 x 7 mm. in size, ovoid in shape, with the more acute end tapering to a short, twisted stalk about 2 mm. in length. These stalks were in turn attached to a common base along the rootlet, so that the clutch had somewhat the appearance of a small cluster of grapes. Some of the living larvae within the egg capsules were coiled dextrally and some sinistrally. Most of them rested with the dorsal side uppermost, but a few were on the side and occasionally one would rest with the venter uppermost. Although most of the larvae were arranged in the capsule so that the head pointed towards the base of the capsule, a few were reversed so that the head pointed distally.

In one of the above clutches of eggs, five of the larvae were preserved as they hatched. These five range in size from 17.5 to 18.5 mm. with an average of 18.00 mm. This is somewhat larger than the measurements Bishop (1941: 318) reports for *D. f. fuscus* in New York.

In all of the larvae that hatched, the yolk seemed to be almost completely used up, since in none of the five specimens preserved at hatching is the belly appreciably distended, nor was a decided bulge noticeable in any of those that were not preserved.

The general tone of pigment in the hatchlings ranges from gray to brown and is concentrated on the dorsum and sides. The throat and most of the venter are immaculate with immaculate areas on the under

sides of the limbs. The distribution of the pigment is more diffuse than in *f. fuscus* as illustrated by Bishop (1941: fig. 61 a and b). There is a concentration of pigment in two narrow bands on each side of the mid-dorsal line, but most of the dorsum seems to have about the same concentration of pigment as does the side so that there is no impression of a broad dorsal dark band. Furthermore, the form and size of the dorsal light spots is different from that described for *f. fuscus.* In life these tiny spots were pearl gray in color and since they were small and not placed within a broad dorsal dark band they were barely noticeable. There are about six spots on each side of the back between the regions of the axilla and groin, and others on the basal half of the tail, but because they are not always arranged on opposite myotomes they do not give the impression of pairs of spots. On all of the newly hatched larvae there is a concentration of dark pigment between the eyes and a smaller concentration of pigment in the occipital region. The gills are as heavily pigmented as are the sides of the body. There is no pigment immediately around the nares.

Morphologically, these hatchlings seem to be very similar to those of *f. fuscus* except that the head is distinctly wider than the body, since the belly is not distended with yolk. The head is broad with the sides nearly parallel from back of the eyes to the base of the gills. The snout is short and converges rapidly to a truncated tip. The eyes are large and prominent. The toes are well developed. The legs are rather stout, with adpressed toes separated by about three costal folds. The tail is keeled above from a point above the vent to the tip, and below for the distal two thirds of the tail.

Manculus quadridigitatus

The presence of the striking dorsal fin in the larva of *Manculus quadridigitatus,* although known to some herpetologists, has never been reported. Therefore a special effort was made to collect the eggs and newly hatched larvae of this form.

Brimley's often cited record of the breeding site of this salamander "where the runlet from a certain small spring trickles sluggishly down a narrow cut," (Brimley, 1923: 81) implies that this species breeds along streams. In Florida the form is quite ubiquitous but all breeding sites so far located have been associated with ponds. Two clutches of eggs have been found recently.

The first of these was taken near the edge of a small hammock pond near Hale's Siding on the western end of Payne's Prairie, Alachua County, Florida, on November 22, 1950, by John S. Mecham. The eggs were under a wet log several feet from the water but only about two inches above water level. It was impossible to tell how much the clutch was disturbed when the log was rolled over, but there were about twelve eggs together in a small depression and about eight more scattered within a radius of six or eight inches. Dirt sticking to the adhesive eggs made them extremely difficult to see so that it is not certain that all of them were collected. There were about six adult *Manculus* in the same general area but none that could be definitely associated with the nest. These eggs started hatching December 7.

On January 14, 1951, Mr. E. H. McConkey found another clutch under a wet log about three feet from water. These eggs were grouped together in a depression about two and a half inches deep and were covered by a piece of loose bark. They were also adhesive and the loose dirt which stuck to them made them very hard to see. When they were put in a hatching pot similar to those used for *Eleutherodactylus* (Goin, 1947 b: 3) they were separated and found to be sixty-two in number. Judging from the dates on which they hatched it seems probable that there were two separate clutches involved. The first group hatched over a period of fifteen days from January 19 to February 2, inclusive. A total of forty hatched within this period, usually just one or two a day, but eight hatched on January 25 and ten on January 26. The second group started hatching on February 9 when one young emerged. Two more eggs hatched on February 12 and two more on the following day, February 13.

Both of the above deposition sites are more in accordance with the observations of Carr (1940: 48) than they are with those of Brimley. It is true that Carr says that the three clutches he found on January 15, 1935, were under logs lying in shallow water in a small pond, but it is easily conceivable that a hard winter rain might have inundated the nests after deposition.

In general appearance the newly hatched larvae of *Manculus* have a striking resemblance to those of *Hemidactylium scutatum* as illustrated by Bishop (1941: fig. 35 a). The specimen described below and illustrated in fig. 3 is one which hatched December 7 from the clutch collected on November 22. In general tone of pigment the hatchling

is a uniform grayish brown with the pigment distributed rather uniformly over the top of head and dorsum, the gills, the upper surface of the limbs and the sides of the tail. The chin, throat and venter are immaculate. Pigment is present in both the dorsal and tail fins but is more diffuse than it is on the rest of the body. The mouth is small and inconspicuous, ventral in position, and not visible from the side. The gills have relatively few filaments. The toes of the front foot are fairly well differentiated but the hind foot has no indication of toes. The most striking feature of the newly hatched larva is the dorsal fin which arises on the mid-dorsal line at about the level of the seventh costal groove and, being continuous with the tail fin, extends uninterrupted to the tip of the tail. Ventrally the tail fin continues anteriorly to the region of the vent. Five specimens from this clutch preserved at hatching range from 7.5 to 8.3 mm. in total length. Four specimens from the same clutch preserved eight to ten days after hatching range from 9.3 to 9.5 with an average of 9.45 mm. in total length. These specimens eight to ten days old differ from the hatchlings only in size and the fact that the toes of the hind foot have differentiated.

The individuals of the second clutch were preserved as they hatched. After about four days it was observed that the specimens that hatched later seemed to be a little larger in size than those that had hatched earlier from the same clutch. Thereafter those that hatched each day were preserved separately to permit determination of the variation in size as correlated with the time of hatching of a single clutch. Those that hatched between January 19 and 24 range from 8.3 to 9.0 mm. in total length and average 8.64. Those that hatched on January 25 range from 8.5 to 9.3 mm. in total length and average 8.9. Those on January 26 range from 9.0 to 10.0 with an average of 9.5, and all of the individuals that hatched January 28 and thereafter until February 2 were 9.5 mm. in total length. Furthermore, these larger individuals which were later in hatching had the hind toes better differentiated than did those that hatched earlier. Four of the five specimens that hatched between February 9 and February 13 inclusive were measured. Three of them were 9.0 mm. in total length while one was 9.5 mm.

Although the later specimens to hatch from the clutch were in general larger in size and had the toes better differentiated, they

seemed to be less hardy, at least under the ecological conditions prevailing in the hatching pot. I regularly preserved the specimens that hatched over a twenty-four hour period every night. All of those that hatched between January 19 and 26, inclusive, were still alive and quite active at the time of preservation whereas seven of the thirteen that hatched between January 27 and February 2 died before they could be preserved.

The dorsal fin apparently diminishes in size with larval growth since a specimen 21 mm. in head and body length (tail broken) collected near Cedar Keys, Levy County, Florida, September 7, 1950, and presented to me by Wilfred T. Neill, still has gills although the dorsal fin is much reduced so that only a remnant of it remains.

Heretofore, *Hemidactylium* has been reported to be the only plethodontid in which the larva has a dorsal fin and in which the hind toes may be undifferentiated at hatching. That the same condition prevails in another four-toed salamander of the same family does not necessarily, of course, imply a close relationship between the two, since the similarity of the larval condition may result solely from convergence. I do feel, however, that since the larvae of *Manculus* differ so strikingly from those of *Eurycea,* there is no justification for lumping these two genera on the basis of our present knowledge.

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EXPLANATION OF PLATE

Miss Esther Coogle, del.

FIG. 1. Lateral view of newly hatched larva of *Triturus viridescens louisianensis*. Actual size 7.5 mm.

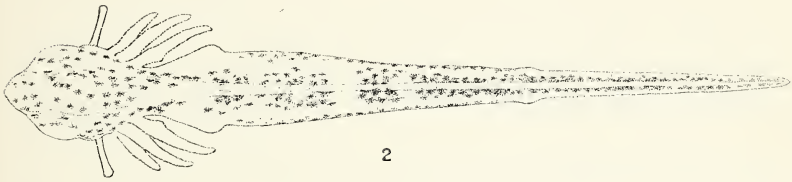
FIG. 2. Dorsal view of same.

FIG. 3. Lateral view of newly hatched larva of *Manculus quadridigitatus*. Actual size 8.3 mm.

FIG. 4. Dorsal view of newly hatched larva of *Desmognathus fuscus auriculatus*. Actual size 18.0 mm.

FIG. 5. Lateral view of same.

1



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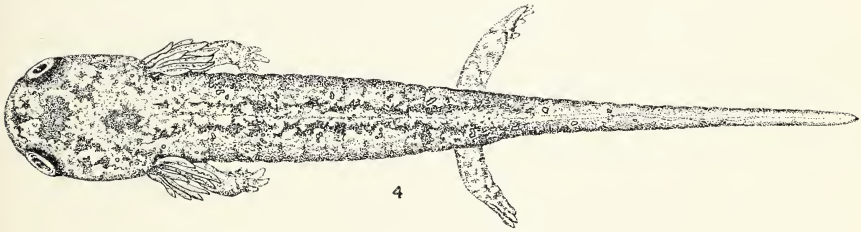

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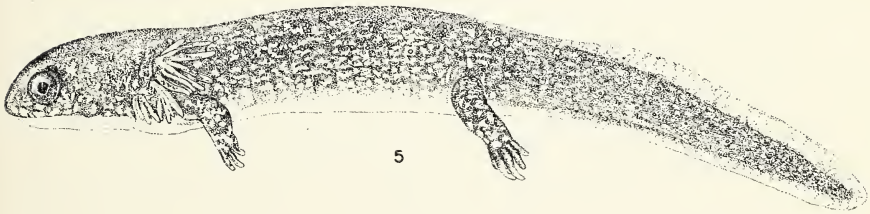

5

ART. 3 A REVIEW OF THE TREMELLALES (FUNGI) OF WESTERN PENNSYLVANIA

By LeRoy K. Henry

(Plates 19-20)

The order Tremellales, or jelly fungi, belongs under the subclass Heterobasidiomycetes, theoretically the more primitive group of the Basidiomycetes, and the species are chiefly saprophytic upon decaying wood.

Of the four families representing this order in our region, the Auriculariaceae, Tremellaceae, and Dacrymycetaceae are fairly common, while the family Phleogenaceae is represented in our collection by only one specimen.

Among the Tremellaceae, all members of the genus Tremellodendron grow on the ground, resembling Clavarias (coral fungi), while only one species of the genus Tremella is found on soil. The remainder live upon decaying wood.

The members of this order display a great range of color, varying from white through cream, yellow, orange, and brown to black. In consistency they are mostly soft-gelatinous or waxy. Some, however, are tough and leathery. It is usually necessary to examine the basidia microscopically to determine whether the specimen belongs to the Tremellaceae or to the Dacrymycetaceae.

This review is based upon the specimens from Western Pennsylvania now in the Herbarium of the Carnegie Museum. As the eastern boundary of Western Pennsylvania, I have arbitrarily chosen the eastern borders of Potter, Clinton, Centre, Huntingdon, and Fulton counties.

Key to Families of the Tremellales

Basidia elongated and divided into four, or fewer, cells by crosswalls arising from hyphal threads; texture of fructification tough or soft-gelatinous to waxy.....*Auriculariaceae*

Basidia ovate, pyriform or spherical, divided into two or four cells by longitudinal or oblique walls; texture of fructification gelatinous, tough, leathery or coriaceous.....*Tremellaceae*

Basidia long, slender, round, forked above into two long branches, not divided into cells; texture of fructification gelatinous or subcartilaginous. *Dacrymycetaceae*

ssued December 14, 1951

Basidia transversely 1-3-septate, cylindrical, straight or curved, borne within a crustose peridium; fructification with stalk and cap, fleshy.
Phleogenaceae

AURICULARIACEAE

Six genera are known in North America, only one of which, *Auricularia,* is represented in our collection.

Auricularia

Fructification tough-gelatinous, cup- or ear-shaped, centrally or laterally attached; yellowish brown or cinnamon, drying horny or nearly black; upper surface sterile, covered with erect brown hairs; hymenium covering the lower surface. Most of the species are tropical and we have in our region only the one commonly called Jew's ear.

Auricularia auricularis (S. F. Gray) Martin (Plate 20, fig. 9)

Allegheny County: Fern Hollow, Frick Park, Pittsburgh. *Armstrong County:* Kittanning. *Bedford County:* Sulphur Springs, near Mann's Choice; 3 mi. e. of Kegg. *Butler County:* Nixon Station; Slippery Rock. *Centre County:* Shingletown Gap. *Westmoreland County:* Latrobe; New Florence.

KEY TO THE GENERA OF TREMELLACEAE

Fructification gelatinous, shrinking and becoming horny upon drying, but reviving when moistened; erumpent or pileate, or if effused (spread out), with determinate margins.

- Hymenium (spore-bearing surface) without spines.
  - Fructification erect, cerebriform, lobate or foliate, spores subglobose or ovate or broadly elliptic ..... *Tremella*
  - Fructification effused and tuberculate-erumpent to pileate or foliose; spores allantoid (sausage-shaped) ..... *Exidia*
  - Fructification erumpent (breaking through the substratum), drying to a varnish-like film; spores allantoid and ventrally depressed. *Seismosarca hydrophora*
- Hymenium with spines; fructification pileate and stipitate, or dimidiate (fan-shaped) ..... *Tremellodon gelatinosum*

Fructification fibrous and leathery or tough-coriaceous or waxy, not shrinking greatly when dry.

- Fructification erect, much branched from a fused base, resembling a Clavaria; growing on the ground ..... *Tremellodendron*
- Fructification resupinate, broadly effused with indeterminate margins; on litter or wood, or running up and encrusting the bases of plants. *Sebacina*

KEY TO SPECIES OF EXIDIA

Fructification smoky white at first, blackish brown at maturity; effused-cerebriform; hymenium dotted with sterile warts.....*E. spiculosa*

Fructification yellowish-brown to deep cinnamon brown, drying black; erect lobate or pileate, usually in clusters; hymenial warts few or lacking; sterile upper portion covered with minute scale-like patches.....*E. recisa*

Fructification at first whitish, cushion-shaped, even or convoluted, becoming broadly effused, vinaceous to vinaceous-brown with numerous seed-like concretions imbedded in the jelly, drying to a thin dark film. *E. nucleata*

Exidia nucleata (Schw.) Burt

Allegheny County: Groveton. *Beaver County:* Aliquippa. *Somerset County:* Kooser State Park, near Bakersville.

Exidia recisa (S. F. Gray) Fries [*E. gelatinosa* (Bull.) Duby] (Plate 19, fig. 3)

Allegheny County: 3 mi. s.e. of Bakerstown; Stowe Twp., near Fleming Park. *Armstrong County:* Mahoning Dam, n.e. of Belnap. *Clarion County:* Cook Forest. *Jefferson County:* 2 mi. e. of Sigel. *Somerset County:* near Jennerstown. *Venango County:* Little Scrubgrass Creek, n.e. of Sutton's Mill.

Exidia spiculosa (S. F. Gray) Somm. [*E. glandulosa* (Bull.) Fr.]

Allegheny County: vicinity of Warden Mine, near Sutersville; Stowe Twp., near Fleming Park; Fern Hollow, Frick Park, Pittsburgh. *Armstrong County:* Kittanning. *Butler County:* Nixon Station; 4 mi. n.e. of Harmony; near Butler. *Clarion County:* Cook Forest. *Forest County:* 1 mi. n.w. of Brookston. *Huntingdon County:* Pine Hill. *McKean County:* Tionesta Tract, near Brookston. *Somerset County:* Kooser State Park, near Bakersville; near Jennerstown. *Westmoreland County:* Hillside; near Laughlintown; Kiski Campus, near Saltsburg.

KEY TO SPECIES OF SEBACINA

Fructification fleshy-tough, white to pale buff, often forming erect branches, sometimes with free lobes; basidia deeply buried among the hyphae. *S. incrustans*

Fructification waxy-coriaceous, dingy buff to dull purplish brown, without free projections; basidia scattered in a palisade layer.....*S. Helvelloides*

Sebacina incrustans (Fr.) Tul.

Allegheny County: Fern Hollow in Frick Park, Pittsburgh; 1 mi. n.e.

of Ben Avon Heights. *Armstrong County:* Buffalo Creek across from West Winfield. *Cambria County:* Cook Forest. *Clearfield County:* 1 mi. s. of Patchinsville. *Forest County:* Rt. 62, s. of Tionesta. *Somerset County:* near Jennerstown. *Venango County:* 3 mi. n. of Lisbon. *Westmoreland County:* Idlewild Park, near Ligonier; Shades Ravine, 2 mi. e. of Trafford; 4 mi. e. of Waterford.

Sebacina Helvelloides (Schw.) Burt

Allegheny County: Sandy Creek. *Bedford County:* Sulphur Springs, near Manns Choice. *Westmoreland County:* Jones Mills; Kingston; 6 mi. s.w. of New Florence.

Seismosarca

Seismosarca hydrophora Cooks

Allegheny County: Keown Station, Sept. 8, 1940, D. R. Sumstine; Aspinwall, Sept. 10, 1940, D. R. Sumstine. *Butler County:* near Butler, June 24, 1939, D. R. Sumstine.

Key to Species of Tremella

Fructification externally gelatinous, but dry and fleshy within.

- Fructification large, up to 5 cm. or more high, deeply rugose and plicate (folded), golden yellow, drying ochraceous to bay; usually on frondose wood ..... *T. aurantia*
- Fructification small, usually less than 1 cm. high; cushion-shaped to subglobose, convoluted; dingy yellowish brown; usually on coniferous wood ..... *T. encephala*

Fructification gelatinous throughout; chiefly on frondose wood.

- Fructification white, becoming pale ochraceous, 3-8 cm. high and nearly as wide, with erect hollow lobes, becoming fused; usually growing on the ground ..... *T. reticulata*
- Fructification sulphur yellow to pallid yellow, composed of a few erect lobes, about 3 cm. in largest dimension ..... *T. lutescens*
- Fructification orange or golden yellow, cerebriform to bluntly lobate, up to 10 cm. in length and 3-4 cm. in thickness ..... *T. mesenterica*
- Fructification straw-colored or dingy yellow, drying brown; large, up to 10 cm. in the longest dimension; lobes large, somewhat foliate. *T. frondosa*
- Fructification cinnamon brown, drying blackish brown; large, 3-12 cm. in greatest dimension; many thin leaf-like folds; usually on oak. *T. foliacea*

Tremella aurantia Schw. [*Naematelia aurantia* (Schw.) Burt; *N. Quercina* Coker]

Armstrong County: Kittanning, on Tsuga, Oct. 1904, D. R. Sumstine.

Tremella encephala Pers.

Jefferson County: 2 mi. n.e. of Sigel, June 9, 1948, Neil Richmond.

Tremella foliacea (S. F. Gray) Pers.

Butler County: Saxonburg; Buhls; Zelienople. *Centre County:* Pa. State College Campus. *Mercer County:* Blacktown near Mercer.

Tremella frondosa Fr. (Plate 20, fig. 8)

Allegheny County: 1 mi. n.e. of Ben Avon Heights; Warden Mine, opposite Sutersville. *Armstrong County:* valley of Buffalo Creek, w. of Slate Lick; Kittanning. *Bedford County:* Sulphur Springs near Manns Choice. *Butler County:* 1 mi. s.e. of Whitestown. *Westmoreland County:* Rock Run, 3 mi. s.e. of Rector.

Tremella lutescens (Pers.) Fr.

Allegheny County: 3 mi. s.e. of Bakerstown. *Butler County:* Little Buffalo Creek, near Monroe Station; 4 mi. n.e. of Harmony. *Cambria County:* Ebensburg. *Venango County:* Little Scrubgrass Creek, n.e. of Sutton's Mill. *Warren County:* Tamarack Swamp, 3 mi. n.e. of Columbus. *Westmoreland County:* Idlewild Park near Ligonier.

Tremella mesenterica (S. F. Gray) Pers.

Allegheny County: on Carpinus, Beaver Grade Rd., near Montour Run. *Beaver County:* Temple Hollow, 1 mi. n.w. of Aliquippa. *Butler County:* near Butler. *Warren County:* Tamarack Swamp, 3 mi. n.e. of Columbus. *Westmoreland County:* Ligonier.

Tremella reticulata (Berk.) Farl.

Armstrong County: Kittanning. *Bedford County:* near Bedford. *Centre County:* Pa. State College Campus; Shingletown Gap. *Westmoreland County:* Idlewild Park, near Ligonier; New Florence.

Tremellodon

Tremellodon gelatinosum (Scop.) Pers. (Plate 20, fig. 10)

Allegheny County: Black's Run, n. of Oakmont; Power's Run, opposite Verona; Darlington Hollow, n. of Aspinwall. *Armstrong County:*

Kittanning. *Beaver County:* Temple Hollow, 1 mi. n. of Aliquippa. *Butler County:* Little Buffalo Creek, near Monroe Station. *Cambria County:* Cresson; Ebensburg. *Clarion County:* Cook Forest. *Fayette County:* Gibbon Glade. *Forest County:* Cook Forest. *Huntingdon County:* Whipple Dam. *Mercer County:* 2 mi. n.e. of Grove City. *Somerset County:* near Buckstown. *Venango County:* 1 mi. n. of Lisbon.

KEY TO SPECIES OF TREMELLODENDRON

Fructification slender, separate, little branched, scattered or gregarious; hymenium dull, becoming cinnamon drab in age, chiefly restricted to basal portion.....*T. Cladonia*

Fructification caespitose, profusely branching; branches often anastomosing (forming a network), both stems and branches fusing where coming together; hymenium covering lower portion of stems and branches.

Branches broadly flattened, anastomosing to the tips, forming rosette-like structures when well developed; hymenium ochraceous to tawny. *T. Schweinitzii*

Branches round or more or less flattened at tips; network confined to lower portion.

Hymenium ochraceous; branches free, at least 1.5 mm. in diameter. *T. candidum*

Hymenium ochraceous to russet or dark red; branches free, round, 0.5 mm. or less in diameter, drying hairlike.....*T. merismatoides*

Tremellodendron candidum (Schw.) Atk. (Plate 19, fig. 4)

Allegheny County: Fern Hollow, Frick Park, Pittsburgh; Powers Run, opposite Verona. *Armstrong County:* Kittanning. *Beaver County:* Raccoon Creek State Park, s. of Harshaville; near Aliquippa; 2.5 mi. s.e. of New Sheffield. *Butler County:* 4 mi. n.e. of Harmony; Rt. 8, 2 mi. n. of Muddy Creek crossing; Little Buffalo Creek at Monroe Station. *Centre County:* Pa. State College Campus; Milheim; 5 mi. w. of State College. *Clarion County:* near Clarion; near Leeper; Cook Forest. *Clearfield County:* 1.5 mi. n. of Westover. *Elk County:* 2 mi. e. of Medix Run. *Fayette County:* Ohiopyle; Claircrest. *Huntingdon County:* Coles Summit, abt. 2.5 mi. n.n.w. of Saltillo. *Somerset County:* Rt. 360, 3 mi. s.e. of Wittenberg; Laurel Hill, near Trent; 2 mi. w. of Berlin; Kooser State Park, near Bakersville. *Venango County:* Rt. 62 near President. *Warren County:* Rt. 62 s. of Warren; 4 mi. s.w. of Youngville. *Westmoreland County:* New Florence; Idlewild Park, near Ligonier; Jones Mills; Forbes Forest, 3 mi. s.e. of

Rector, near Waterford; Shades Ravine, 2 mi. e. of Trafford; Youngstown.

Tremellodendron cladonia (Schw.) Burt

Allegheny County: Fern Hollow, Frick Park, Pittsburgh. *Centre County:* 5 mi. e. of Woodward. *Venango County:* 3 mi. n.e. of Emlenton. *Westmoreland County:* Derry; near Saltsburg; 6 mi. e. of New Florence; Lynn Run, 3 mi. s.e. of Rector.

Tremellodendron merismatoides (Schw.) Burt (Plate 19, fig. 2)

Armstrong County: Kittanning. *Beaver County:* intersection of Conway and Ambridge roads; 2.5 mi. s.e. of New Sheffield. *Butler County:* 2 mi. s. of Leasuresville. *Centre County:* State College; 8 mi. e. of Woodward. *Clarion County:* near Clarion. *Fayette County:* 3 mi. n.e. of Seaton's Lake; Ohiopyle; Claircrest. *Indiana County:* near Glen Campbell. *Lawrence County:* Rock Point. *Potter County:* near Odin. *Westmoreland County:* near South Greensburg; Jones Mills; 2 mi. s.e. of Kingston; near New Florence; Laurel Hill, 3 mi. e. of Rector.

Tremellodendron Schweinitzii Peck [*T. pallidum* (Schw. Burt] (Plate 19, fig. 5)

Allegheny County: North Park; 1 mi. n.e. of Mt. Nebo; Aspinwall; Rochester Road, near North Park; near Large; Black's Run, n.e. of Oakmont; woods near intersection of routes 22 and 30, Pike's School; Fallen Timber Hollow, opposite Sutersville. *Armstrong County:* Kittanning. *Beaver County:* Temple Hollow, 1 mi. n.w. of Aliquippa; Raccoon Creek, 4 mi. w. of Clinton; Potato Garden Run, e. of Murdocksville; 2 mi. w. of New Sheffield. *Bedford County:* Sulphur Springs near Manns Choice. *Blair County:* Yellow Springs, off Rt. 22, e. of Altoona. *Butler County:* 4 mi. n.e. of Harmony; 1 mi. s.e. of Whitestown; Slippery Rock; Plains Church, s.e. of Evans City on Rt. 528. *Centre County:* State Game Lands No. 33, s.e. of Philipsburg; near Pleasant Gap; Pa. State College Campus; 5 mi. e. of Woodward; Pine Grove Mills; Woodward. *Clarion County:* near Clarion. *Clearfield County:* State Game Lands No. 34, s. of Medix Run; Little Medix Creek, 1 mi. n. of Caledonia Pike. *Crawford County:* French Creek near Cochranton; Conneaut Lake. *Erie County:* 4 mi. s. of Girard. *Fayette County:* Ohiopyle; New Geneva; Killarney

Park; 6 mi. s.e. of Farmington. *Forest County:* Rt. 62, s. of Tionesta. *Indiana County:* Crooked Creek, 2 mi. e. of Chambersville. *Jefferson County:* Elbell Junction. *Potter County:* near Carter Camp. *Somerset County:* near Jennerstown. *Venango County:* 1 mi. n.e. of Lisbon; 3 mi. n.e. of Lisbon; 3 mi. n.e. of Emlenton. *Westmoreland County:* Lynn Run, 3 mi. s.e. of Rector; scout camp near Rector; 1.5 mi. e. of New Alexandria, off Rt. 22; 6 mi. s. of New Florence; Kiski Campus near Saltsburg; South Greensburg; Shades Ravine, 2 mi. e. of Trafford; 2.5 mi. s.e. of Laughlintown; Latrobe; Jones Mills, Ligonier.

KEY TO GENERA OF THE DACRYMYCETACEAE

Fructification broadly effused (spread out), at first discoid or pustulate and appressed; tough-waxy to waxy-gelatinous; orange-yellow, drying reddish brown, thin and film-like.....*Arrhytidia involuta*

Fructification separate, sessile and attached by a point, rarely substipitate.
- Cushion-shaped or flattened discoid, rarely cup-shaped, often becoming convoluted; firm-gelatinous or waxy; hymenium covering all exposed portions .....*Dacrymyces*
- Definitely cup-shaped, sessile or with a stem-like base; orange-yellow when young, externally white-tomentose with age; hymenium concave, becoming darker with age.....*Femsjonia Pezizaeformis*

Fructification separate, stipitate and pileate.
- Fructification tough or cartilaginous, spatula- or cup-shaped when young, becoming fan-shaped or petaloid; hymenium on one side of pileus.....*Guepinia*
- Fructification club-shaped, awl-shaped, or subcylindrical; simple, forked, or branching; firm-gelatinous to tough; yellow or yellowish orange, drying reddish brown; hymenium covering entire fructification except the stipe.....*Calocera cornea*

Arrhytidia

Arrhytidia involutus (Schw.) Coker

Lawrence County: woods at mouth of Muddy Creek, L.K.H,. Oct. 17, 1944. *Clarion County:* Cook Forest, L.K.H., Oct. 7, 1938.

Calocera

Calocera cornea (Fr.) Link (Plate 19, fig. 1)

Allegheny County: Fern Hollow, Frick Park, Pittsburgh. *Armstrong County:* Kittanning. *Beaver County:* 2.5 mi. s.e. of New Sheffield; 1 mi. n.w. of Aliquippa. *Bedford County:* Sulphur Springs, near Manns Choice. *Butler County:* 2 mi. e. of Slippery Rock; near Slip-

pery Rock; Saxonburg; near Butler. *Centre County:* Rural Park near Milroy. *Clarion County:* Cook Forest. *Crawford County:* Conneaut Park. *Elk County:* along Rt. 68, s. of Kane. *Erie County:* near Erie; Presque Isle. *Fayette County:* Ohiopyle. *Forest County:* 1 mi. n.w. of Brookston. *McKean County:* 4 mi. n.e. of Clermont. *Warren County:* Tionesta Tract near Brookston. *Westmoreland County:* Idlewild Park, near Ligonier; Latrobe; Shades Ravine, 2 mi. e. of Trafford.

KEY TO SPECIES OF DACRYMYCES

Fructification cushion-shaped to flattened discoid, smooth or somewhat convolute; small (up to 3 mm. in diameter except when confluent); dull greenish amber at first, then orange or yellow; firm to gelatinous; drying dark and inconspicuous; on frondose wood.....*D. minor*

Fructification cerebriform or lobed, 1 cm. or more in diameter.

Fructification bright orange or orange-red, drying orange to red; tough-gelatinous, then soft to more or less watery; at first erumpent in clusters, branching to form petaloid or cerebriform masses to 6 mm. in diameter; attached by tough white radicating base, or substipitate; on coniferous wood.....*D. palmatus*

Fructification bright orange to yellow or wine color, fading dirty yellow or pallid; firm, becoming soft-gelatinous, then watery; pustulate, smooth, then wrinkled, branching to form erumpent clusters up to 2 cm. in diameter; attached by tough, stalk-like bases; on frondose wood; our largest species.....*D. Ellisii*

Dacrymyces minor Peck

Allegheny County: on oak, 2 mi. n.e. of Mt. Nebo, L.K.H., July 28, 1948; 3 mi. s.e. of Bakerstown, L.K.H., Aug. 8, 1945. *Warren County:* 2 mi. s.w. of Kinzua, H. Mozingo, Apr. 4, 1947.

Dacrymyces Ellisii Coker

Allegheny County: 3 mi. s.e. of Bakerstown; Guyasuta Hollow, near Aspinwall; intersection of Flaugherty Run Rd. and Rt. 51, 1.5 mi. n.w. of Carnot. *Butler County:* 4 mi. n.e. of Harmony. *Forest County:* 1 mi. n.w. of Brookston. *Jefferson County:* 5.5 mi. n.e. of Sigel. *McKean County:* 3 mi. n.e. of Clermont. *Venango County:* 4.5 mi. n. of Lisbon. *Washington County:* 2 mi. s. of Murdocksville. *Westmoreland County:* Shades Ravine, 2 mi. e. of Trafford.

Dacrymyces palmatus (Schw.) Bres. [*D. aurantius* (Schw.) Farl.] (Plate 20, fig. 7)

Allegheny County: 0.5 mi. s.e. of Wildwood. *Beaver County:* 2.5 mi.

s.e. of New Sheffield. *Bedford County:* Sulphur Springs near Manns Choice. *Butler County:* Rt. 528, 0.25 mi. s.e. of junction with Rt. 8; 2 mi. s. of Leasuresville. *Clarion County:* Cook Forest (2 specimens — 1 on birch, 1 on hemlock). *Forest County:* Cook Forest. *Lawrence County:* Muddy Creek Falls at mouth of Muddy Creek. *McKean County:* Tionesta Tract near Brookston. *Somerset County:* near Buckstown. *Venango County:* 1 mi. n. of Lisbon; 0.5 mi. n. of Emlenton. *Westmoreland County:* Shades Ravine, 2 mi. e. of Trafford.

Femsjonia

Femsjonia Pezizaeformis (Lev.) Karst.

Fayette County: New Geneva, August 31, 1940, D. R. Sumstine. Det. by J. A. Stevenson.

Key to Species of Guepinia

Fructification orange when fresh; pileus spathulate, much broader than the stipe; hymenium becoming dull wine-colored, longitudinally ribbed; stipe cylindrical at base, flattened toward pileus; growing in clusters or lines on both frondose and coniferous wood ..... *G. Spathularia*

Fructification amber-brown to blackish brown, obliquely cup-shaped, becoming spathulate or fan-shaped; hymenium lining the cup; growing singly or in clusters on deciduous wood ..... *G. elegans*

Guepinia elegans Berk. & Curt.

Allegheny County: 0.5 mi. s. of Smithdale, June 27, 1940, L.K.H.

Guepinia spathularia (Schw.) Fries (Plate 20, fig. 6)

Allegheny County: North Park; Frick Park, Pittsburgh; Powers Run, opposite Verona; 1.5 mi. e. of Ambridge; Schenley Park; Sandy Creek; Warden Mine region, opposite Sutersville; 2 mi. e. of Talleycavey. *Armstrong County:* Kittanning; near Ford City. *Beaver County:* near Beaver. *Bedford County:* Sulphur Springs near Manns Choice. *Bradford County:* 3 mi. s.e. of Laquin. *Butler County:* near Saxonburg; near Cooperstown; 4 mi. n.e. of Harmony; near Culmerville. *Centre County:* Woodward; 7 mi. w. of Bellefont. *Erie County:* Mercyhurst College, s. of Erie; near North East. *Lawrence County:* Muddy Creek Falls, at mouth of Muddy Creek. *Somerset County:* 2 mi. w. of Kooser State Park; Jennerstown. *Washington County:* Buffalo Creek near junction with Buck Run. *Westmoreland County:* near Darlington;

1 mi. e. of Mt. Pleasant; Hillside; along Conemaugh River across from Saltsburg.

PHLEOGENACEAE

Phleogena

Phleogena decorticata (Schw.) Martin [*Pilacre Faginea* (Fr.) Berk. & Br.]

Allegheny County: Fern Hollow, Frick Park, Pittsburgh, Aug. 19, 1907, D. R. Sumstine.

SUMMARY

In this paper keys are provided for the families of the Tremellales discussed and for the genera of the Tremellaceae and the Dacrymycetaceae. The families Auriculariaceae and Phleogenaceae are represented in our collections by only one genus and one species each. Distributional records in Western Pennsylvania are given for each species, and collectors' names are given if the species is rare.

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EXPLANATION OF PLATE 19

Figures drawn by Mrs. LeRoy K. Henry

All figures are natural size

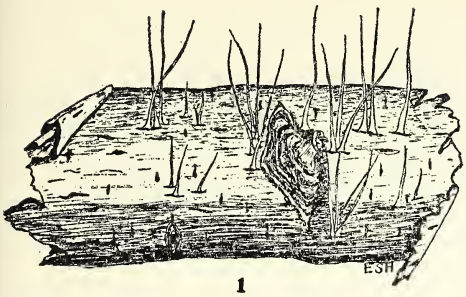
FIG. 1. *Calocera cornea* (Fr.) Link

FIG. 2. *Tremellodendron merismatoides* (Schw.) Burt

FIG. 3. *Exidia recisa* (S. F. Gray) Fries

FIG. 4. *Tremellodendron candidum* (Schw.) Atk.

FIG. 5. *Tremellodendron Schweinitzii* Peck



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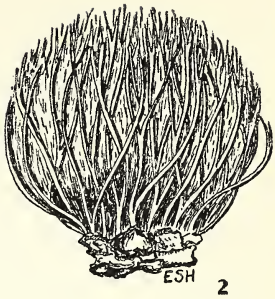

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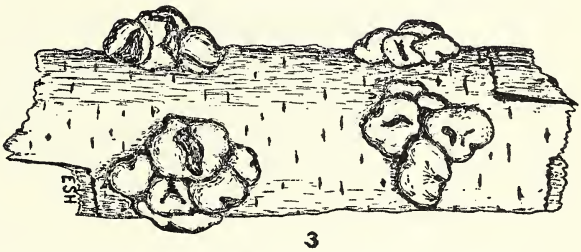

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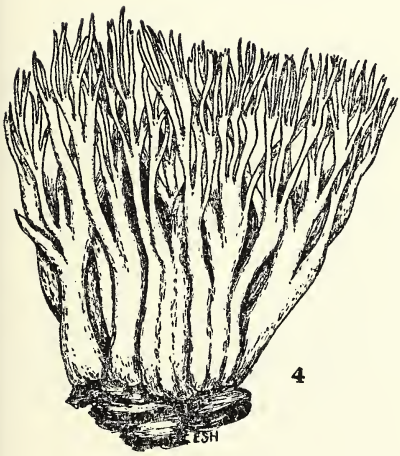

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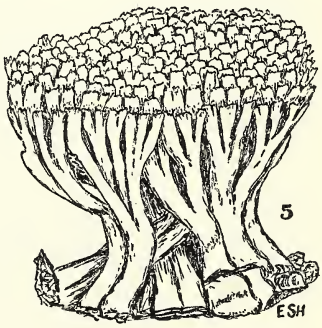

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EXPLANATION OF PLATE 20

Figures drawn by Mrs. LeRoy K. Henry

All figures are natural size

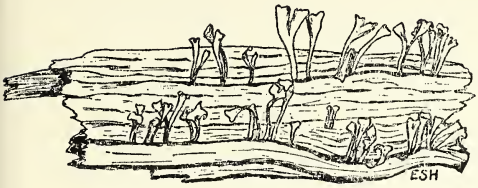
FIG. 6. *Guepinia Spathularia* (Schw.) Fries

FIG. 7. *Dacrymyces palmatus* (Schw.) Bres.

FIG. 8. *Tremella frondosa* Fr.

FIG. 9. *Auricularia auricularis* (S. F. Gray) Martin

FIG. 10. *Tremellodon gelatinosum* (Scop.) Pers.



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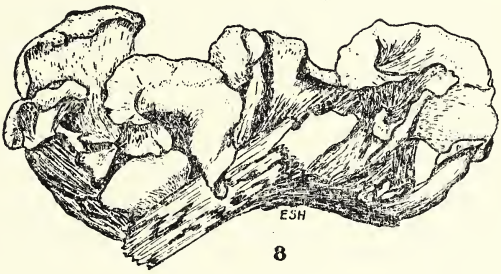

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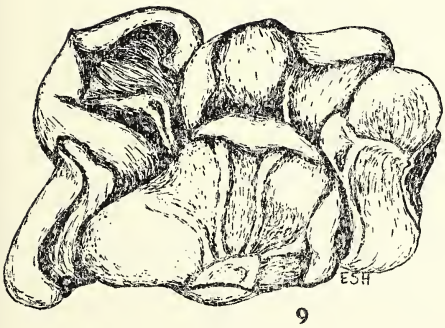

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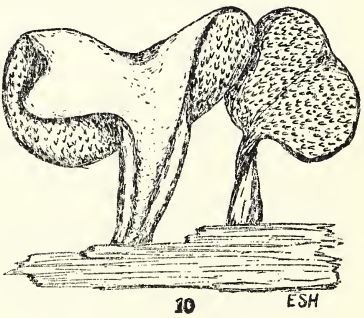

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ART. 4. THE RED-BELLIED TERRAPIN, *PSEUDEMYS RUBRIVENTRIS* (LE CONTE), IN PENNSYLVANIA*

By Roger Conant

Philadelphia Zoological Garden; Philadelphia, Pennsylvania

(Plate 21)

Proof of the occurrence of *Pseudemys rubriventris* in Pennsylvania has rested, until recently, upon the following evidence:

(a) Le Conte (1830, p. 102), in the original description of the species, stated "in the Delaware, near Trenton, they are very numerous." The Delaware, of course, forms the eastern boundary of Pennsylvania.

(b) In the handwritten *Catalogue of the Testudinata in the Museum of the Academy of Natural Sci., Philadelphia, Pa.,* compiled in September, 1889, by George Baur, the eminent student of turtles, there is the following entry: "*Chrysemys rubiventris,* Le C., [No.] 223, stuffed ♀. Delaware, Philad." This specimen, which has a carapace measuring 199 mm. in length, is still in the Academy collection.

(c) There is a published record for Bristol in Henry W. Fowler's list of amphibians and reptiles of Bucks County (1917, p. 14). During a recent conversation, Mr. Fowler advised me that he based this record upon specimens of *rubriventris* which he had seen exhibited from time to time, about forty years ago, in the window of the Cloosen Haus, a hostelry and restaurant at Bristol, and which were alleged to have been taken in the millpond near by.

In addition to the above apparently valid records, four or five red-bellied turtles have been found in various parts of Philadelphia and brought to the Philadelphia Zoological Garden during the past fifteen years. One of these was stated to have been caught in the Schuylkill River, in Fairmount Park, but it, and all the others at the time they were acquired, had deep, pitted scars on their plastrons, an almost certain indication that they had been held in captivity on concrete or some other substance abrasive to turtle shells. Some were found in business or residential areas far from any streams or ponds. These

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ssued December 31, 1951

specimens presumably escaped or were released by persons unknown. Since this species is not rare in southern New Jersey, and since it is sometimes offered for sale in Philadelphia fish markets, it is not surprising that these turtles occasionally turn up in unusual places.

Robert Sutcliffe, of the Academy of Natural Sciences of Philadelphia, caught two specimens in Neshaminy Creek, near Trevose, in 1940, but he learned they had been liberated a short time previously by a professional turtle hunter who had obtained them in New Jersey.

Evidence has come to hand recently to indicate that *Pseudemys rubriventris* is well established and may occur naturally in at least three places in the narrow strip of Coastal Plain in extreme southeastern Pennsylvania. These are: (1) The Tinicum Marshes, in the southernmost part of Philadelphia and adjacent Delaware County; (2) Manor Lake, near Tullytown, Bucks County; and (3) Fowler's old locality at Bristol. Several specimens are now available for study. They, with their attendant collecting data, are as follows:

CM 27420 — adult female with carapace measuring 268 mm. in length; Tinicum Marshes, Delaware County, June 18, 1947, collected by Nelson D. Hoy.

CM 29400 — adult male with carapace 285 mm. in length; Manor Lake, Bucks County, August 19, 1950, collected by Dr. Francis J. Trembley.

CM 29457 — adult male with carapace 289 mm. in length; Manor Lake, Bucks County, August 20, 1950, collected by Dr. Francis J. Trembley.

ANSP 26308 — adult male with carapace 242 mm. in length; Manor Lake, Bucks County, December 20, 1950, collected by Edward T. Balderston.

CM 29502 — adult female with carapace 288 mm. in length; Tinicum Marshes, Delaware County, June 24, 1951, collected by Howard Donaghy.

It should be mentioned that some of these turtles, including the one portrayed upon Plate 21, were kept in captivity for weeks or months, and the pits and scars on their plastrons developed after they were collected.

In addition to the above turtles, I have examined the shell of another large specimen, as mentioned below, and there are numerous

sight records for the two localities in Bucks County. Data at hand are herewith summarized:

1. THE TINICUM MARSHES, in the extreme southern part of Philadelphia and adjacent Delaware County. — This area is part of what, in the not distant past, was a very large freshwater marsh bordering the Delaware River and extending for many miles down stream. The marshes lie within the (former) extensive delta system between Darby Creek and the Schuylkill River, and, like the comparable marshes on the New Jersey side, they are partly the result of the gradual rise of the ocean waters and the development of the Delaware River estuary. Dredging operations, industrial expansion, the creation of municipal dumps, and other activities have so encroached upon the marshes that they are considerably reduced in extent. The spot where Mr. Hoy caught the specimen on June 18, 1947, and a nearby pond, where the turtle may have lived, are very close to the Philadelphia International Airport. Any enlargement of this facility would quickly destroy the pond and its environs. Mr. Hoy states that the reptile was on a dirt road about ten feet from the nearest ditch (in which there was some water). There was some evidence that it may have been digging (nesting?), but neither eggs nor definite excavations were found.

The shell of an adult female that had a carapace 299 mm. long was found in another part of the marshes during June, 1947, by Carl Lorup and Nelson D. Hoy. The remains of this reptile, consisting of the shell, the hind legs, and some of the dermal scutes from the carapace and marginals, were lying along a dike that separates Darby Creek from the marshes. It probably had been shot, for there was a round hole in the third right costal. Although most of the scutes had sloughed off the shell, enough of them remained to make out gross details of the pattern. These compared favorably with a large well-marked female *rubriventris* from near Mt. Ephraim, Camden Co., New Jersey, that was alive at the time in the Philadelphia Zoo. The only obvious anomaly was that the dead turtle had thirteen marginals on each side of the shell instead of the normal twelve. This specimen was accidentally discarded.

The turtle found on June 24, 1951, was taken as it crossed a paved road close to the airport. There was a deep, water-filled ditch near by.

A considerable area of marsh still exists, and it is the home of a distinctive flora and fauna. Its remaining years as a wild-life habitat probably will be few, especially in view of the industrial expansion planned for the Philadelphia area, the demand for property along the navigable Delaware River, and the constant onslaughts, through drainage and the application of chemicals, like DDT, against the swarms of mosquitoes that abound in such places.

As pointed out by Miller (1946), the Tinicum Marshes have been repeatedly subjected to drastic changes, ranging all the way from virtually complete drainage in 1917 to severe flooding in 1934. Miller's paper, which is concerned with the Florida gallinule, relates how neglect of the drainage ditches caused the water to rise, with the result that cattails (*Typha*) increased vastly and provided extensive habitats for this member of the rail family. High water doubtless also favored aquatic turtles, such as *Pseudemys*. Even during periods when the marshes were driest, however, water probably remained in at least some of the ditches and sloughs of the region, and turtles also may have survived in the streams if pollution was not too great.

During a recent visit to the Tinicum area with Dr. John M. Fogg, Jr., of the University of Pennsylvania, to whom I am indebted for the botanical observations that follow, we found that considerable portions of the marsh proper are now covered with masses of common reed-grass, *Phragmites communis*. The broad-leafed cattail, *Typha latifolia,* purple loosestrife, *Lythrum salicaria,* and bur marigold, *Bidens coronata,* are also present in abundance in many places. The black willow, *Salix nigra,* grows densely upon the dikes and other elevated spots. Many exotic plants, chiefly European and probably introduced as a by-product of the import commerce of the port of Philadelphia, are well established upon the man-made prairies where silt from dredging operations from the Delaware River has been deposited. The water primrose, *Jussiaea repens,* var. *glabrescens,* which is essentially a neotropical plant and is here at its northernmost known locality, thrives in shallow pools and along the margins of an extensive open marsh.

2. MANOR LAKE, near Tullytown, Bucks County. — This is an artificial body of water occupying the former valley of Scott's Creek. The stream was dammed in 1929, and the dam breast rises about nine

feet above low water level in the Delaware River, which is almost directly adjacent. Approximately 750 acres of water are impounded. Scott's Creek was originally subject to tidal influence, but its waters were always fresh. Its valley, in part, was marshy.

Manor Lake serves as a reservoir for a series of lakes owned by a large builders' supply company. In these, dredging for sand and gravel is carried on almost continually. Water loss, occasioned by evaporation, seepage, etc., is made up by taking water from Manor Lake. To accomplish this, water is pumped into Manor Lake from the Delaware River, and then pumped from the former into the dredge lakes. Manor Lake supports a rich flora and fauna; it is fertilized by leaching and runoff from the surrounding fields, which are intensively cultivated. Dominant plants in the lake include spatterdock, pickerel weed, elodea, white water-lilies, and three species of potomogetons.

The general locality is in the Coastal Plain, and the soil consists of sand and gravel, obviously fluvial in character and probably (at least in part) outwash from glaciers that melted farther north.

The two turtles collected by Dr. Trembley in August, 1950, were taken in a trap net set off the end of one of the points of land jutting out into the lake. Both Dr. Trembley and Edward T. Balderston, manager of the Penn Manor Club, which leases the lake, report having seen a number of these turtles sunning on logs or other objects in the water.

The specimen collected by Mr. Balderston in December, 1950, was taken by chopping a hole through the ice on the surface of the lake. He also obtained a large snapper, *Chelydra s. serpentina,* in the same manner, and he saw three other *Pseudemys* resting on the bottom or on submerged logs. These he did not disturb.

Accompanied by my wife, Mr. Balderston, and two other men, I spent an hour walking about on the ice on December 21, 1950. Because the freeze-up had begun on a still, virtually windless night and had continued through several more quiet nights, the ice was crystal-clear over large areas and visibility to the mud bottom of the lake was excellent. We saw only one *Pseudemys,* which was lying still on the mud in a depth of three or four feet of water. As we walked about we also saw four musk turtles, *Sternotherus odoratus,* and about

twenty-five painted turtles, *Chrysemys p. picta.* Several of these were slowly walking about on the bottom, and two or three painted turtles were swimming, not fast, but fairly rapidly considering how low their body temperatures must have been in the cold water. Others were digging in the mud at the bottom, making small, almost round burrows for themselves; a few others were just emerging from similar burrows.

3. SILVER LAKE, Bristol, Bucks County. — This is the same body of water as the Bristol Millpond mentioned by Fowler. However, it was deepened and "improved" by the Works Progress Administration and given a new name. The lake is formed by a dam across Mill (Otter) Creek just north of the Pennsylvania Railroad main line tracks; it is a long, narrow body of water, slightly in excess of a mile in length, and with some bordering marshland, especially at its upper end and along its eastern shore. Mr. Robert Hendricks, of Bristol, informs me that he has known of the presence of *Pseudemys rubriventris* in this pond since 1916. He reports seeing specimens basking each year during the warmer months, and, as is typically the case with *rubriventris,* he has found them to be very wary and difficult to approach.

In reviewing the distribution of the red-bellied turtle in eastern Pennsylvania, the question inevitably arises whether this reptile occurs naturally in the region or whether it has been introduced by man. The latter possibility cannot be overlooked, but there is considerable evidence, most of it circumstantial, to indicate that *Pseudemys* is indigenous to the area.

First, it should be pointed out that *P. rubriventris* is a common turtle in southern New Jersey. It occurs in marshes on the eastern side of the Delaware River that are quite comparable to the Tinicum Marshes, and it lives in New Jersey streams and ponds that are similar in many respects to Scott's and Otter Creeks, and to Manor and Silver Lakes. Conceivably the Delaware River, burdened as it is today by organic and industrial pollution, might possibly serve as a barrier. But certainly in earlier days, *rubriventris* must have crossed and re-crossed this large stream; Le Conte mentioned its abundance in the river near Trenton 120 years ago (*loc. cit.*). Also, there are the facts that this turtle occurs in the state of Delaware and that the river

marshes, although partly brackish* toward the south, were more or less continuous along the Delaware River estuary before the development of the cities and industries that are strung out along the river from Wilmington to Philadelphia. *Pseudemys* probably could have made its way northward into eastern Pennsylvania by staying completely upon the west side of the Delaware.

Further, there are certain other elements of the fauna of the Coastal Plain of southeastern Pennsylvania that, like *P. rubriventris,* occur nowhere else in the Keystone State although they are common and widespread in southern New Jersey. According to information supplied by Henry W. Fowler and Dr. Reeve M. Bailey, of the University of Michigan Museum of Zoology, there are several fishes that fit this distributional pattern, *viz.* — the Delaware swamp darter, *Hololepis fusiformis erochrous;* the black-banded sunfish, *Mesogonistius chaetodon*; and the mud sunfish, *Acantharcus pomotis.* There is also the chorus frog, *Pseudacris* (collected near Tullytown), which is identical with the chorus frog of southern New Jersey but differs in essentials of pattern from the population of *Pseudacris* occurring in the Piedmont Province of Pennsylvania farther west.

It is quite likely that *Pseudemys rubriventris* was widespread in the Coastal Plain strip of Pennsylvania in pioneer days. The development of the City of Philadelphia and its suburbs has resulted in the destruction of many small streams and large areas of marshland that probably furnished suitable habitats for this turtle. It is possible that the species also may be found in other localities in extreme eastern Pennsylvania. James A. Fowler, of the Academy of Natural Sciences of Philadelphia, saw two large turtles basking in the Springton Reservoir, Delaware County, which he believed to be this species. This locality, however, is in the Piedmont.

Throughout this paper I have used the binomial designation, *Pseudemys rubriventris.* This I have done pending a thorough and detailed study of this complex. Babcock (1937) in assigning a name, *Pseudemys rubriventris bangsi,* to the population of these turtles occurring

* The water in the Delaware River is very slightly brackish, but the amount of salinity is virtually negligible. According to data recently supplied by the U. S. Geological Survey, the averages for the year 1950 were 13 parts of "chloride" per million parts of water at League Island (Philadelphia Navy Yard) and 17 at Eddystone. Normal sea water is 19,000 parts to a million.

in Plymouth County, Massachusetts, diagnosed his new form solely upon the basis of the relative height of the carapace. He stated that in *bangsi* "the greatest height of shell [is] included in its greatest length 2.4 times." He gave the comparable figure for the subspecies *rubriventris* as 2.63 times.

Among sixteen adult female specimens of *Pseudemys rubriventris* from southern New Jersey, the ratios (length of carapace divided by height of shell) vary from 2.21 to 2.72, with a mean of 2.48. The figures for nine adult New Jersey males are 2.39 to 2.93, mean 2.61. Using Babcock's diagnostic ratios, eight New Jersey turtles could be identified as *bangsi* and six could be identified as *rubriventris*. The other eleven specimens have ratios that fall between Babcock's two figures. The ratios for the six Pennsylvania specimens are as follows: Females, 2.47, 2.57 and 2.63; males, 2.54, 2.72 and 2.94.

The New England population may be worthy of subspecific designation, but it is obvious that some character other than shell ratios must be found if the form *bangsi* is to be recognized. The shells of turtles are subject to considerable individual and ontogenetic variation.

Melanism is of quite frequent occurrence among adult New Jersey and Pennsylvania specimens, but many individuals retain strong indications of pattern even when they have grown to large size. In almost all of these turtles (even in the darkest ones) each of the first three costals is marked with a fairly broad vertical brownish or reddish brown line. These lines sometimes are forked, producing inverted "Y's" as may be seen in the specimen illustrated in Plate 21.

For assistance in the preparation of this paper I am indebted to the several persons named in the text and also to Dr. M. Graham Netting, of Carnegie Museum, and Dr. Horace G. Richards, of the Academy of Natural Sciences of Philadelphia.

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EXPLANATION OF PLATE 21

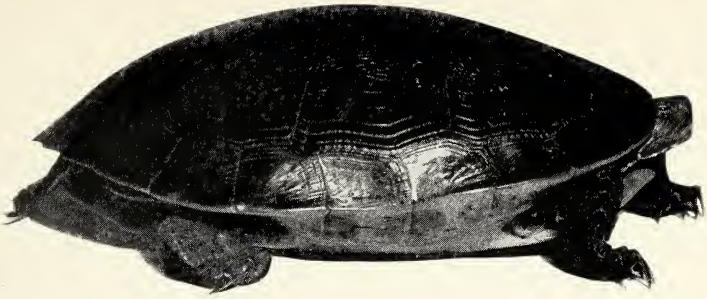
PHOTOS BY ISABELLE HUNT CONANT

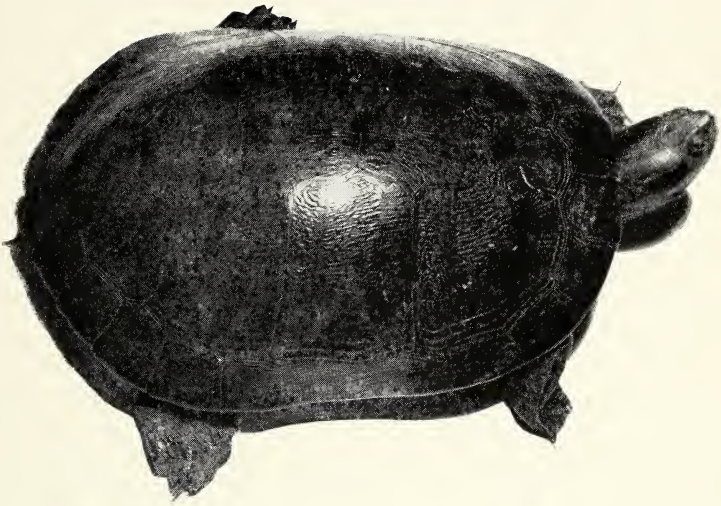
An adult female of *Pseudemys rubriventris* (CM 27420) with a carapace measuring 268 mm. in length. Collected June 18, 1947, in the Tinicum Marshes, Delaware County, Pennsylvania, by Nelson D. Hoy.

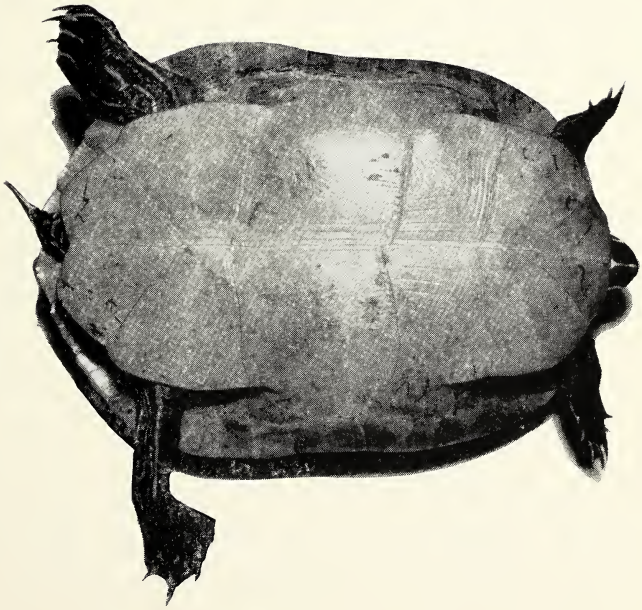
FIG. 1. Lateral view.

FIG. 2. Dorsal view.

FIG. 3. Ventral view.







ART. 5. NEW TYRANT FLYCATCHERS FROM SOUTH AMERICA

By W. E. Clyde Todd

The Tyrannidae, or Tyrant Flycatchers, comprising one of the largest families of the neotropical avifauna, are represented in the collection of Carnegie Museum by 10,100 specimens. A recently completed study of the family shows that we have an even 100 genera, 308 species, and 250 additional subspecies, or 558 forms in all. Some years ago an attempt was made to revise certain of the genera — *Pipromorpha, Myiobius,* and the South American *Myiarchus* — but the results were not entirely satisfactory, even to the writer, and later receipt of additional material has served to modify some of the conclusions then reached. Sporadic studies of our South American material in this group have resulted in the description of thirty-five supposedly new forms, but of these at least nine must be relegated to synonymy — not a creditable record. Most of the remaining novelties contained in our collection have already been described by Messrs. Zimmer, Phelps, deSchauensee, and others, but there are at least fourteen more subspecies which appear to be new. These are named and described in the present paper, with some additional critical comment on certain other species. For the loan of specimens useful in this connection I am indebted to Messrs. James L. Peters of the Museum of Comparative Zoölogy, John T. Zimmer of the American Museum of Natural History, Rodolphe M. deSchauensee of the Academy of Natural Sciences of Philadelphia, and Herbert Friedmann of the U. S. National Museum. All measurements are in millimeters, and that for the bill, where given, is of the exposed culmen. The names of colors are mostly taken from Ridgway's "Color Standards and Color Nomenclature" (1912).

Pitangus sulphuratus argentinus, subsp. nov.

Eight specimens: Puerto Suarez, Santa Cruz de la Sierra, and Buena Vista, Bolivia; La Plata, Argentina.

Additional specimens examined: Bolivia: Buena Vista (2), Comarapa (1), La Merced, Tarija (1), Chatarona, Dept. Beni (1), Bermejo, Rio Bermejo, Dept. Tarija (1), Todos Santos, Rio Chaparé (1), and Samaipata (1). Argentina: Conchitas (1), Mendoza (2), Quilmes (1), Lavalle (2), and Formosa (1). Paraguay: Sapucay (1) and Puerto Pinasco (1). Uraguay: San Vicente (2) and Lazcano (1).

ued February 15, 1952

Type, No. 284,392, Collection U. S. National Museum, adult male; Lavalle, Province Buenos Aires, Argentina, November 13, 1920; Alexander Wetmore.

Subspecific characters. — Similar to *Pitangus sulphuratus bolivianus* (Lafresnaye) of the Bolivian highlands, but upperparts averaging slightly paler, and underparts slightly brighter yellow; coronal spot deeper (light cadmium) yellow; and rufescent margins of the wing-coverts, remiges, and rectrices much reduced. Wing (type), 127; tail, 101; bill, 31; tarsus, 29.

Range. — Paraguay, Uruguay, and Argentina, south to Buenos Aires; migrating northward in winter to the lowlands and foothills of Bolivia.

Remarks. — The breeding race of *Pitangus sulphuratus* in the lowlands of Bolivia is *P. s. maximiliani,* which is characterized by its decidedly smaller size as compared with *P. s. bolivianus* and the present form. Our larger birds from lower altitudes in Bolivia, however, are not properly referable to *bolivianus,* of which we have a seasonally comparable series from the highlands. The great reduction and pallor of the rufescent external edgings of the remiges and rectrices is apparent in all our adult birds, and in one young bird (June 14) without the coronal spot. Two other young birds are dated January 26. The adults were taken in June, July, and September. This would suggest that they must be winter migrants from farther south. Hudson (1888, Argentine Ornithology,1: 147) claims that the species is resident in Argentina, but it is evident that it must be partially migratory, and that some individuals must go north to invade the range of *maximiliani.*

Additional specimens from Argentina, Paraguay, and Uruguay, kindly lent by other institutions, serve to confirm the validity of this race as compared with *bolivianus.* A specimen from Mendoza, Argentina (U.S.N.M. no. 237,178), is dated June 29, which circumstance suggests that the race is partially sedentary and partially migratory. This example, and one from Quilmes, Argentina (U.S.N.M. no. 258,099), April 21, are in fine fresh plumage, in which condition the rufous outer edgings of the wings and tail approximate in width those of *bolivianus,* from which the other characters, however, serve to separate it. The deeper yellow of the crown-spot is the best character.

Two specimens of this race, together with two of *P. s. bolivianus* from the highlands, were sent to Mr. James L. Peters. He reports as

follows: "The comparison with Lafresnaye's type of *Saurophagus bolivianus* is not too satisfactory, but I believe the answer is right. The type is in somewhat worn plumage; the yellow of the underparts is faded to nearly white; presumably the coronal patch may have lost some of its intensity; and the upperparts are slightly foxed. Otherwise the type does agree with the two birds from Cochabamba that you have labeled *bolivianus,* in the greater extent of rufous in the tail, and in its slightly larger size; the coronal patch is also exactly the same shade of yellow (provided there has been no foxing).

"The type measures as follows: wing (chord), 130.6 mm.; tail, 98; culmen from anterior edge of nostril, 25.5. The specimen is not sexed."

From Hellmayr's remarks (1927, Field Mus. Zool. Ser., 13,pt. 5:154, note) it is obvious that he confused this race with *bolivianus.* The exact distribution of the two races remains to be worked out.

Myiarchus ferox orenocensis, subsp. nov.

Eleven specimens: Maripa, La Lajita, Rio Mato, San Felix, El Callao, and Altagracia, Venezuela.

Type, No. 32,083, Collection Carnegie Museum, adult male; La Lajita, Rio Caura, Venezuela, October 26, 1909; M. A. Carriker, Jr.

Subspecific characters. — Similar in general to *Myiarchus ferox australis* Hellmayr of southern Brazil, eastern Bolivia, and northern Argentina, but pileum slightly more dusky; posterior underparts averaging duller yellow; and light tips and edgings of wing-coverts duller-colored, less buffy. Wing (type), 89; tail, 85; bill, 19.5; tarsus, 22.5.

Range. — Middle and lower Orinoco region of Venezuela, south and east to the Guiana frontier.

Remarks. — When I reviewed the South American Myiarchi some years ago (1922, Proc. Biol. Soc. Washington, 35: 202) I "lumped" all the Venezuelan specimens I had under *venezuelensis* of Lawrence. This was of course quite inexcusable, since I had his type-specimen before me, but I attributed its characters to immaturity. My conception of *venezuelensis* was thus erroneous, as Hellmayr later (1927, Field Mus. Zool. Ser., 13, pt. 5: 177, note) duly pointed out, but at that time I remarked the close similarity the Orinoco birds bore to the southern race of the species, which I called *swainsoni* (again in error). Hellmayr did not venture to name the Orinoco birds, however, and Dr. Zimmer

(1938, Am. Mus. Nov., no. 994: 14) also side-stepped the question at that time. Although I stated that the two races involved "are so close that no one would think of formally separating them if their ranges were continuous each with the other," a re-examination of the available material convinces me that such separation is possible and justifiable. In a later paper (1946, Am. Mus. Nov., no. 1312: 11), however, Messrs. Zimmer and Phelps describe a race *brunnescens* from the upper Orinoco, and take occasion to refer their birds from the middle Orinoco to the same race, although conceding that they were intermediate (presumably in the direction of true *ferox*).

In the same paper these authors record *australis* from Venezuela as a winter migrant from beyond the Equator. It might be supposed that our specimens above listed were such migrants, but since the dates of collection run from October 14 to March 2 it is obvious that they must represent the local breeding race, and not birds that had traveled north to spend the southern winter (May-September). I strongly suspect that the Venezuelan specimens referred by Messrs. Zimmer and Phelps to *australis* (because of their dates) are really referable to the present slightly differentiated race.

Dr. Zimmer places British Guiana birds with *ferox,* but our two specimens from El Callao, on the Guiana frontier, clearly belong to the present race. Obviously, also, the middle Orinoco birds are not *brunnescens,* to judge from the description of that race and from the single specimen before me from the Apure which corresponds to that description. As already said, the new race is barely separable by its characters from *australis.* It is only proper to add that my comparisons in the present instance were made with Bolivian specimens of the latter form.

MYIARCHUS ATRICEPS AND M. TUBERCULIFER

Consider the curious case of *Myiarchus atriceps* and *M. tuberculifer*—rated by Hellmayr, Zimmer, and other authors as conspecies. To my mind the evidence points to a different conclusion, and I predict that when the habits and general economy of these two forms become better known this prediction will be duly verified. *M. tuberculifer* was described by Lafresnaye and D'Orbigny from Guarayos in eastern Bolivia, and it enjoys an extensive range in the lowlands of that country and beyond. *M. atriceps,* on the other hand, is known only

from the Peruvian and Bolivian highlands, south to Tucuman, Argentina. Granted that these two respective forms look amazingly alike, and that the difference between them is mainly one of size, with no overlap, they might possibly be considered geographical races of one specific type, as these authors contend. Virtually the only constant color-difference between them is in the pileum, which is deep black in *atriceps,* but brownish black in *tuberculifer.* Also, in *tuberculifer* the secondaries tend to be margined with rufescent color — absent in adult *atriceps.* But it so happens that in the Bolivian highlands, side by side with *atriceps,* there lives an undoubted race of *tuberculifer* with a distinctly black cap. Four specimens of this form are in the collection of the Carnegie Museum, and I have examined eleven additional specimens in other museums. Moreover, I am unable to separate these black-capped birds satisfactorily from *M. tuberculifer nigriceps* of Ecuador and Colombia, although Dr. Zimmer, who has also examined them, does not agree, but believes them to be intergrades between *tuberculifer* and *atriceps,* and thus to indicate the conspecificity of these two forms. He writes that "it may be one of those cases where an intermediate population bears a striking resemblance to a form living in a very distinct region, but even if it should be necessary to recognize *nigriceps* as reappearing in Bolivia, that would not necessitate recognition of it as a full species." So far as available material indicates, however, Bolivian specimens of *nigriceps* appear to belong to a homogeneous population, with no intermediate tendencies whatever in the direction of *atriceps.* Their affinities are clearly with *tuberculifer* instead. The uniformly larger size of *atriceps,* and in particular its longer tail (not mentioned by Zimmer), set it off from its smaller relative, and suffice to distinguish it therefrom. In short, re-examination of this question with the aid of additional material has merely served to confirm my earlier impressions. There is no rule in taxonomy, so far as I know, that would compel us to associate as conspecies two related forms which differ from each other mainly in relative size. I cannot believe that they should be so ranked in this case.

Tolmomyias assimilis subtropicalis, subsp. nov.

Three specimens: San José and Incachaca, Bolivia.

Type, No. 85,854, Collection Carnegie Museum, adult female; Incachaca, Bolivia, October 9, 1912; José Steinbach.

Subspecific characters. — Similar to *Tolmomyias assimilis assimilis* (von Pelzeln) of western Brazil, eastern Bolivia, etc., but upperparts lighter and purer green (between yellowish oil green and calla green); pileum paler gray, with greenish bases to the feathers; underparts duller yellow; and white orbital ring and loral spot better developed. Wing (type), 69; tail, 59.

Range. — Highlands of Bolivia.

Remarks. — The above examples are very different — much duller colored — from lowland birds from Bolivia, referred (I think rightly) to *calamae*. They have not been compared with *obscuriceps* of Zimmer, the description of which they do not fit. The pale-colored pileum — green, washed externally with dull plumbeous, and thus almost matching *examinatus;* the decidedly greenish back; and the dull-colored underparts serve to distinguish this from related forms.

Rhynchocyclus olivaceus sordidus, subsp. nov.

Twenty-six specimens: Benevides, Santarem, Colonia do Mojuy, Villa Braga, and Mirititubа, Brazil.

Type, No. 72,847, Collection Carnegie Museum, adult male; Santarem, Brazil, May 15, 1919; Samuel M. Klages.

Subspecific characters. — Similar to *Rhynchocyclus olivaceus olivaceus* (Temminck) of southeastern Brazil, but general coloration duller; underparts paler yellow, and breast and throat duller olivaceous; wing-markings duller buffy; and size smaller. Similar also to *R. o. guianensis* McConnell of eastern Venezuela and the Guianas, but general coloration lighter, and wing-markings paler buff. Wing (type), 70; tail, 60; bill, 15.5; tarsus, 16.

Range. — Lower "Amazonia," Brazil (Rio Tocantins and Rio Tapajóz).

Remarks. — Single specimens of this form could not invariably be placed, so subtle are the differential characters, but with a good series available it is at once obvious that birds from south of the Amazon differ perceptibly both from true *olivaceus* and from *guianensis.* These differences are not easy to describe, but are readily apparent to the eye. In *guianensis* the upperparts are a close match for the olive green of Ridgway, while in the new form they more nearly approach the warbler green of the same authority. The outer edgings of the wing-coverts are paler buff, and those of the remiges and rectrices are purer

green. Also, the sides of the head and neck are appreciably paler, while the underparts are duller-colored, with less yellow and more green in evidence. Dr. Zimmer (1939, Am. Mus. Nov., no. 1045: 22) mentions the lighter and brighter green of the Rio Tapajóz birds, but judges that their characters are not well enough established to justify their formal separation. Our series consists of twenty-six specimens, while for comparison we have twenty-eight specimens of *guianensis,* and four of true *olivaceus* (American Museum). The latter are easily separable from the lower Amazon birds by their brighter yellow underparts and somewhat larger size.

Our Benevides specimens, which at first (following Zimmer) I thought were referable to *olivaceus* proper, fall in better with the Rio Tapajóz birds when compared with *olivaceus* from southeastern Brazil. The supposed differences are mainly seasonal in nature.

Rhynchocyclus olivaceus tamborensis, subsp. nov.

Seven specimens: El Tambor, Colombia.

Type, No. 59,271, Collection Carnegie Museum, adult female; El Tambor, Santander, Colombia, January 11, 1917; M. A. Carriker, Jr.

Subspecific characters. — Similar to *Rhynchocyclus olivaceus flavus* (Chapman) of northwestern Venezuela and the Santa Marta region of Colombia, but underparts obviously brighter yellow (Martius yellow), this color invading the throat and breast, leaving the darker flammulations on these parts less distinct. Similar also to *R. o. bardus* (Bangs and Barbour) of eastern Panama, etc., but upperparts brighter and purer green (dull yellowish and less buffy), with the flammulations less distinct.

Range. — Known at present only from the type-locality, in the valley of the Rio Lebrija.

Remarks. — Mr. deSchauensee (1950, Caldasia, 5: 842) refers his single specimen from El Tambor to *bardus,* but actual comparison of our series with eight authentic specimens of that race, kindly placed at my disposal by Mr. Peters, discloses obvious racial differences. The El Tambor specimens agree well among themselves, although only one male is included in our series. The brighter yellow color of the underparts, combined with the purer green of the upperparts, serve to set it off from its nearest allies.

Todirostrum latirostre austroriparium, subsp. nov.

Nine specimens: Santarem, Brazil.

Type, No. 71,592, Collection Carnegie Museum, adult male; Santarem, Brazil, March 28, 1919; Samuel M. Klages.

Subspecific characters. — Similar in general to *Todirostrum latirostre senectum* Griscom and Greenway of the north bank of the lower Amazon, but upperparts darker-colored (Roman green rather than serpentine green), and outer margins of tertials inclining to buffy rather than yellowish.

Range. — Presumably the south bank of the lower Amazon, but definitely known only from the type-locality.

Remarks. — In describing the supposed race *difficile* (1937, Ann. Carnegie Mus., 25: 254) I erred in completely overlooking Messrs. Griscom and Greenway's *senectum,* and merely re-described *latirostre,* as Dr. Zimmer pointed out (1940, Am. Mus. Nov., no. 1066: 7-9). I undertook to show that *caniceps* ranges unchanged from the upper Amazon to Obidos and the Rio Tapajóz. A recent critical examination of our series convinces me that I erred again in this conclusion, and that our Obidos skins are, as a matter of fact, slightly but sufficiently distinct from *caniceps* to be worthy of a name. Dr. Zimmer opines that *senectum* is not a very strongly marked form; this may be partly because he has confused two forms under it. In view of this circumstance it may seem presumptuous to subject it to division, but my impression is that the Rio Tapajóz race is as much entitled to recognition as *senectum* itself, the range of which will now have to be restricted to the north bank of the lower Amazon.

Euscarthmornis granadensis andinus, subsp. nov.

Nine specimens: Las Ventanas and La Pica, Santander, Colombia.

Type, No. 59,422, Collection Carnegie Museum, adult male; La Pica, Santander, Colombia, February 10, 1917; M. A. Carriker, Jr.

Subspecific characters. — Similar to *Euscarthmornis granadensis granadensis* (Hartlaub) of western Colombia, but loral region buffy instead of white, and gray of the breast less solid. Similar also to *E. g. lehmanni* deSchauensee of the Santa Marta region, but breast grayer, with the pectoral spot reduced in size, and with no suggestion of greenish yellow tinge.

Range. — Subtropical Zone, Eastern (and Central?) Andes of Colombia.

Remarks. — *Todirostrum granadense* of Hartlaub (1843, Rev. Zool., 6: 289) was described from a "Bogotá" skin, but the description calls for a bird with the "space between the bill and the eye white" (translation). Now, the only specimens I have seen answering the description in this particular come from the Subtropical Zone of the Western Andes (Sancudo, Caldas). Hence I consider that typical *granadensis* should be restricted to this region, and that the bird of the Eastern Andes should be given a name, since it is clearly distinct from the other as well as from that of the Santa Marta Mountains. The case is precisely parallel to that of the hummingbird *Chalybura buffoni* which I discussed a few years ago (1942, Ann. Carnegie Mus., 29: 331). In this latter case my proposed shift has not been accepted by other authorities, mainly I suspect on the ground that in Hartlaub's time birds were not supposed to be coming in from western Colombia. But it seems clear that so-called "Bogotá" skins may have come from any part of the country, and in such case is not the presumption in favor of the author's description rather than the uncertain type-locality he assigns? Hartlaub's type, if extant, should be examined in this connection.

Lophotriccus pileatus santaeluciae, subsp. nov.

Eight specimens: El Limón and Santa Lucia, Venezuela.

Type, No. 105,303, Collection Carnegie Museum, adult male; Santa Lucia, Miranda, Venezuela; September 14, 1929; Ernest G. and Margaret L. Holt.

Subspecific characters. — Similar to *Lophotriccus pileatus squamaecrista* (Lafresnaye) of the Eastern Andes of Colombia, but upperparts darker, duller green (olive green instead of warbler green) and crest-feathers tipped with Sudan brown (instead of ochraceous-tawny).

Range. — Coast Range of Venezuela.

Remarks. — Discrimination of this race rests upon the proper determination of the *Todirostrum squamaecrista* of Lafresnaye (1846, Rev. Zool., 9: 363), described from "Bogotá." The type-specimen, still extant in the Museum of Comparative Zoölogy, is almost certainly an immature bird, so Mr. J. L. Peters advises me. Compared with three Colombian specimens sent him for the purpose, it has the "forehead

brown without shaft-stripes or cinnamomeous edgings [surely a sign of immaturity]; ear-coverts brown rather than greenish brown; underparts practically without trace of yellow [this color well marked in our Colombian skins], but a very faint yellowish wash on the belly and under tail-coverts; malar region and sides of throat brownish gray; center of throat and breast pale with indistinct darker shaft-stripes; wing 48.5; tail 37.9 mm. There is no essential difference in the color of the back or the edgings of the crest-feathers." Mr. Peters further suggests that the type-specimen may have faded in the hundred years since it was taken. Everything considered, it would seem best to restrict Lafresnaye's name to the form with light greenish upperparts and yellowish-tinged underparts which inhabits the Eastern Andes of Colombia. The West Andean form is different again. The coast-range bird from Venezuela is slightly but constantly different from the East Andean form, as above pointed out. Dr. Zimmer had one specimen, on which he remarked (1940, Am. Mus. Nov., no. 1066: 19).

Lophotriccus pileatus hesperius, subsp. nov.

Ten specimens: Heights of Caldas, Bitaco Valley, and La Cumbre (Valle), Colombia.

Type, No. 67,050, Collection Carnegie Museum, adult male; Heights of Caldas, Valle, Colombia, June 7, 1918; M. A. Carriker, Jr.

Subspecific characters. — Similar to *Lophotriccus pileatus luteiventris* Taczanowski of Chiriqui and Costa Rica, but underparts with little or no greenish suffusion. It differs in like manner from *L. pileatus squamaecrista* as heretofore defined and restricted, and also in having the streaking on the underparts not so heavy. Wing (type), 50, tail, 40.

Range. — Subtropical Zone, Western Andes of Colombia.

Remarks. — Chapman (1917, Bull. Am. Mus. Nat. Hist., 36: 442) declares that the nominate race of *Lophotriccus squamaecristatus* (sic) is common to all three ranges of the Colombian Andes, and in this decision he is followed by the latest authority (deSchauensee, 1950). Our material does not support this view. Specimens from the Western Andes agree with Costa Rican birds (*luteiventris*) in being heavily streaked below, but are markedly less yellowish. Compared with birds from the Eastern Andes, they are not only less yellowish, but also more heavily streaked. There is of course some variation in both series as to these characters, but the average difference is well main-

tained. I note that in female examples the markings of the crest are much less distinct.

Pogonotriccus ophthalmicus purus, subsp. nov.

Nine specimens: La Cumbre de Valencia, Loma Redonda, and El Limón, Venezuela.

Type, No. 104,624, Collection Carnegie Museum, adult male (?); El Limón, Distrito Federal, Venezuela, February 15, 1929; Ernest G. and Margaret L. Holt.

Subspecific characters. — Similar to *Pogonotriccus ophthalmicus ophthalmicus* Taczanowski of Peru and Colombia, but underparts more purely and uniformly yellow; pileum purer and lighter gray; and upperparts duller and darker green.

Range. — Subtropical Zone, Coast Range of Venezuela.

Remarks. — Venezuelan birds of this species have heretofore been referred to true *ophthalmicus,* described from Junin, Peru, but actual comparison with Peruvian specimens shows that they may be distinguished in series by the slight but obvious color-characters above specified. Colombian specimens are clearly referable to the Peruvian race, thus leaving the Venezuelan form to be described. An additional character may be that the chin in Venezuelan birds appears to be more uniform with the throat — less mottled with gray and white.

Inezia subflava saturatior, subsp. nov.

Five specimens: Sabana de Mendoza, Venezuela.

Type, No. 88,483, Collection Carnegie Museum, adult male; Sabana de Mendoza, Venezuela, April 29, 1922; M. A. Carriker, Jr.

Subspecific characters. — Similar to *Inezia subflava intermedia* Cory, but upperparts darker- and duller-colored; wing-bars whiter; and underparts duller yellow, with more dark-colored suffusion on the breast. Similar also to *I. subflava obscura* Zimmer of the upper Orinoco region, but not so dark-colored above, with less brownish wash; underparts purer yellow, with less olivaceous shading on the breast and sides, and an obvious buffy wash on the breast; and outer rectrices with outer webs wholly pale.

Range. — Known at present only from the type-locality, but probably the race inhabiting the Maracaibo Basin (except at its northern end).

Remarks. — These five specimens appear to be the only ones at present known from the Maracaibo Basin of Venezuela, where it might

be expected, judging by analogy, that a different race might occur. In its relatively darker coloration the new race resembles *obscura,* but in its tail-pattern it is like *intermedia.* Our specimens were secured between April 29 and May 3.

Elaenia pallatangae exsul, subsp. nov.

Three specimens: Incachaca, Bolivia.

Type, No. 120,376, Collection Carnegie Museum; Incachaca, Province of Cochabamba, Bolivia, June 24, 1927; Francisco B. Steinbach.

Subspecific characters. — Similar to *Elaenia pallatangae intensa* Zimmer of Peru, but upperparts more olivaceous, less brownish; yellow color of underparts purer and brighter, overspreading the breast and throat; and wing-bands wider and tinged with yellowish. Wing (type), 77; tail, 69.

Range. — Presumably the Subtropical Zone of the Bolivian Andes, but at present known only from the type-locality.

Remarks. — The above have been compared with four specimens of *intensa,* kindly placed at my disposal by Dr. Zimmer. The yellow of the underparts in this form, as I see it, is not as deep as "Barium Yellow × Straw Yellow," as the describer puts it, but nearer naphthalene yellow, while the throat and breast have little yellow wash as compared with our Bolivian birds. The specimen selected as the type of the new race, however, has the underparts nearer to barium yellow than the other two.

This species is a new record for Bolivia.

Myiopagis viridicata restricta, subsp. nov.

Six specimens: El Limón and Santa Lucia, Venezuela.

Type, No. 105,182, Collection Carnegie Museum, adult male; Santa Lucia, Miranda, Venezuela, September 4, 1929; Ernest G. and Margaret L. Holt.

Subspecific characters. — Similar to *Myiopagis viridicata pallens* Bangs of the Santa Marta region and Magdalena Valley of Colombia, but general coloration darker, and external margins of inner remiges duller green, without yellowish tinge. Wing (type) 71; tail, 63.

Range. — Northern coast of Venezuela.

Remarks. — Four adult and two immature specimens from northern Venezuela agree together and differ from a series (eleven specimens)

from the Santa Marta region of Colombia in their generally darker and duller coloration. The upperparts are close to Ridgway's olive, whereas in *pallens* they are yellowish olive; the gray of the pileum is decidedly darker; and the wing-edgings are serpentine green rather than citron green.

I certainly cannot follow Dr. Zimmer in proposing to unite *pallens* and *accola* — a course which our material contra-indicates. The arrangement recently proposed by Mr. deSchauensee (1950, Caldasia, 5: 859-860) I consider more nearly correct.

SUBLEGATUS GLABER AND S. MODESTUS

Dr. Zimmer's remarks on my *Sublegatus glaber obscurior* (1941, Am. Mus. Nov., no. 1109: 3) were based on the supposition that Carnegie Mus. no. 63,728 from Mana, French Guiana, sent in exchange to the American Museum, correctly represented that form. Unfortunately this is not the case. Our type-specimen of *obscurior* (no. 56,689, from Cayenne) belongs to the stubby-billed *modestus* group, while the two specimens from Mana (nos. 63,064 and 63,728) are long-billed by comparison, and belong to the *glaber* group. If they are as different from birds from south of the Amazon (*sordidus*) as Dr. Zimmer claims, they would be entitled to a name, but I confess I cannot find any salient color-characters wherewith to separate them from *obscurior*. The differently shaped bill is the only character in evidence. Pending further study of the value and significance of this character in the case of *Sublegatus glaber* and *S. modestus,* I refrain from bestowing a name on the Mana specimens.

Myiopagis caniceps subsp.?

One specimen (no. 65,780): Pied Saut, French Guiana, January 17, 1918; Samuel M. Klages.

This female is much duller below than females from Tonantins, on the upper Amazon, and probably represents a new and different race, as suggested by Hellmayr (1927, Field Mus. Zool. Ser., 13, pt. 5: 441, note). Its formal description, however, would better be delayed until more specimens are available.

Suiriri suiriri subsp.?

Three specimens: Rio Quiser, Bolivia, June 7, 1918; José Steinbach.

These are markedly paler above, with scarcely a trace of olive wash

on the back, than other Bolivian specimens comparable for season. Coming as they do from Chiquitos in eastern Bolivia, they may represent the true *suiriri* of Vieillot, based on the bird of Paraguay. But since the species appears to be migratory, the chances that they may represent a resident race in this region are small. In any case, they certainly differ from the general run of Bolivian specimens.

Mionectes olivaceus improvisus, subsp. nov.

Fifteen specimens: Quibdó, El Tambo, Andagoya, Potedó, Malagita, and Cordoba, Colombia.

Type, No. 66,860, Collection Carnegie Museum, adult male; Cordoba (Valle), Colombia, May 29, 1918; M. A. Carriker, Jr.

Subspecific characters — Similar to *Mionectes olivaceus hederaceus* Bangs of the Subtropical Zone, Western Andes of Colombia, but general coloration duller and dingier; upperparts darker olive green; pileum with a deeper shade of plumbeous; and underparts with more olive and less yellow, producing a distinctly duller effect.

Range. — Colombian-Pacific Fauna of Colombia, south at least to Buenaventura.

Remarks. — Previous records of *Mionectes olivaceus* from western Colombia have been referred to *hederaceus* without question, but a comparison in series of uniformly made-up specimens suffices to show that two races have been confused under this name. *M. o. hederaceus* was described from the Subtropical Zone of the Western Andes, and birds from lower altitudes agree among themselves, and differ from the others, in obviously duller coloration throughout. Although I have not examined the specimens on which the records are based, I have no doubt but that all the published records for *hederaceus* from the lowlands of western Colombia and probably those from eastern Panama also will prove to belong to the new race. *M. o. improvisus* is much duller-colored than true *olivaceus.* Our specimens come from the valleys of the Atrato and San Juan rivers.

ART. 6. A REVIEW OF THE GEOGLOSSACEAE (FUNGI) OF WESTERN PENNSYLVANIA

By LeRoy K. Henry

(Plate 22)

This family of fungi belongs to the ascomycetous order Pezizales, suborder Inoperculatae. The spores are borne in an ascus sac without an opening or lid at the apex and are discharged as the swollen apical portion bursts.

The fruiting bodies, chiefly club-shaped or capitate, vary from a few millimeters to five centimeters or more in height. They are usually found where plenty of moisture is available, such as on rotted wood, among decaying leaves or on moss or wet soil. A few grow attached to twigs lying in small pools or in flowing water.

A microscopic examination of the spores is often necessary to determine the genera and species of this family.

Key to the Geoglossaceae

Fruiting body clavate, usually compressed or stipitate; spore-bearing portion not, or slightly, decurrent on the stem.

Spores non-septate, short-cylindrical; spore-bearing portion bright yellow; stem white ..... *Mitrula phalloides*

Spores long-elliptical to cylindrical, 3-many septate when mature.

Spore-bearing portion golden yellow; stem pale yellow; spores hyaline (transparent) ..... *Microglossum rufum*

Spore-bearing portion black or blackish; spores smoky or brown.

Fruiting body smooth, sticky ..... *Gloeoglossum*

Fruiting body smooth, not sticky; spores 7-septate at maturity. *Geoglossum glabrum*

Fruiting body hirsute, not sticky; spores 100-170 microns long, 8 in each ascus, normally 15-septate ..... *Trichoglossum hirsutum*

Fruiting body spatulate or fan-shaped; spore-bearing portion decurrent on opposite sides of the stem ..... *Spathularia clavata*

Fruiting body capitate, stipitate, or sessile.

Spores elliptical-fusiform; fruiting body gelatinous ..... *Leotia*

Spores filiform; fruiting body fleshy-gelatinous, aquatic or semi-aquatic. Stipitate ..... *Vibrissea*

ued April 14, 1952

Sessile ..... *Apostemidium*
Spores filiform-clavate; fruiting body fleshy-leathery, terrestrial..... *Cudonia*

The following listings are based upon the specimens from western Pennsylvania now in the Herbarium of the Carnegie Museum. The date of collection and the collector's initials have been used only if the species is infrequent or rare. The initials used are to be interpreted as follows: D.R.S., David R. Sumstine; O.E.J., O. E. Jennings; L.K.H., L. K. Henry.

Apostemidium

Apostemidium Guernisacri (Cr.) Boud.

Centre County: 3.5 mi. NW of Wingate, at Gum Stump, on twigs in water, June 28, 1950, Neil D. Richmond.

Cudonia

Cudonia lutea (Peck) Sacc.

Elk County: near Kane, Aug. 19, 1942, D.R.S. *Fayette County:* Ohiopyle, Aug. 20, 1940, D.R.S.

Geoglossum

Geoglossum glabrum Pers. (Plate 22, fig. 5)

Beaver County: 1 m. E of Murdocksville, Potato Garden Run, Sept. 1, 1947, Ellen Mason. *Centre County:* Shingletown Gap, Aug. 2, 1938, Marie Knauz. *Forest County:* S of Tionesta on Rt. 62, July 21, 1938, M. Knauz; western part of Allegheny National Forest, Aug. 6, 1942, M. Knauz.

KEY TO THE SPECIES OF GLOEOGLOSSUM

Spores 0-7-septate when mature, clavate-cylindrical..... *Gl. glutinosum*
Spores 15-septate when mature..... *Gl. difforme*

Gloeoglossum difforme (Fr.) Durand

Cameron County: 10 mi. NE of Sinnemahoning, woods along Rt. 872. *Elk County:* 2 mi. E of Medix Run, woods along Rt. 552. *Erie County:* Presque Isle. *Fayette County:* Ohiopyle. *Potter County:* near Odin. *Westmoreland County:* 3 mi. SE of Rector, Lynn Run; Jones Mills.

Gloeoglossum glutinosum (Pers.) Durand

Elk County: near Kane, Aug. 19, 1942, D.R.S. *Venango County:* 3 mi. NE of Lisbon, July 7, 1946, Mrs. A. B. Lord.

KEY TO THE SPECIES OF LEOTIA

Both cap and stem yellow-ochraceous.....*L. lubrica*

Cap greenish olive; stem yellow.....*L. lubrica* f. *Lloydii*

Cap deep green; stem white to yellowish.....*L. stipata*

Leotia stipata (Bosc.) Schröt. (*L. chlorocephala* Schw. *sensu* Lloyd) (Plate 22, fig. 3)

Armstrong County: Kittanning. *Beaver County:* Glenn's Hollow near Aliquippa. *Butler County:* 2 mi. S of Leasuresville; Little Buffalo Creek at Monroe Station. *Clarion County:* Cook Forest. *Crawford County:* French Creek near Cochranton. *Fayette County:* Ohiopyle. *Huntingdon County:* Jackson Twp., Stone Valley. *Indiana County:* near Glen Campbell. *Lawrence County:* Muddy Creek Falls near mouth of Muddy Cr. *McKean County:* near Kane. *Potter County:* near Odin. *Somerset County:* 4 mi. SW of Somerset; Downey, 0.75 mi. S of Allegheny Tunnel on Pa. Turnpike. *Westmoreland County:* Derry; near Saltsburg; Idlewild Park near Ligonier; 2 mi. E of Trafford, Shades Ravine; 6 mi. SE of New Florence, Rachelwood; 3 mi. SE of Rector, Lynn Run; SE of Rector, top of Laurel Hill.

Leotia lubrica (Scop.) Pers.

Allegheny County: 2 mi. NE of Mt. Nebo; 2 mi. SW of Carnot; 1 mi. W of Mt. Nebo. *Armstrong County:* Kittanning. *Beaver County:* 2.5 mi. SE of New Sheffield; intersection of Beaver-Conway and Ambridge-Rochester roads. *Blair County:* Yellow Springs, east of Altoona, off Rt. 30. *Butler County:* 2 mi. S of Leasuresville. *Cameron County:* 10 mi. NE of Sinnemahoning, along Rt. 872. *Clearfield County:* 1 mi. S of Patchinsville; State Game Lands No. 34, S of Medix Run. *Elk County:* Ridgeway; near Kane. *Fayette County:* Ohiopyle; Claircrest. *Indiana County:* near Glen Campbell. *Jefferson County:* 5.5 mi. NE of Sigel. *Lawrence County:* Muddy Creek Falls at mouth of Muddy Cr. *Lycoming County:* 5 mi. N of Salladasburg, along Rt. 84. *Mercer County:* 2 mi. W of Mercer, Mercer Bog. *Somerset County:* 6 mi. W of Somerset. *Venango County:* 3 mi. NE of Emlenton. *Westmoreland County:* 3 mi. SE of Rector, Lynn Run; 6 mi. SE of New Florence, Rachelwood; Kiski Campus; Waterford; Idlewild Park near Ligonier; 1.5 mi. E of New Alexandria, off Rt. 22.

Leotia lubrica f. Lloydii (Rehm.) Durand

Elk County: 2 mi. E of Medix Run, along Rt. 555. *Erie County:* Presque Isle. *Fayette County:* Ohiopyle. *Venango County:* 3 mi. NE of Emlenton. *Westmoreland County:* Laurel Hill, E of Rector; NE of Hopewell, Pikes Run.

Mitrula

Mitrula phalloides (Bull.) Chev. (*M. paludosa* Fr.) (Plate 22, fig. 2)

On leaves in standing water. *Clearfield County:* State Game Lands No. 34, S of Medix Run. *Crawford County:* Pymatuning Swamp, Linesville. *Fayette County:* Ohiopyle; NE of Normalville, Indian Cr. *Franklin County:* Mont Alto near Pond Bank. *Jefferson County:* 5.5 mi. NE of Sigel. *Potter County:* Little Kettle Cr. below Oleona. *Somerset County:* near Buckstown. *Venango County:* near Lisbon. *Warren County:* 3 mi. NE of Columbus, Tamarack Swamp. *Westmoreland County:* top of Chestnut Ridge, SE of Latrobe; Forbes Forest, 3 mi. SE of Rector; Hillside; Jones Mills.

Microglossum

Microglossum rufum (Schw.) Underw.

Erie County: Corry, July 1, 1908, D.R.S. *Fayette County:* Ohiopyle, July 1905, D.R.S. *Huntingdon County:* Alan Seegar State Forest, S of State College, July 14, 1937, Marie Knauz. *Somerset County:* 2.5 mi. S of Reels Corners, off Rt. 160, July 8, 1948, L.K.H.

Key to the Species of Spathularia

Stem pallid or yellowish.....*S. clavata*
Stem bay-brown, minutely velvety.....*S. velutipes*

Spathularia clavata (Schaeff.) Sacc.

Allegheny County: Powers Run, Sept. 27, 1940, Marie Knauz. *Centre County:* Woodward, Sept. 7, 1939 and July 29, 1941, D.R.S.

Spathularia velutipes Cke. and Farlow (Plate 22, fig. 1)

Bedford County: Sulphur Springs, Aug. 7, 1940, D.R.S. *McKean County:* Tionesta Tract near Brookston, July 25, 1940, L.K.H. *Potter County:* near Odin, Aug. 18, 1935, O.E.J.

Trichoglossum

Trichoglossum hirsutum (Pers.) Boud.

Armstrong County: Kittanning, Aug. 1905, D.R.S. *Fayette County:* Ohiopyle, Aug. 7, 1907, D.R.S. *Huntingdon County:* Alan Seegar State Monument, Aug. 11, 1949, Neil D. Richmond. *Somerset County:* 4 mi. SW of Somerset, Aug. 27, 1947, Wm. Grimm. *Westmoreland County:* Forbes Forest, 3 mi. SE of Rector, Sept. 6, 1947, L.K.H.

Vibrissea

Vibrissea truncorum (A. & S.) Fr. (Plate 22, fig. 4)

On twigs in running water. *Clearfield County:* 1 mi. NW of McGees

Mills, Apr. 11, 1944, Neil D. Richmond. *Jefferson County:* 5.5 mi. NE of Sigel, May 11, 1948, L.K.H. *Somerset County:* 0.75 mi. S of Allegheny Tunnel on Pa. Turnpike, Sept. 10, 1949, L.K.H. *Venango County:* 4.5 mi. N of Lisbon, May 25, 1946, H. Mozingo. *Warren County:* Tionesta Tract near Brookston, July 25, 1940, L.K.H. *Westmoreland County:* Hillside, May 20, 1922, O.E.J.; Laurel Hill E of Laughlintown, July 8, 1906, D.R.S.; Jones Mills, May 16, 1940, H. Roslund.

SUMMARY

A key to the genera and species of the Geoglossaceae represented in the Carnegie Museum Herbarium is provided. Distributional records in western Pennsylvania (west of the eastern borders of Potter, Clinton, Centre, Huntingdon, and Fulton counties) are given for each species. *Apostemidium Guernisaci* is represented by one collection only. *Cudonia lutea, Gloeoglossum glutinosum,* and *Spathularia clavata* are each recorded from only two counties. *Geoglossum glabrum, Microglossum rufum,* and *Spathularia velutipes* were each obtained in three counties. None of these can be considered common in our region, but additional collecting should fill many gaps in our distributional records.

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EXPLANATION OF PLATE 22

Figures drawn by Elinor S. Henry

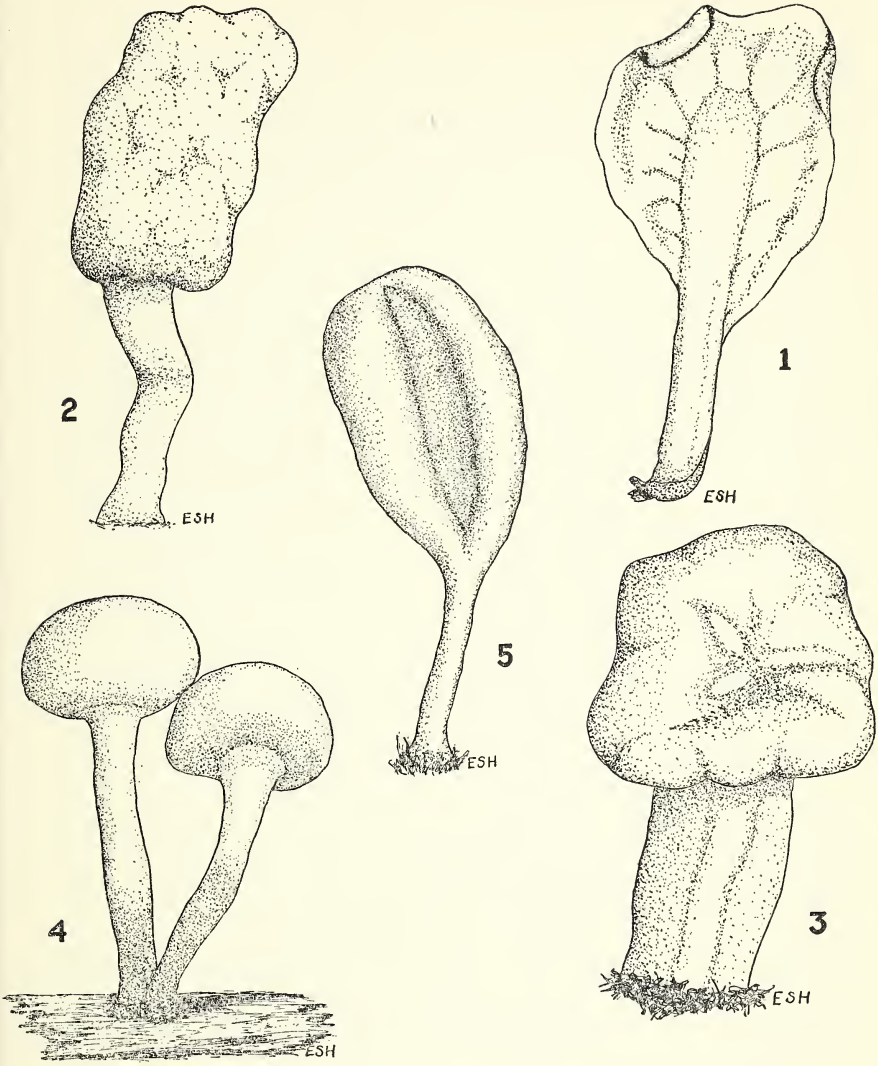
FIG. 1. *Spathularia velutipes* Cke. & Farlow × 4

FIG. 2. *Mitrula paludosa* (Bull.) Chev. × 3

FIG. 3. *Leotia stipata* (Bosc.) Schröet × 2.5

FIG. 4. *Vibrissea truncorum* (A. & S.) Fr. × 5

FIG. 5. *Geoglossum glabrum* Pers. × 2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ART. 7. FIRST RECORD OF THE GREEN SALAMANDER IN PENNSYLVANIA, AND OTHER RANGE EXTENSIONS IN PENNSYLVANIA, VIRGINIA AND WEST VIRGINIA*

By Neil D. Richmond

Since a new edition of the *Check List of North American Amphibians and Reptiles* is now in preparation, it appears desirable to report various specimens in Carnegie Museum that extend or better define the ranges of a number of eastern amphibians and reptiles.

Aneides aeneus (Cope)

During the twenty years since the green salamander was first found at Cooper Rock, West Virginia, sporadic efforts have been made to find it farther north. Since Cooper Rock is an outcrop of the Pottsville sandstone that also forms cliffs and ledges farther north along Chestnut Ridge, a study was made of the ridge from Cooper Rock to near Uniontown, Pennsylvania, in an effort to find the northern limits of *Aneides* and, if possible, to determine the limiting factors.

Chestnut Ridge is an anticlinal fold that dips to the north, finally disappearing about 50 miles north of the West Virginia state line. At the southern end, the crest of the ridge is 2,500 feet while at the northern end it is 2,000 feet and much narrower. Associated with the decrease in altitude, but not necessarily caused by it, is an abrupt change in the amount of precipitation. There is a decrease from an annual average of 46 inches near the West Virginia line to approximately 40 inches within a distance of 20 miles. The rock formations that were visited were generally more exposed and drier than those in West Virginia. An exception is the deep ravine on the western slope below Wymps Gap, which is cool, moist and forested with hemlock and maples. When I visited this site on August 3, 1951, there had been light showers all day and *Aneides* were beginning to come out on the face of the rocks at dusk. Of the 6 seen, 5 were collected. The rocks, here, are isolated blocks of Pottsville sandstone, similar to those at Cooper Rock but approximately 500 feet lower on the mountain. This

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ravine is about 10 miles northeast of Cooper Rock, the previous northernmost locality.

SPECIMENS EXAMINED:

Pa., Fayette Co., 5 mi. SE of Smithfield, Wymps Gap, 1,500 feet. 5, CM 29749-53

Plethodon richmondi Netting and Mittleman

In 1949, Harry R. Roslund and I found the ravine salamander to be abundant at Coburn, Centre County, Pennsylvania. This extends the known range 70 miles northeastward from its previous most eastern station (Everett, Bedford Co., Pa.) and establishes it as a part of the fauna of the Ridge and Valley Section of northcentral Pennsylvania. At Coburn, these salamanders were under small flat rocks and leaves on steep hillsides of clay soil overlying limestone ledges, in which habitat they were the most common salamander. The only other salamander associated with them was *Plethodon g. glutinosus;* no *P. c. cinereus* were found.

SPECIMENS EXAMINED:

Pa., Centre Co., Coburn, 1100 feet. 41, CM 29067 (41)
Pa., Bedford Co., 2 mi. E of Osterburg, top of Dunning Mt., 2,100 feet. 1, CM 29066

Pseudacris brachyphona (Cope)

Recent collections have delimited the northern and northwest limits of the upland chorus frog. Specimens from near Sigel, Jefferson County, Pennsylvania, extend the range 50 miles north of the Kiskiminitas River, the type locality and former northernmost station. They also demonstrate the presence of the species in the High Plateaus Section of northern Pennsylvania. A specimen from northern Beaver County along the Ohio state line establishes the presence of the species north of the Ohio River in extreme western Pennsylvania. To date, no specimens have been reported north of the glacial boundary in Pennsylvania, although the Beaver County locality is just south of the Wisconsin terminal moraine.

SPECIMENS EXAMINED:

Pa., Jefferson Co., 5.5 mi. NE of Sigel. 3, CM 28193-95
Pa., Beaver Co., 2 mi. N of Smith's Ferry, Bieler Run. 1, CM 26788

Thamnophis brachystoma (Cope)

Recent collections of the small-headed garter snake clarify the limits of its range in Pennsylvania and emphasize that this form is a High Plateaus endemic. See Fig. 1.

Except for a few stations in the edge of the glaciated area, the range of *T. brachystoma* is restricted to one physiographic section, the Allegheny High Plateaus Section of the Appalachian Plateaus Province. This is bounded on the west and north by the Glaciated Section of the same Province. The few records from within the Glaciated Section are in areas where the glacial drift is thin and the topography is essentially similar to the unglaciated areas to the east.

Approximately three-fourths of the High Plateaus Section is drained by the Allegheny River and its tributaries. Only the eastern one-fourth lies within the Susquehanna drainage. It is noteworthy that no specimens of *brachystoma* have ever been taken in this eastern portion. Oddly enough, it does not appear to have been able to cross the low drainage divide.

Although *brachystoma* is abundant in the large valleys, it is not restricted either to valleys or to glacial outwash soils, and it is equally abundant on uplands away from large streams. East of the Allegheny River most of the plateau lacks glacial outwash deposits, even in the larger valleys.

The factors that operate to restrict the range of this snake present an interesting problem. Unlike many relict forms it is not restricted to isolated relict habitats such as bogs.

The western limits of the range are now well outlined by a series of localities. It is unlikely that the range will be extended much farther west, in view of the great amount of collecting that has been done over a half century in the vicinity of Pymatuning Swamp and Reservoir in western Crawford County and around Erie in Erie County. The eastern and southern limits are marked by several stations.

WESTERN STATIONS ARRANGED NORTH TO SOUTH:

Pa., Erie Co., Corry (extreme SE corner of Erie Co.). 2, CM 29881-82
Pa., Crawford Co., Titusville (extreme eastern Crawford Co.). 2, CM 29870-71
Pa., Venango Co., 1 mi. NE of Franklin. 1, CM 27732
Pa., Mercer Co., Sandy Lake. 1, CM 5472
Pa., Mercer Co., 2-3 mi. N of Grove City on PA 78. 1, CM 28633

SOUTHERN STATIONS WEST TO EAST:

Pa., Mercer Co., 2-3 mi. N of Grove City on PA 78. 1, CM 28633
Pa., Clarion Co., Strattonville. 32, CM 28291-322

EASTERN STATIONS ARRANGED NORTH TO SOUTH:

N. Y., Allegany Co., Ceres. 2, CM 29645-46
N. Y., Cattaraugus Co., Portville. 3, CM 29647-49
Pa., McKean Co., 4 mi. NE of Clermont. 1, CM 28740
Pa., McKean Co., Port Allegany. 7, CM 5396-5402
Pa., Elk Co., Portland Mills. 3, CM 28393-95

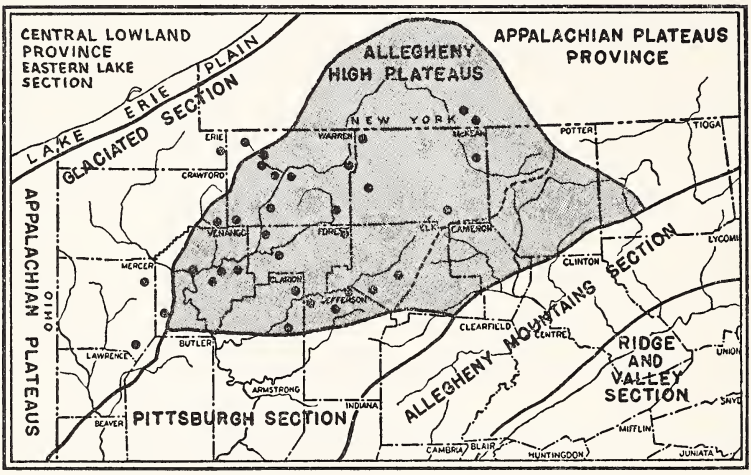

FIG. 1. Northwest Pennsylvania showing the distribution of *Thamnophis brachystoma* in relation to physiographic divisions (physiographic divisions after Pennsylvania Topographic and Geologic Survey). The dashed line represents the drainage divide between the Allegheny and Susquehanna rivers.

Desmognathus quadramaculatus quadramaculatus (Holbrook)

The series of *D. q. quadramaculatus* in Carnegie Museum represent the most northern and eastern localities known for the black bellied salamander. Along the Allegheny Front, locally known as Peters Mountain, its range extends northward to Monroe County, West Virginia, and Alleghany County, Virginia, both in the James River drainage. It is also common at Mountain Lake, Giles County, Virginia, in the New River drainage. Eastward it is represented by one

specimen (CM 18101) from Spencer, Henry County, Virginia. This locality is on an outlier of the Blue Ridge and is in the Dan River system. It is also noteworthy that this specimen was taken at the unusually low altitude of 900 feet.

SPECIMENS EXAMINED:

W. Va., Monroe Co., Potts Creek Valley. 3, CM 14374-76

W. Va., Mercer Co., nr. Bluefield, Bluefield Reservoir. 31, CM 5662 (28), 8048-49, 15397

Va., Alleghany Co., 1 mi. E of Potts Cr. P. O., 1,650 feet. 1, CM 26312

Va., Giles Co., Mountain Lake, 3,800-4,000 feet. 63, CM 24050, 24044-46, 18494-95, 18464 (12), 17621-22, 14011 (10), 13991 (26), 13983 (9)

Va., Craig Co., Peters Mt., W of Paint Bank. 2, CM 14365-66

Va., Henry Co., Spencer, 900 feet. 1, CM 18101

Pseudacris brimleyi Brandt and Walker

I have heard the Carolina chorus frog calling at three places in New Kent County, Virginia, 70 miles northwest of Dismal Swamp and north of the James River. The New Kent County localities are all within the Atlantic Coastal Plain. One is on the same coastal plain terrace as Dismal Swamp, the Pamlico, but the other two are on higher terraces, the Wicomico and Chowan.

In every breeding pool, *brimleyi* was greatly outnumbered by *Pseudacris nigrita feriarum*. The call resembles that of *Pseudacris brachyphona* and is easily heard above the rapid calls of *feriarum*. The males of *brimleyi* invariably called from well-concealed positions, usually in a tangle of briers or in piles of debris or brush lying in the shallow breeding ponds. Occasionally, they were found concealed in a tussock of grass. The calling position, although concealed from above, commanded a good view of the surface of the pool so that the calling male could be seen if the observer could get close enough to the surface of the water. By contrast, the *feriarum* in the same pools were calling from exposed positions around the shore and from partially submerged vegetation in the open water.

P. brimleyi was heard in a variety of breeding pools but appeared to be more abundant in those in woods or along the edge of woods. Although heard in many pools, collecting was successful in only one,

a large drainage ditch along a railroad. This ditch had been cleared of brush the previous fall and the only cover in it was grass. In the other pools the frogs were so well protected that they could escape even when it was possible to see them calling. In fact, of the 15 species of frogs and toads in New Kent County, *brimleyi* was the most difficult to collect.

SPECIMENS EXAMINED:

Va., New Kent Co., 2 mi. NW of Windsor Shades along US 60. 30 feet. 10, CM 18646

ART. 8. NOTES ON THE MYLAGAULID RODENT DENTITION

By John A. Dorr, Jr.

(Plate 23)

Attempts to identify mylagaulid rodents make it apparent that in many past discussions or descriptions, authors have been extremely indefinite about the proper names to apply to the individual teeth. This is not surprising in view of the highly specialized and unusual nature of the mylagaulid dentition, but it is nevertheless extremely confusing to the uninitiated student who does not at first fully appreciate the reasons for such vagueness. Carnegie Museum fortunately has in its paleontological collection three excellent mylagaulid lower jaws which preserve parts of the milk dentition. The three specimens are: CM 742, holotype of *Mesogaulus pristinus* (Douglass); CM 843, holotype of *M. proximus* (Douglass); and CM 723, *Mesogaulus* sp. [*Mylagaulus* sp. of Douglass]. Since Douglass described *M. pristinus* and *M. proximus,* they have been removed from the genus *Mylagaulus* Cope and placed by Cook and Gregory (1941: 551) in the genus *Mesogaulus* Riggs.

Douglass' interpretation (1903: 186-191) of the dental formula and succession in these specimens was summarily rejected by Matthew (1924: 77) as being erroneous. The Carnegie Museum specimens were restudied and this paper will review the interpretations of Douglass and Matthew and record some of the writer's own observations. Unfortunately, only lower jaws were available for study, so evidence of upper dentitions was taken from the literature.

The original descriptions by Douglass of the Carnegie specimens proved to be essentially accurate, but the text and labeling of the figures contain *lapsi* which must be recognized. In the quotations following, changes to make his discussion clearer, more accurate, or consistent are indicated in brackets. In a general description of the three specimens, all found in the upper Miocene beds along the lower Madison River valley, Montana, Douglass (1903: 186-87) said:

> In one specimen (*M. pristinus*) [should read *M. proximus*] the erupting large premolar was apparently pushing out with its posterior portion a short-crowned, long-rooted tooth. Its anterior portion is replacing a tooth, only a portion of one root of which remains. In two other specimens [*M. pristinus* and *M.* sp.] the large premolar has missed this short-crowned, rooted tooth; or the anterior portion of the latter has apparently been

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absorbed and its posterior portion still remains between the large premolar and first prismatic molar.

There can be little doubt that this last rooted tooth is a *milk molar.* It is not at all prismatic, has long roots, is much worn in the young animal, and in one case is being shed. The permanent premolar and the two permanent molars are prismatic. In the descriptions which follow, the rooted tooth above described will be designated as the fourth temporary molar, $dm_{\bar{4}}$ [$dP_{\bar{4}}$]. If the above conclusions be true the large, permanent, prismatic premolar replaces two temporary molars. In one specimen [*M. proximus*] the posterior inner root of $dm_{\bar{3}}$ [$dP_{\bar{3}}$] is still preserved in place. . . .

The molar that is wanting in the adult animal is apparently the first, as there is no evidence of the loss of $M_{\bar{3}}$. The development of the first molar is evidently prevented by the large, permanent premolar. Perhaps under favorable conditions rudiments of $M_{\bar{1}}$ might be found.

Describing the holotype of *M. pristinus* Douglass (1903:187-88) said:

Permanent premolar large, very high, and with short roots. The fourth temporary molar [$dP_{\bar{4}}$], which is retained in the present specimen, is short, low and has long roots. Molars $_{\bar{2}}$ and $_{\bar{3}}$ are of moderate size and hypsodont. . . . .

$M_{\bar{2}}$ [$dP_{\bar{4}}$] is nearly worn out. It is closely crowded against the premolar, and on the anterior portion next to this tooth the enamel is absent. Like the corresponding tooth in specimen no. 723, to be described later, it looks as if the anterior portion of the tooth has been absorbed. If the animal had lived the tooth would evidently soon have been shed. $M_{\bar{2}}$ is prismatic and quite high though its lower portion cannot be seen. $M_{\bar{3}}$ cannot be very high on account of its proximity to the posterior portion of the incisor. It is undoubtedly much like the corresponding tooth of no. 723.

Describing the holotype of *M. proximus,* Douglass (1903: 189-90) said:

When the animal died the large permanent premolar was erupting and had nearly reached the alveolar border. This tooth, being much larger than its two predecessors [$dP_{\bar{3}-\bar{4}}$], the portion of the jaw containing the roots of the latter had to be absorbed. A small part of this alveolar portion, with one root of the anterior temporary molar [$dP_{\bar{3}}$] remains above the postero-external portion of the large premolar. The last temporary molar being unreduced in antero-posterior diameter was being pushed out by this new tooth. This last temporary molar has a larger grinding surface than that of *M. proximus,* but is low, nearly worn out, and has two long slender roots.

$P_{\bar{4}}$ is not as large, but it would undoubtedly have become larger as there is considerable space between its posterior border and the anterior border of $M_{\bar{2}}$. This last tooth is long vertically on account of its greater age,

longer than the premolar. It appears to be open below and not to have completed its growth. It is very doubtful if this tooth would be shed during the lifetime of the animal. It had not yet come into use, at least it is not worn, though it projects some distance above the alveolar border. $M_{\bar{3}}$ was just erupting.

Describing Carnegie Museum specimen no. 723 which he identified as *Mylagaulus* sp., Douglass (1903: 190) said:

> The last temporary premolar is much reduced, as if by partial absorption, as in the specimen of *M. proximus* (no. 842). Its antero-posterior is half its transverse diameter. The crown is nearly worn down to the roots. $M_{\bar{2}}$ is not so high as in *M. pristinus*. $M_{\bar{3}}$ is still lower. Both molars might be shed in old age.

From the above quotations and his figures, the concept Douglass had concerning the identities of the teeth in the three specimens is clear. He thought the large, hypsodont premolar was $P_{\bar{4}}$ and believed the two low-crowned, long-rooted teeth that it replaced were $dP_{\bar{3}}$ and $dP_{\bar{4}}$. He considered the last two teeth to be $M_{\bar{2}}$ and $M_{\bar{3}}$. (On figure 28 of Douglass' paper the last molar is mislabeled. From his discussion he must have meant to label that tooth $M_{\bar{3}}$? instead of $M_{\bar{1}}$?)

Matthew (1924: 77) remarked:

> The molars in the mylagaulidae are progressively deciduous, $M_{\bar{1}}$ dropping out shortly after the large premolar breaks through the jaw, $M_{\bar{2}}$ and $M_{\bar{3}}$ at later stages of wear. The alveolus of $M_{\bar{1}}$ is early reduced and disappears as the premolar pushes its way upward; the alveolus of $M_{\bar{2}}$ is similarly eliminated and that of $M_{\bar{3}}$ is reduced and finally disappears before the premolar is wholly worn down. Mr. Douglass [1903] has interpreted the $M_{\bar{1}}$ as $dP_{\bar{4}}$ and the $P_{\bar{4}}$ as $P_{\bar{3}}$, but this interpretation is certainly erroneous.

Discussing the mylagaulid dentition (1924: 81) Matthew said:

> A lower jaw obtained in 1921 gives the long desired evidence of the milk dentition in this group. . . . The milk premolar is a short-crowned *Allomys*-like tooth, totally unlike its permanent successor.

The jaw referred to by Matthew, A.M.N.H. 18902, was identified and figured by him (1924, fig. 8) as *Mylagaulus vetus*. This species later was assigned to the genus *Mesogaulus* by Cook and Gregory (1941:551).

My examination of the Carnegie specimens leads me to suspect that neither Douglass nor Matthew was completely correct in this matter, but that Douglass was more nearly so. Both authors and subsequent writers seem agreed to call the large, hypsodont permanent premolar

$P_{\bar{4}}$. The only apparent objection to this lies in the fact that this tooth rises beneath two deciduous teeth, both of which appear to belong to the milk dentition and which I believe to be $dP_{\bar{3}}$ and $dP_{\bar{4}}$. In early stages its crown lies mostly below $dP_{\bar{3}}$, but its base lies partly below $dP_{\bar{4}}$ and shortly after eruption the crown would fill the space previously occupied by both teeth. It seems best to refer to this last premolar as $P_{\bar{4}}$ rather than to suppose that it is $P_{\bar{3}}$ with $P_{\bar{4}}$ missing.

Between the large permanent premolar and the hypsodont molar behind it lies a tooth whose identity is in dispute. Douglass called it $dP_{\bar{4}}$ and Matthew called it permanent $M_{\bar{1}}$. Matthew apparently based his decision upon the condition in the previously mentioned lower jaw of *M. vetus,* where the permanent premolar appears to be rising wholly beneath a rather similar deciduous tooth which is anterior-most in a series of four teeth. His assumption was that $P_{\bar{4}}$ replaced $dP_{\bar{4}}$. I recently failed to locate the jaw or any record of its whereabouts at the American Museum. One cannot tell for certain from Matthew's figure whether or not the second tooth in the premolar-molar series is brachyodont or hypsodont. The amount of wear on the second tooth appears too great even for an early erupting M_1 and seems to relate it more closely to the preceding deciduous premolar. The side view of the tooth suggests that it may be brachyodont. So, it is possible that the two anterior teeth in the A.M.N.H. specimen (no. 18902) of *M. vetus* are both deciduous. In the Carnegie Museum specimens, the nature of the last brachyodont, double-rooted tooth suggests that it is a deciduous premolar, $dP_{\bar{4}}$, as Douglass maintained rather than permanent $M_{\bar{1}}$ as considered by Matthew. The evidence for this belief, most of which has already been stated by Douglass and quoted here, is as follows:

1. The tooth is brachyodont, while the molar teeth behind and the permanent premolar in front are hypsodont. Unless the tooth was under separate genetic control, which is improbable, instead of belonging to the same genetic field as the other permanent teeth, it is difficult to suppose that as $M_{\bar{1}}$ (instead of $dP_{\bar{4}}$) it would remain brachyodont in the midst of a strongly hypsodont dentition.

2. It possesses two long roots while the permanent teeth behind are single-rooted.

3. The roots are not the secondary result of partial resorption due to crowding by the large premolar, because the enamel, which extends the full length of the hypsodont teeth, does not extend down the roots of this tooth but is restricted to the low crown. Also, there is considerable space in CM 843 between the large premolar and hypsodont molar, so that neither tooth is crowding the roots of the tooth between.

4. In the holotype of *M. proximus* this tooth is actually being pushed up and out by the hypsodont premolar and molar.

5. In degree of wear and nature of its roots, it closely resembles the deciduous molar in *M. vetus* and *M. novellus* Matthew (1924: 84) that Matthew called $dP_{\bar{4}}$. It bears no resemblance to the hypsodont permanent premolar and molars. This is the same condition which Matthew (1924: 81), as quoted above, considered to be indicative of the deciduous nature of the tooth being replaced by $P_{\bar{4}}$ in *M. vetus*. Matthew proposed that the last brachyodont, long-rooted tooth in the Carnegie specimens was $M_{\bar{1}}$. This would require that $M_{\bar{1}}$ erupted as part of the premolar series, was worn out and nearly lost before the permanent teeth came into wear.

The evidence then is taken as strongly favoring the original interpretation of Douglass that this tooth is $dP_{\bar{4}}$.

White (1952: 199-200) stresses the fact that the activity of the thyroid strongly influences the nature of teeth by its effect on metabolism and growth. He further cites the inhibitory effect which gonadic and adrenal cortex hormones have, beginning shortly before puberty, upon the growth stimulating effect of the thyroid. For an example of possible change in thyroid activity, he refers to the advanced form of milk dentition over permanent dentition in some late Tertiary horses and the advanced nature of $P_{\bar{3}}$ over $P_{\bar{4}}$ in *Hyracotherium*. On similar grounds, changed thyroid control might explain the seeming anomaly of a brachyodont $M_{\bar{1}}$ in the midst of a hypsodont permanent mylagaulid dentition. For instance, assume that the last long-rooted cheek tooth in mylagaulids is $M_{\bar{1}}$ and that the order of tooth germ formation and growth of the teeth was $dP_{\bar{4}}$-$M_{\bar{1}}$-$P_{\bar{4}}$-$M_{\bar{2}\text{-}\bar{3}}$. Then, it is conceivable that a change in thyroid activity between the time of formation of $M_{\bar{1}}$ and $P_{\bar{4}}$ might result in an $M_{\bar{1}}$ which was distinctly different from the other

permanent teeth. However, in order for $M_{\bar{1}}$ to be brachyodont we would then have to conclude that thyroid activity, as affecting tooth growth, was increased rather than inhibited after the formation of $M_{\bar{1}}$. This would be exactly the reverse of what may have happened in White's examples of horses. Furthermore, the order of tooth formation was probably different, $M_{\bar{1}}$ forming after $P_{\bar{4}}$. A change in endocrine control of growth may in some manner be involved in the observable difference between low and high-crowned teeth. But, too many assumptions are necessary to support such a completely unusual situation. A much simpler and more normal interpretation, acceptable on similar grounds, would be that the last brachyodont tooth is $dP_{\bar{4}}$.

Both Douglass and Matthew regarded the last two molars as being $M_{\bar{2}}$ and $M_{\bar{3}}$. Douglass thought that $M_{\bar{1}}$ was missing completely, Matthew that it was the brachyodont tooth just discussed, and that it was lost early in the life of the animal. Douglass' quoted statement that there is no evidence for the loss of $M_{\bar{3}}$ is not necessarily correct. In the holotype of the early Miocene *Promylagaulus riggsi* McGrew, the upper dentition as McGrew figured it (1941, fig. 1) shows definite reduction of $M_{\bar{3}}$. Figure 3 of the same paper shows $M_{\bar{1}\text{-}\bar{3}}$ of a specimen identified by McGrew as *Promylagaulus* cf. *riggsi* in which $M_{\bar{3}}$ is apparently reduced. Although the tooth has just erupted, the dimensions of the triturating surface would not have increased much, if any, with wear. The hypsodont molars in the Carnegie specimens have been dissected to the base of their roots and show a decrease in diameter toward the base. The preceding two teeth in *Promylagaulus riggsi* appear from the figures to be at least somewhat hypsodont and thus to be molars. Furthermore, in five mylagaulid lower jaws in the Carnegie collection, all referable to *Mesogaulus,* the last of the two hypsodont molars was inclined forward in the jaw at an angle of 35-45 degrees from the teeth anterior to it. The specimens in which this can be seen are the three already listed, from Madison Valley, Montana plus CM 9565 from southeast of Fort Logan, Montana, and CM 8865 from the vicinity of Bozeman, Montana. This last molar also has a shorter root and impinges upon the posterior portion of the long, curved incisor which rises into the coronoid process. No space remains between the inclined molar, the incisor, and the dental foramen for another tooth. It therefore seems probable that reduction had occurred and was continuing posteriorly. Thus, $M_{\bar{3}}$ could have been eliminated at the stage

in the evolution of the mylagaulid lower dentition represented by the Carnegie specimens.

Johnson (1952) recorded evidence suggesting that upper and lower M3 have been lost in other rodents when he described the presence of an additional molar tooth in a specimen of *Mesembriomys* and reviewed similar occurrences of extra molar teeth in *Saccostomus, Microtus, Hystrix* and *Proechimys.* As he put it (p. 71), this supports the interpretation of others, whom he cites when he says that:

> Among rodents the anterior tooth in the series is homologous with the fourth deciduous premolar of other mammals (but not with the permanent premolar that usually replaces it), and that the remaining two teeth correspond to the first and second molars. If this is true, an occasional vestige of the lost third molar might be expected to appear at the posterior end of the tooth row.

Whether or not such a conclusion will ultimately prove applicable to all rodents, the embryological mode of tooth formation theoretically makes the loss of $M_{\bar{3}}$ much more likely than loss of $M_{\bar{1}}$ in any case. The permanent molar teeth arise in the embryo from the backward-growing, free extension of the dental lamina (Arey, 1941: 193). Any limitation of the continued backward growth of the dental lamina, such as the presence of the posterior portion of the long incisor in mylagaulids, might well interfere with the development of a full dentition at the posterior end of the molar series. On the other hand, interference with the growth of the dental lamina or the formation of tooth buds at the site of $M_{\bar{1}}$ might arrest development of all teeth posterior to it.

Matthew's statement (quoted) that the molars are deciduous progressively backward, does not receive support from study of CM 8865. In this specimen, which lacks the tooth crowns, the root division of $P_{\bar{4}}$ has approached to within less than three millimeters of the lip of the alveolus, yet both $M_{\bar{1}\text{-}\bar{3}}$ remained. It appears likely that $M_{\bar{1}}$ would have persisted as long as either $P_{\bar{4}}$ or $M_{\bar{3}}$. Certainly, in this specimen a long time would have separated the loss of $dP_{\bar{4}}$ ($M_{\bar{1}}$ of Matthew) and the loss of any of the permanent teeth.

SUMMARY AND CONCLUSIONS

Several lower jaws of *Mesogaulus* in the Carnegie Museum collection preserve parts of the milk dentition. Study of these leads to the

rejection in part of the interpretations of both Douglass and Matthew, concerning the identity of the lower teeth in these specimens. It is concluded that in mylagaulids, at least in those of the *Mesogaulus* stage, the enlarged, hypsodont $P_{\bar{4}}$ replaces two brachyodont, double-rooted deciduous premolars $dP_{\bar{3}}$ and $dP_{\bar{4}}$. The two hypsodont, single-rooted teeth behind are $M_{\bar{1}\text{-}\bar{2}}$. Deciduous upper dentitions were not available for study but Matthew's figures (1924, figs. 2, 5, 7) of *Mylagaulus laevis* Matthew and *M. vetus* suggest that similar conclusions may be applicable to the upper dentition.

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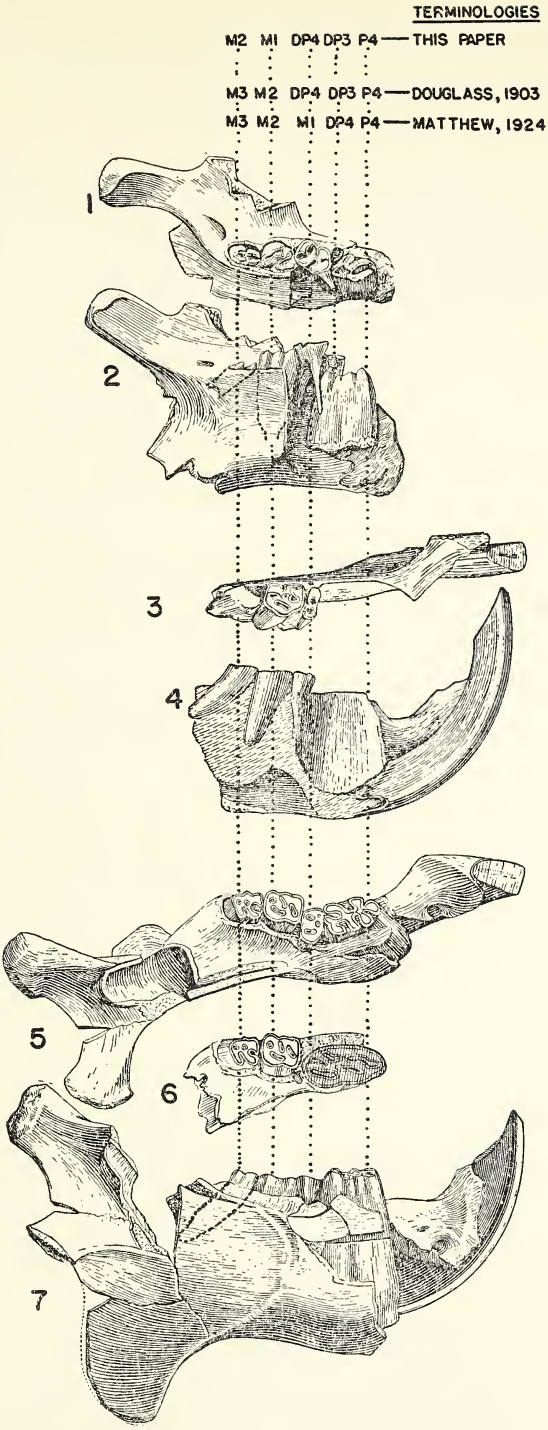
EXPLANATION OF PLATE 23

Comparison of lower teeth in three specimens of *Mesogaulus* from late Miocene beds along the Madison River, Montana. All figures ca. × 3/2

FIGS. 1, 2 *Mesogaulus proximus* (Douglass), holotype, CM 843, occlusal and lingual views, from photograph of original drawings published by Douglass (1903, fig. 27). Lower outlines of $M_{\bar{1}-\bar{2}}$ added as shown by dissection.

FIGS. 3, 4 *Mesogaulus* sp., CM 723, occlusal and labial views, from photograph of text figure, Douglass (1903, fig. 28).

FIGS. 5-7 *Mesogaulus pristinus* (Douglass), holotype, CM 742, occlusal, sectioned $P_{\bar{4}}$ and labial views, photographically *reversed* from original drawings published by Douglass (1903, fig. 26). Outline of $M_{\bar{2}}$ added as shown by dissection.


TERMINOLOGIES
M2 M1 DP4 DP3 P4 — THIS PAPER
M3 M2 DP4 DP3 P4 — DOUGLASS, 1903
M3 M2 M1 DP4 P4 — MATTHEW, 1924
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ART. 9 AN ADDITION TO THE HERPETOFAUNA OF NOVA SCOTIA, AND OTHER RECORDS OF AMPHIBIANS AND REPTILES ON CAPE BRETON ISLAND

By Neil D. Richmond

While collecting molluscs in Nova Scotia in August, 1950, Mr. Gordon K. MacMillan obtained a small collection of amphibians and reptiles on Cape Breton Island. Of especial interest is a specimen of the four-toed salamander, *Hemidactylium scutatum*, previously unreported in Nova Scotia. Mr. MacMillan's collection consists of 83 specimens of 9 species; 2 snakes received later from Cape Breton Island increase to 10 the number of species listed below.

1. *Triturus viridescens viridescens* (Rafinesque) Three aquatic adults; one juvenile land stage.

   Victoria Co., Baddeck. 4, CM 29230, 29251-53.

2. *Plethodon cinereus cinereus* (Green) Red-backed salamanders comprised over half of the total number of specimens collected and occurred in 5 of the 7 localities visited. Of these, 42 were red-backed and 3 dark-backed. In the red-backed series a fine speckling of black pigment, most dense along the mid-dorsal line, appears to increase with age for in 6 of the largest specimens it occupies most of the dorsal stripe. No such increase occurs in the dark-backed series of one hatchling, one juvenile and one adult.

   Cape Breton Co., Sydney. 21, CM 29223-25, 29229 (18).
   Cape Breton Co., Ironville. 2, CM 29227-28.
   Victoria Co., Baddeck. 1, CM 29243.
   Victoria Co., Baddeck Bay. 11, CM 29255-65.
   Inverness Co., Whycocomagh. 10, CM 29276-85.

3. *Hemidactylium scutatum* (Schlegel) The single specimen, a large male with 14 costal groves, total length 76 mm., tail, 24 mm., was collected "along Baddeck Bay Brook; under bark along shore." This extends the known range of this species approximately 500 miles, since the nearest locality previously reported is Lake Cobbesseecontee near Augusta, Maine (Fowler, Copeia, 1942, no. 3: 185-186).

   Victoria Co., Baddeck Bay, August 14, 1950, 1, CM 29254.

4. *Bufo terrestris americanus* (Holbrook)
   Victoria Co., 4, CM 29270-73.

5. *Rana clamitans* Latreille One tadpole, 12 juveniles and 6 adults.

   Victoria Co., Baddeck Bay. 4, CM 29266-69.
   Victoria Co. Baddeck. 14, CM 29232-38, 29241-42, 29245-46, 29248-50.
   Cape Breton Co., 4 mi SW of Northwest Arm, along Frenchvale Cr. 1, CM 29286.

Issued September 11, 1952

6. *Rana pipiens* Schreber Four recently transformed juveniles, collected August 9-12, are too small to offer any evidence on the question of *brachycephala* in the northeast.

Victoria Co., Baddeck. 4, CM 29231, 29239, 29240, 29247.

7. *Opheodrys vernalis vernalis* (Harlan) Two specimens of the green snake, collected July 15, 1951, by Paul L. Swanson are included here. The scutellation of these is as follows: CM 29547, ♀ containing 4 eggs, 15 scale rows, 126 ventrals, 67 subcaudals, 7 upper labials, 7-6 lower labials, 2 preoculars on the left side and one on the right: total length 434 mm., tail length 123 mm. CM 29548, ♀ containing 3 eggs, 15 scale rows, 122 ventrals, 68 subcaudals, 7 upper labials, 7 lower labials, one preocular on each side, total length 368 mm., tail length 110 mm. Grobman (1941. Misc. Publ. Mus. Zool. Univ. Mich., 50: 1-33) pointed out that the number of subcaudals in this species is reduced in the northern part of its range, averaging 67.7 ± .9 for a series of 15 females from Quebec, New Brunswick and Nova Scotia.

Richmond Co., btw Grande Anse and St. Peters. 2, CM 29547-8.

8. *Storeria occipitomaculata occipitomaculata* (Storer) An adult ♂ with 15 scale rows, 118 ventrals, 47 subcaudals, 6 upper labials, 8 lower labials, total length 214 mm., tail length 47 mm., was found under a small log lying on a railroad embankment.

Cape Breton Co., Ironville. 1, CM 29226.

9. *Thamnophis sirtalis sirtalis* (Linne) Three specimens of the common garter snake were collected. The scutellation of these is as follows:

CM	*Sex*	*Scale Rows*	*Ventrals*	*Sub-caudals*	*Upper Labials*	*Lower Labials*	*Total L. (mm.)*	*Tail L. (mm.)*
29244	♀	19-19-17	142	63	7	10	606	129
29274	♂	19-19-17	154	67	7	10	294	96
29275	♂	19-19-17	131	65	7	10/9	305	71

CM 29275 has only 131 ventrals, but there are 7 partial scales inserted along the right side, and of those counted as entire 8 are partially divided transversely so that they appear as a single scale on the left but as two scales on the right. One of the garter snakes contained a juvenile *Rana clamitans*.

Victoria Co., Baddeck. 1, CM 29244.
Victoria Co., 1 mi NW of Baddeck. 1, CM 29274.
Inverness Co., Whycocomagh. 1, CM 29275.