

II. THE LEPIDOPTERA COLLECTED BY G. M. SUTTON ON SOUTHAMPTON ISLAND

RHOPALOCERA.

BY W. J. HOLLAND AND A. AVINOFF.*

Of course the main object of Dr. Sutton's stay on Southampton Island was to make as thorough an investigation of its birds as the time at his command permitted. He, however, did not fail to make collections in other orders and paid attention to the earnest request of the senior author of the pages, which immediately follow, to collect such butterflies as might come under his observation.

Dr. Sutton's collection of the diurnal lepidoptera, while not very extensive, is upon the whole one of the most complete which has thus far been made in that part of the world, and in fact is the only collection which has come from the great island which he went to explore.

The collection brought back by Sutton contains no representation of the *Papilionidae* and the *Hesperiidae*. Whether these families are not represented upon the island must of course remain more or less a matter of conjecture. The probability is that they do not occur upon the island, thus proving its more truly arctic character than lands lying to the west in even higher latitudes. Both in its fauna and its flora Southampton Island shows closer likeness to Baffinland and the islands and peninsulas lying northward than to the Northwest Territories and Alaska, the climate of which, except in the extreme north, is more or less softened by "the Chinook winds," blowing in from the vast expanse of the heated waters of the Kuro-Shiwo, which corresponds in the Pacific to the Gulf-stream in the Atlantic.

Without further preliminary observations I proceed to the enumeration and description of the species brought by Sutton from the Island, which his investigations have done so much to bring to our knowledge.

Family NYMPHALIDÆ.

SUBFAMILY NYMPHALINÆ.

Genus BRENTHIS Hübner.

Of this genus Sutton collected representatives in excellent condition of four species.

1. *B. butleri* (Edwards). Pl. XXVIII, figs. 4-6.

Argynnis butleri Edwards, Canad. Entom., XV, (1883), p. 32.

Brenthis butleri (Edwards) Holland, Butt. Book (Rev. Ed.) 1931, p. 109, Pl. LV, figs. 17-19.

*The initial part of the manuscript by Dr. Holland was preserved as far as possible in the same state as it was before he passed away, this paper being the last scientific writing left by him. My task was to continue and conclude the article embodying the views which I was privileged to exchange with the deceased dean of American lepidopterists and in which we were in full accord.

For the portion of this article on Lepidoptera dealing with the genus *Colias*, Dr. Holland prepared only preliminary notes in which he incorporated some of the discussions we had on certain involved taxonomic questions pertaining to this group, and to the affinities of the American and Eurasian forms. A. A.

Of this well marked species, Mr. Sutton secured in beautiful condition eighteen specimens, thirteen males and five females. They were captured on dates ranging from August 1 to August 3, fourteen of the species having been taken on the latter date. They appear to have all been taken at, or in the vicinity of, Coral Inlet, upon which the Post of the Hudson's Bay Company is located. They display remarkable uniformity. This species has been treated as a synonym of *chariclea* by Elwes and others who have followed him.

Brenthis (Argynnis) chariclea was originally described by Schneider from subarctic Europe. I have before me, as I write, a very extensive series of specimens, partly determined by the veteran lepidopterist of Europe, the late Otto Staudinger, which represents the insect as it occurs in Lapland and elsewhere in its range in the Old World. I have also a large suite of specimens taken at Ramah, the Moravian mission-station in northern Labrador. All these specimens appear to quite closely agree, with the markings of the lower sides more obscure than is the case with typical *B. butleri*, in which the upper sides of both the primaries and secondaries are broadly dark brown or blackish on the inner two-thirds, while the characteristic spots of the lower side of the secondaries are brightly silvered, which does not appear to be the case in the European and Labradorian examples of *chariclea* before me.

It may be of interest at this point to summarize the account given by the late R. McLachlan of his study of the specimens collected by Captain H. W. Feilden and Mr. Hart in the voyage of the "Alert" and the "Discovery" toward the North Pole. It is to be found in the *Journal of the Linnean Society of London, Zoölogy*, XIV, 1879, pp. 109-111.

A CHARICLEA, Schneider.

Under this head are grouped twenty examples from various localities, "ranging from lat. 79° to 81° 52' N. (Feilden and Hart). The places indicated by name are Hayes Sound, Port Foulke, Walrus Island, Franklin-Pierce Bay, Cape Hayes, and Discovery Bay. Never before have I been so perplexed over a series of any insect of which I had made a serious study. Without exaggeration I may safely say that no two of the twenty individuals are precisely alike; and the extremes present numerous discrepancies." Not one example precisely resembles specimens of the typical *Chariclea* of Northern Europe also subject to considerable variation, "and a comparison of the rather numerous figures of it only added to my perplexity, for no two agree. A visit to the British Museum in order to consult the materials obtained from previous Arctic Expeditions did not in the least help me; for I found just as much uncertainty existing in the arranged collection as in my own mind. The upperside of the insects is subject to great variation, but in a measure that cannot be compared with that presented by the underside of the posterior wings, which is usually considered as furnishing the surest characters in *Argynnis*. I essayed an examination of the anal parts of the males (which I am convinced will often serve to distinguish allied species in Butterflies), but found that it would be necessary to have the insects in a fresh state (or in fluid) if any reliable characters were to be sought in these parts.

"It would be utterly useless to attempt to describe the forms; the only thing that could be of service would be to give coloured figures of both sides of nearly every example. Some of them may perhaps resolve themselves into *arctica* of Zetterstedt and *Boisduvallii* of Duponchel, now both grouped with *Chariclea*. There is, however, one extreme individual that I propose to briefly notice by name.

"ARGYNNIS CHARICLEA, var. obscurata.

"Wings above smoky greyish-fulvous, the basal portion very densely clothed with long brownish-grey hairs, having a bluish or greenish reflection in certain lights: in the anterior

pair the basal third is blackish, the black markings all distinct, the post-median zigzag line complete and rather broad, the submarginal series of spots very large, the border broad, the fringes dirty cream-colour interrupted with blackish; in the posterior wing more than the basal half is blackish, almost confused with the median band, the submarginal series of spots distinct and ordinary, the border surmounted by a series of triangular spots, fringes as in the anterior but less interrupted. Underside—ground-colour of anterior wings brighter; of the discocellular spots only the angulate one and that at the end are distinct; zigzag band distinct, but narrow; submarginal series of spots very indistinct; in the posterior wings the basal half is dark brown, inclosing the median band of pale spots, which is very broad, all the spots more or less coalescent and dirty cream-colour; the outer edge of the dark basal portion margined with a narrow whitish line, the space between this and the border light greyish brown, with scarcely any indication of the submarginal series of spots; border broad, dirty cream-colour, surmounted by triangular dark brown spots. Legs . . . greyish.

"There is one ♀ of this from 81° 42' N. Another specimen in the British Museum from the voyage of the 'Enterprise,' somewhat resembles it, differing principally in the middle spot of the median band of the underside of posterior wings being more produced externally, a point in which great variation is exhibited in all the insects.

"In concluding my remarks on the twenty examples referred to *A. Chariclea*, I will only say that, so far as I can see, no two entomologists would probably agree as to the number of so-called species comprised therein, nor do I hope for any immediate settlement of the difficulty. Either there is only one species, or there are several; and in favour of the latter hypothesis it might be argued that we in England have species as closely allied as *A. Euphrosyne* and *A. Selene*, which we know, from habits, &c., to be perfectly distinct; yet each of these has modified forms in northern and alpine districts."

Some years after McLachlan had published the foregoing account of the specimens collected on the voyage of the "Alert" and the "Discovery," William H. Edwards sent to Dr. Arthur G. Butler at the British Museum the specimen of which the under side is shown in the revised edition of *The Butterfly Book*, Pl. LV, fig. 19. This had been taken by E. W. Nelson at Cape Thompson in northwestern Alaska and had been identified, as being the same as a female taken at Kotzebue Sound by the same collector. The female is in the Edwards collection, but, being a somewhat tattered specimen, I did not use it in making the figures given in the new edition of *The Butterfly Book*. Butler in replying to the inquiries of W. H. Edwards said: the specimen "differs from *Chariclea* in the redder coloration, and much heavier markings on the upper surface; the basal area is blacker, the spots and stripes much thicker. Below, the markings are altogether darker than in *Chariclea* of Europe. Your example agrees perfectly with a specimen (in Br. Mus. Col.), labelled Nova Zembla, and with two of the Grinnell Land series, included under McLachlan's varieties of *Chariclea*. It is in my opinion worthy of a distinct name."

Accordingly W. H. Edwards described the insect as *Argynnis butleri*, naming it after his learned correspondent in London.

Other specimens than the two taken by Nelson subsequently came into the possession of W. H. Edwards, and two of these are figured by me in the revised edition of *The Butterfly Book*. Now comes the remarkable series of eighteen almost absolutely perfect specimens of the species collected by Sutton on Southampton Island, revealing that we are dealing with a perfectly constant form.

I may here state that of several hundreds of examples of *B. chariclea* before me as I write, coming from Labrador, Europe, and Asia, not one corresponds with the form of the insect which is shown upon our plate, and with the types of Edwards. Judging from the

material which I have seen, it is quite proper to designate this insect as representing a valid species, rather than a subspecies of *B. chariclea*.

The insect ranges from Southampton Island northward and westward in the more rigorous regions of Arctic America, and according to Butler also occurs in Nova Zembla. It is in its habitat the northernmost representative of the great family to which it belongs.

2. *Brenthis frigga* (Thunberg). Pl. XXVIII, figs. 1-3.

Argynnis frigga Thunberg, Diss. Ins. Suec., 233, 1791.

Argynnis frigga var. *saga* Staudinger, (Kaden MS.) Stett. Ent. Zeit., XXII, 1861, p. 350; Holland, Butt. Book (Rev. Ed.) 1931, 110, Pl. XV, figs. 13-14.

In the Revised Edition of The Butterfly Book as above cited I said: "Typical *frigga* described from subarctic Europe and Asia apparently does not occur in our fauna. The variety *saga* Staudinger is, however, not uncommon."

Since publishing the foregoing lines I have had occasion to examine a very large number of specimens collected in all parts of arctic America and on the alpine peaks of the western mountain ranges, and am led as the result to modify the foregoing statement. The variety *saga*, originally founded by Staudinger upon specimens coming from Labrador in the Collection of Dr. Kaden, and which is well represented in the figures above cited, seems to be the prevalent form in Labrador, whence I have a long series; and it occurs also upon the high mountains of the Western States and in the region of the lower Yukon Valley. Its differentiating feature is the more or less complete obscuration of the mesial band of light spots on the under side of the secondaries. In the four specimens collected by Sutton on Southampton Island from July 12 to August 1 the mesial band is not obscured, but is prominent as in typical *frigga* represented in my collection by specimens from subarctic Europe, some of them determined by the late Dr. Staudinger, the author of the subspecies or variety *saga*. In a long series which we have from the upper valley of the Yukon (elevation 2,000 ft.) similar specimens occur. The specimens we have from the lower Yukon near its mouth, are more like the specimens from Labrador, taken near sea-level.

From the foregoing it seems to be apparent that the difference between typical *frigga* and its variety *saga* is climatic.

3. *Brenthis improba* (Butler). Pl. XXVIII, figs. 9-11.

Argynnis improba Butler, Ent. Mo. Mag., XIII, 1877, p. 206.

Brenthis improba Holland, Butt. Book, (Rev. Ed.) 1931, p. 111, Pl. LV, fig. 27; Pl. LIX, fig. 23; Pl. LX, fig. 12, *underside*.

Of this species Sutton collected in beautiful condition four males and two females at dates ranging from July 22 to August 3. They agree well with the specimens figured in the new edition of The Butterfly Book. Schoyen (Ent. Tidschr., VI, 1885, p. 142) and Elwes (Trans. Ent. Soc. Lond., 1889, p. 540), followed by Gibson (Can. Arctic Exped., 1913-18, Vol. III, Pt. I, p. 24) treat this as a variety of *B. frigga*, which is not correct. It represents a valid species found on the wing on Southampton Island at the same time as typical *frigga*, from which it is entirely distinct.

It is a truly arctic species, found at high latitudinal or vertical elevations in the far north, so far as has been ascertained, which is instantly recognizable by the markings of the lower side of the secondaries, which are quite different from those of *frigga*, with which Schoyen and Elwes confounded it. So far as is known, this species does not occur so far

south as Labrador. It ranges from Southampton Island eastward and northward to Baffin Island, and thence northward and westward at high elevations in the Yukon region to the borders of the Arctic Ocean. With the exception of *B. butleri* it is the northernmost of the *Nymphalidæ* in its range. It must not be confounded with the obscurely marked specimens of *frigga* found in Lapland to which Bryk has given the subspecific name *improba*.

4. *Brenthis polaris* (Boisduval). Pl. XXVIII, fig. 7.

Argynnis polaris Boisduval, Europ. Lep. Index Method., 1829, p. 15.

Brenthis polaris Gibson, Can. Arct. Exped., 1913-18, Vol. III, 1920, p. 23i; Pl. V, figs. 2-4; Holland, Butt. Book (Rev. Ed.), p. 110, Pl. LV, fig. 12.

Of this well marked and widely distributed species, Sutton collected thirteen specimens in excellent condition, seven males and six females ranging in the dates of capture from July 2 to July 22, the largest number, seven, being recorded as taken on July 8th.

The specimens do not appear to differ in any respect from examples in our possession from northern Europe and Asia.

SUBFAMILY SATYRINÆ.

Genus *ÆNEIS* Hübner.

5. *Æneis arctica* Gibson. Pl. XXVIII, figs. 12-15.

Æneis semidea var. *arctica* Gibson. Can. Arct. Exped., 1913-18, Vol. III, p. 11i, Pl. XXX, II, fig. 4; Pl. IV, fig. 4; genitalia, Pl. I, fig. 4.—Holland, Butt. Book (Rev. Ed.) 1931, p. 200, Pl. LXXII, fig. 5 (after Gibson).

Gibson designated this insect as a variety of *Æ. semidea* (Say).

I am, after studying the material before me, inclined to give the insect full specific rank. Sutton returned one female, taken on July 5, and five males ranging in their dates of capture from July 3 to July 28. They all agree closely with each other on the upper and lower sides and in having the fringes white except at the outer terminations of the nervules. The latter feature separates them very distinctly from typical *Æ. semidea* (Say). Of over sixty specimens of *Æ. semidea* from the White Mountains of New Hampshire, which I have examined carefully, only two reveal a slight trace of whitening of the fringes and this only for a fractional part of the wings, whereas all of the specimens from Southampton Island possess this as a marked and conspicuous feature. One specimen in the collection of W. H. Edwards labelled "*semidea*" is identical with these specimens received from Sutton, but it is from Ungava, at the northernmost part of Labrador, and is unmistakably referable to *Æ. arctica* Gibson. Besides the well marked distinction of the white fringes separating this species from *Æ. semidea* it is evident that all these specimens differ from typical specimens of the latter species in the form of the primaries which are more acute at the apex, and less rounded on the outer margin, and, as pointed out by Gibson, without the contrast in the maculation of the underside of the secondaries, which is prevalent in specimens from the high mountains of New Hampshire.

Genus *EREBIA* Dalman.

6. *Erebia rossi* (Curtis). Pl. XVIII, figs. 16-18.

Hipparchia rossi Curtis. Ross' Second Voyage, Appendix, 1835, p. lxxvii, Pl. A, figs. 7, 8.

Erebia rossi Gibson. Can. Arct. Exped., 1913-18, Lepidoptera (1920) pp. 17i, Pl. IV, fig. 9.—Holland, Butt. Book (Rev. Ed.) 1931, p. 203, Pl. LXXIII, figs. 3-4.

Of this species Sutton returned five examples, three males and two females, taken in the latter half of the month of July. They are absolutely typical specimens, and the males might have been used by the artist to prepare the original figure of the species published nearly one hundred years ago. Two of these specimens, a male and a female, were used by me in illustrating the species in the revised edition of *The Butterfly Book*, as above cited.

The range of this species, including its varieties, is wide; but the typical form is confined to the more strictly arctic lands, lying north of Hudson Bay, west of Davis Strait, and the eastern portion of the Yukon Region. Westwardly it is replaced by the variety *kuskoquima* Holland.

Family LYCÆNIDÆ.

SUBFAMILY CHRYSOPHANINÆ.

7. *Chrysophanus feildeni* McLachlan. Pl. XXVIII, figs. 19-21.

Chrysophanus phloeas, var. *feildeni* McLachlan. Journ. Linn. Soc. Lond., Zool., Vol. XIV, 1878, p. 111.

Heodes hypophlaeas feildeni Gibson, Can. Arct. Exped., 1913-18, (1820) p. 27i.

Chrysophanus feildeni (Misprint *fieldeni*) Holland, Butt. Book (Rev. Ed.) p. 251, Pl. LXVIII, figs. 5-6.

We received from G. M. Sutton ten specimens of this species, six males and four females, most of which were taken on August 1st, but two are labelled as captured on August 5th. Two of these specimens are shown as above cited, on Pl. LXVIII of the new edition of *The Butterfly Book*.

The specimens agree perfectly with the original description given by McLachlan. In the females the spots on the upper side of the primaries are smaller and much less distinct than in the males, and indeed in the case of the spot near the inner angle between the inferior vein and the first submedian complete obsolescence in one of the females before me occurs, while in the others this spot is barely distinguishable. As pointed out by both McLachlan and myself the red ground-color of the primaries is quite different from that in *C. hypophlaeas*, being as McLachlan says "brassy," or, I prefer to say, with lustrous metallic golden reflections. In this respect the species differs greatly from *C. hypophlaeas*, as well as in other respects.

The distribution of this insect is strictly speaking arctic, and, so far as we know, it occurs north of Hudson Bay, west of Davis Strait, and ranges northward and westward from Southampton Island to the eastern borders of the Mackenzie Drainage.

SUBFAMILY LYCÆNINÆ.

Genus LYCÆNA Fabricius.

(Subgenus *Agriades* Hübner).

8. *Lycaena* (*Agriades*) *aquilo* (Boisd.) var. *suttoni* Holland. Pl. XXVIII, figs. 22-25.*

Argus aquilo Boisduval, Icones, 1832, p. 62, Pl. 12, figs. 7-8.

Polyommatus franklinii Curtis, Ross' Second Voyage, Appendix, 1835, p. lxi, Pl. A, figs. 8-9.

Lycaena aquilo var. *suttoni* Holland, *Butterfly Book*, (Rev. Ed.), 1931, p. 269, Pl. LXVIII, figs. 7-9.

*The specimen of ♂, fig. 22, shows an exceptionally wide dark margin; it was erroneously figured as ♀, type, on pl. LXVIII, fig. 8, Holl. Butt. Book, 1931. A. A.

The name *aquilo* (Boisd.) has priority over *franklini* (Curtis), Staudinger and Rebel to the contrary notwithstanding (Cf. Catal. d. Lep., p.81). In the original description Boisduval cited as the localities where the species occurs "the North Cape, the Altai Mountains of Siberia and Labrador." Later writers have restricted the form, treated by them as a variety of *orbitulus* (auct.), which it is not, to "arctic America and Labrador."

I have before me a considerable series of specimens, some of them determined by the late Dr. Otto Staudinger, all coming from Labrador, which agree perfectly with the description and figures given by Boisduval. The figure of the lower side of the wings given by Curtis materially differs from that of Boisduval in that the outer third of both wings is shown by Curtis as prevalently lighter, with the spots and lines less accentuated, and the medial band or elongated spot on the secondaries running from the outer end of the cell toward the costa much more extended than is the case in all specimens of *aquilo* from Labrador, which I have seen, and more like the configuration of the same spot in the variety *suttoni*.

Sutton collected twelve males and six females* of the form I have named after him. The dates of capture range from July 28 to August 5. They all closely agree in their markings, and differ greatly from the insects described and figured by Boisduval and Curtis. The most distinctive feature of this subspecific form is the intensification and sharp definition of the dark spots on the underside of the secondaries, forming a dark brown or black marginal border and a black band running from the lower or outer end of the cell to the costa. The inner half of the wing is dark brown, almost black, upon which the light spots stand out sharply defined, and not semi-obscure as shown in typical examples of *aquilo* (Boisd.) and in the figure of *franklini* given by Curtis.

Family PIERIDÆ.

Genus COLIAS Fabricius.

The generic name *Eurymus* Horsfield, which was a "manuscript name" suggested to Horsfield by Swainson, and published by the former in 1827, with *hyale* as the type, was at the time preoccupied in the Coleoptera by Rafinesque, as is pointed out by Sherborn. *Eurymus* is untenable as a generic name in the Lepidoptera, and the name *Colias* Fabricius, the type of which was designated as *hyale* by Leech in 1815, twelve years before Horsfield's publication, should stand. (See Holland, Ann. Car. Mus., Vol. XIX, pp. 198-200).

The only representatives of the family Pieridæ brought from Southampton Island belong to the genus *Colias* of which Sutton returned one hundred and fifteen specimens taken by him at dates ranging from July 3 to August 5, and a solitary female taken at Coral Inlet on August 24th said by the Factor, Mr. Ford, to be an "unusually late date for the appearance on the wing of a butterfly."

The series of representatives of the genus *Colias* secured by Dr. Sutton is a most valuable assemblage of biological documents shedding a new light on the systematic relationship of *Colias nastes* Boisduval, *boothi* Curtis, and *hecla* Lefevre. The forms which belong to the systematic entities conventionally considered by students of Lepidoptera as three distinct species are characterized by a gradation in coloration and pattern running through the complete set of individuals. The whole picture as it is revealed by the material of *Colias* from Southampton can be summarily stated as follows:

*The female of *suttoni* is shown for the first time on Plate XXVIII, figs. 23 and 25. A.A.

1. The larger proportion of the specimens belong to a local race of *nastes*, the identity of which will be subsequently discussed, and denote an unusual variability. Ranging from a greenish yellow tinge of the male and grayish white of the female these constitute a series of imperceptible gradations to forms increasingly tinted with a more definite orange. In the most extreme specimens the orange tint exceeds the saturation typical in the form *rossi* and leads gradually to an approximation of the coloration of the so-called *boothi*. This whole series of variable forms of *nastes*, including in part *rossi*, is by far the most numerous representative of the genus on the Island.

2. A smaller portion of the whole set of *Colias* from the Island is a beautiful series of *boothi* showing intergradation toward the race of *nastes*, specifically toward *rossi*, and on the other hand with a sporadic and less continuous transition toward *hecla*. The females form a more complete chain of connecting links between *rossi* and *boothi*.

3. A stable, not numerous, set of typical *Colias hecla*.

Such are the characteristic features disclosed by the material of Sutton and may suggest in a natural way a hypothesis of cross-breeding between the extreme links of the sequence with the possibility of primary and secondary hybridization. An observer of the whole series cannot fail to be impressed not only by the fact of a successive merging of three species usually considered as separate, but also by the uneven intergrading and relative stability of certain portions of this gamut of forms.

A student of this telltale lot is convincingly driven to a theory of surmising interbreeding although it will remain the task of future investigators to prove this conjecture by actual experiments.

The chief problems arising out of the study of the Southampton material of *Colias* involve: (1) the systematic position of the special race of *Colias nastes* found on the Island as compared with other American and Palearctic kindred representatives of the group; (2) the taxonomic status of *C. boothi*; and (3) the more general question of the concept of a species as a taxonomic term applicable to the genus *Colias*.

These problems will be treated in conjunction with the question pertaining to the actual specimens secured on the Island. The result of the study of the material may be stated in the following more detailed exposition.

9. *Colias nastes* Boisduval. Pl. XXVI, figs. 1, 1a; Pl. XXVII, fig. 36.

This species was originally described from specimens obtained from North Cape, Iceland, and Labrador. It has been almost the universal custom among writers to refer specimens from the Arctic region of Europe to *nastes* var. *werdandi* Zetterstedt (Ins. Lapp., 1840, p. 908). As Dr. McDunnough mentions in the Canadian Entomologist, Vol. 60, No. 11, p. 270, "subsequent authors have been unanimous in considering the Labrador race to be the typical one, the rather crude colored figure fitting in better with Labrador specimens than with the paler European ones."

The customary usage may be erroneous from the point of view of specific affinities. While it is indeed true that *Colias werdandi* in some respects resembles *Colias nastes* from Labrador, they are not identical and *werdandi* could be treated as a separate species in the same sense and on similar grounds as *melinos* is separated specifically from its European relative; conversely the Labradorian insect to which by common consent the specific name *nastes* is attached should be regarded as distinct. Such a procedure would also dismiss a nomencla-

torial complication which rises from the fact that *werdandi* was described before *nastes* and would imply a subspecific position for *nastes* if the two forms were to be looked upon as conspecifically related.

In the investigation of the affinities among the various related races of the *nastes* circle various sources of information have been consulted with the aid of qualified authorities in different museums, to whom the most sincere gratitude is expressed herewith for a most helpful assistance.

There is in the Barnes Collection, now the property of the United States National Museum, a male specimen from Labrador which belonged to Dr. Boisduval and passed into the collection of the late M. Charles Oberthur, from which the late Dr. Barnes obtained it with many other of Boisduval's types. This specimen is figured on our plate XXVI, figs. 1 and 1a. The specimen has been accepted by Höfer as one of the types of *nastes* in the sense of multiple types set aside as such by earlier authors of descriptions, and according to F. H. Benjamin absolutely agrees with Boisduval's description.

A male and female, from Nain, Labrador, are figured in The Butterfly Book, Pl. XXXVI, figs. 11 and 12. These figures do not agree absolutely with the figures given by Boisduval in his Icones, Pl. 9, figs. 4 and 5, but nevertheless they have been accepted as typical by Staudinger, Verity and other authors. They represent the form of the species which prevails along the sea-coast of Labrador, where are located the Moravian Missions, from which there came to Europe almost all of the Labradorian material studied by earlier writers in the first half of the Nineteenth Century. The figures given by Boisduval are somewhat crude, and do not agree very closely with his types.

Accepting the specimen from the Barnes collection as the type of *C. nastes*, it will be noted that on the under side there is almost an entire absence of the dark antemarginal spots and of the darkening of the inner two-thirds of the secondaries which reveal themselves for example in *subarctica* McDunnough (See Pl. XXVI figs. 6a and 7a) from the eastern coast of Hudson Bay; in 8a, which represents the under side of what is accepted as the type of *Colias rossi* Guenée, and in 14a and 15a, which represent the male and female types of *Colias moina* Strecker, now preserved in the Field Museum of Natural History in Chicago. The insect figured on Pl. XXVI, figs. 1 and 1a, being the type of *C. nastes* Boisduval, represents a form which is abundant on the eastern coast of the peninsula of Labrador. This typical form seems to be largely confined to that region. A varietal form occurs on the high mountain peaks about Laggan, Alberta. This western form is represented on Pl. XXVI, figs. 2 to 5a, both the upper and lower sides being given. It has been named *C. nastes* var. *streckeri* by Groum-Grshimailo. While not appreciably differing on the under side from typical *C. nastes*, which occurs upon the coast of Labrador, it may be separated by the greater intensity and diffusion of the dark markings upon the upper side of the wings. The specimen figured on Pl. XXVI, figs. 5 and 5a is designated by F. H. Benjamin in the Barnes collection as the aberration of *streckeri* named *obscurata* by Verity. This attribution should be accepted within a certain latitude of individual variability since a reference to Verity's work (Rhop. Pal., p. 355, Pl. LXXI, fig. 6) shows that Verity's *obscurata* is a singularly aberrant specimen in which the dark greenish scales have completely covered the primaries, while the secondaries are almost white. The text-figure is a reproduction of Verity's figure of the type of his *C. nastes* ab. *obscurata*, which according to Verity was taken near Lake Louise, Alberta.

The variety *streckeri* occurs at Laggan, Alaska and high levels. Specimens from the north of Alaska, namely from Kotzebue Sound and the regions eastward are almost identical

with *streckeri* and may be ascribed to the race *alaska* O. Bang-Haas, figured on Pl. 5, figs. 24-25 of Horæ Macrolepidopterologicae. The type specimen of Bang-Haas was taken at Rampart, Alaska. Specimens from Nome, Alaska, in the Hall collection are identical with the type of Bang-Haas. Both *streckeri* and *alaska* may be accepted as races of *nastes*, but can scarcely be identified as being conspecific with *werdandi*.*

Proceeding with the revision of varietal forms of *nastes*, one should note that the study of the figures given by Verity (Rhop. Pal., Pl. LXXI, figs. 8, 9) shows that these specimens stated to be "*C. nastes* from the Barren Lands" are in all probability *C. moina* Strecker.

Dr. McDunnough described under the name of *subarctica* the race of *nastes* which is characterized as follows: "Corresponding to the form *obscurata* of *streckeri* a very similar dark form is the dominant one along the northern coast; in the long series brought back by the Canadian Arctic Expedition from Bernard Harbor only one or two specimens at all approach the Labrador *nastes* in coloration of upper side; the males are heavily suffused with black on the primaries with the submarginal row of pale spots generally well developed; the secondaries show much less of the black suffusion. On the underside the secondaries are also suffused, the color of the entire disk being a dark smoky green with a paler terminal band which at times contrasts very sharply with the remainder of the ground-color. The females show a similar smoky suffusion but it is scarcely so pronounced, there being more or less of a pale yellow-green ground color visible, as well as the similarly colored submarginal spots. On the underside of the secondaries however, the suffusion is heavy, the entire disk at times being almost blackish with a pale orange-yellow terminal band which, at times, as in the ♂ sex, may stand out sharply." A male, captured at Bernard Harbour, N.W.T., August 9, 1915, is shown on pl. XXVI, fig. 6.

In northern Asia the species named *C. melinos* Eversman and several varieties, or subspecies, occur. In its range *C. melinos* replaces *C. werdandi* Zetterstedt, from which it is sufficiently distinct. This species in its habitat wholly supplants *werdandi* of the Arctic regions of western and northern Europe. Guenée in his description of *C. rossi* claims that the latter cannot be identified with *C. melinos*. This view is quite correct because of the character of the under side of both wings and the different color of the upper side of the wings.

In central Asia at various localities there occurs the species *Colias cocandica* Erschoff, which, while in some respects resembling *C. werdandi* and *nastes* in many respects is nevertheless distinct from them. The under side of the wings is not immaculate, as in *nastes* (save for the discal spot in *nastes*), but marked by antemarginal dark spots on the primaries, which are continued and more or less profoundly accentuated on the secondaries, while the inner two-thirds of the secondaries are darkly colored. This species more nearly resembles on the under side the insect named *Colias rossi* Guenée. Furthermore it might be mentioned that there is marked resemblance both in maculation and coloration between the insect so abundant on Southampton Island and the insect occurring at high elevations in Thibet known as *Colias elwesi* Röber (syn. *leechi* Elwes). The resemblance is very close on the under side. *C. elwesi* Röber is accepted by some students as an alpine variety of *C. cocandica*, others regard it apparently with better reason as an independent species. There is, however, a clear diacritical difference in the fringes: those of *elwesi* being greenish gray, those of the North American insect being more or less pinkish.

Attention is now called to the fact that not a single specimen of typical *C. nastes* Bdv.

*If a broader view is taken in widening the limits of the *nastes* circle as one species on the grounds of a lack of stable structural differences, one should merge into one specific entity the whole group of *melinos*, *cocandica*, possibly *elwesi*, and even *nebulosa*—which is obviously going too far even for an astute "lumper" in systematics.

occurs in the collection from Southampton Island. All the specimens from Southampton must be referred not to the true *nastes*, but to a distinct local form coinciding in part with *C. rossi* Guenée. Some of the specimens belong to typical *rossi* with the characteristic faint orange suffusion on the upper side of the wings. The great majority, however, while in all other respects conforming to the original description of *rossi* and to its type, differ in the absence of the orange tint on the upper and under sides, the ground-color being greenish or yellowish white. This is the dominant tint in the specimens from Southampton Island. While a few of the specimens absolutely agree with Guenée's original description, the vast majority are distinguished by the absence of the orange tint.

10. *Colias nastes* Boisd. *gueneei* Avinoff subsp. nov.

Pl. XXVII, figs. 1, 11, 21-22, 25-27, 31-32.

In regard to the nomenclatorial designation of the race of Southampton Island I am not in favor of accepting the name *rossi*, since it was definitely used for an aberrant, possibly hybrid, form characterized by the presence of an orange tinge on the upper side. We cannot amplify the description as worded by the original author and disregard his indication of the unusual tinge in the color of the upper side, consequently the normal type of the race of *nastes* as found in Boothia Felix and apparently identical with the one from Southampton Island, should receive a new name. To name it *gueneei* would be only a mark of accepted nomenclatorial courtesy practiced in cases when it is desired to commemorate the first author of a related form, the name of which cannot be maintained for a wider application. On the basis of the foregoing reason, the form *rossi* should be envisaged as an aberration of the subspecies *gueneei*, or as a hybrid of the latter and of *hecla*. The description would then be as follows: similar to *rossi*, but lacking the orange tint on the upper wings. This character is typical for the normal representatives of *nastes* in both arctic localities mentioned heretofore.

The race *gueneei* has certain affinities with *moina* and *subarctica* and is distinguishable from the first by more developed maculation of the antemarginal maculation of the underside and from the latter not only by this characteristic but also by an absence of a predominant suffusion with dark scales of the basal portion of the underside of the secondaries. Occasional specimens approximating these two races may be nevertheless found among *gueneei* although the general habitus of the race from Southampton Island is quite marked being probably identical, as was mentioned before, with the representative of the species from Boothia Felix deprived of the orange tinge of *rossi*. It is worth stating that the majority of the series secured by Sutton show a tendency toward a greater development of antemarginal maculations on the reverse than the type of *rossi* from Boothia Felix. It may be remarked that in many cases of racial distinctions within the boundary of a definite species it would be reasonable to indicate the prevailing trend of the characteristics which may not be exhibited in every specimen. It is more the physiognomy of the whole series that bears the mark of certain peculiarities than the absolute properties of every individual link in the whole chain of events. With a leaning toward nomenclatorial differentiations one might assign separate subspecific names to the two arctic races, but I prefer not to follow such a course before a more thorough study of the fauna on Boothia Felix is accomplished, and in view of the fact that a certain proportion of the individuals from both localities as known at present are practically indistinguishable.

In the explanatory remarks pertaining to the plates attention will be drawn to the wide

range of variation of these insects from Southampton Island which might easily tempt addicts of a more liberal policy into giving names to incidental forms.

11. *Colias hecla* Lefebvre. Pl. XXVII, figs. 10, 20, 35.

This species is represented in the material assembled by Dr. Sutton in 7 ♂ and 4 ♀. The specimens of the species are relatively uniform and show but little variation in the width of the dark marginal portions in the intensity of the orange coloration and in the dark suffusion on the reverse of the wings which does not show any antemarginal maculation. The form of *sulitelma* found in the arctic region of the Scandinavian peninsula is less divergent from the American typical form than is the corresponding case with the group of *nastes*. Although the grounds of specific divisions will always remain somewhat arbitrary with scarcely any sufficient structural divergence existing among insects attributed to various species, nevertheless within the accepted taxonomic terminology for this genus it is appropriate to ascribe to the European *sulitelma* a merely subspecific position whereas *werdandi* has the right to be envisaged as a species in accordance with preceding statements in this paper.

12. *Colias boothi* Curtis. Pl. XXVI, figs. 12-13a; Pl. XXVII, figs. 6-9, 17-19, 28-29, 34.

Colias boothi is justly considered to be among the rarest species of the genus. With the exception of *Colias imperialis*, the origin of which until now remains an unsolved question, and which has been attributed at various times to the fauna either of Patagonia or the Sandwich Islands, the northern American polar species is represented in but very few collections. It is only in recent times that small series of *boothi* were obtained since the original capture of the typical series described by Curtis in 1834. It seems to be a pity that this insect has to be deprived, in my opinion, of a specific status. I am advancing this idea that has not been suggested by any other entomologist and that has been recorded as my opinion in the last edition of The Butterfly Book on the basis of the material collected by George M. Sutton, confirming the suspicion I entertained heretofore in regard to this butterfly. I am inclined to think that *C. boothi* is a hybrid between *Colias hecla* and the local race of *Colias nastes* designated as *gueneei*.

Already the series of *boothi*, published by Verity on Plate LXXI of Rhop. Pal., demonstrates the extraordinary instability of this butterfly. The most variable part of it is the dark exterior border which either shows the configuration of a solid band characteristic of *hecla* or denotes a more or less clear development of the light spots in this band of *nastes*. The extreme form diverging in the latter direction, showing a confluence of this light maculation to the extent of an almost total obliteration of the dark parts, has been designated by the original author as ab. *chione*. It may be interesting to note that the form *chione*, described by Curtis, which is characterized by an absence of the exterior dark border of the wings and which is represented in various transitional forms in the set collected by Mr. Sutton, is referred to by Elwes (p. 140, Trans. Ent. Soc. of London, 1880) as a possible hybrid between *nastes* and *boothi*, although this author does not doubt the specific validity of the latter. In my opinion he was thus half way to the truth. Verity indicates the variability of *boothi* both in the direction of *nastes* and *hecla* with which it is found flying, but does not draw the conclusion of their crossing. There are good reasons to believe that *C. werdandi* ab. *christienssoni* is actually a paralleling hybrid between the European representatives of *nastes* and *hecla* (*sulitelma*). It has been considered as being but an aberrant form with a more or less orange pigmentation of the discus of both wings; but anyone who has seen a considerable

large series of this form will observe the extreme instability of this sport showing sometimes the continuous exterior banding of *hecla*. The theory of the hybrid nature of *boothi* receives a considerable substantiation by occurrences in the genus *Colias* from Central Asia. In the mountains of Pamir and adjacent ranges are found flying together two representatives of the genus *Colias* corresponding to *hecla* and *nastes*—namely, *C. eogene* and *C. cocandica*. A peculiar form of the first was described as ab. *brunneo-viridis*. This considerably rare butterfly shows a mutation of *eogene* in the direction of *cocandica*. The original brick-red color of the first turns in varying degrees into a dull brown reaching an entirely green hue in a form I described as ab. *oshanini*. Once in a while, light antemarginal maculae begin to show as a distinct tendency toward the characters of *cocandica*. At the time I described *oshanini* in 1912 I advanced the hypothesis that such truly intermediate forms in reality originate as actual hybrids, although naturally the crossing was never proved experimentally as the earlier stages of both butterflies are unknown. What seems to be such a plausible case in the mountains of Central Asia could easily have happened in boreal America in connection with *nastes* and *hecla*.

The forms of *nastes* from North America which have been described at various times throw some light on this question. *C. nastes* var. *rossi* shows a certain degree of orange tint on its wings, and there is good reason to believe that it owes this character to a direct inheritance from *hecla* as one of the parents of this mixed brood. The form *rossi* was described from Boothia Felix, namely from the same locality from which *C. boothi* was originally obtained. The study by Verity of the series of *rossi* in the British Museum shows that a considerable variability prevails in this form which I take as a secondary indication of its mixed nature.

Gibson, in describing the entomological results of the Canadian Expedition of 1913-1918, remarks in a rather significant way that some specimens of *hecla* were erroneously attributed to *boothi*. They may have been specimens which belonged to the transitional set of intermediate forms like those which now have become known through the exploration of Sutton. The material brought by Sutton makes it clear that the *nastes* from Southampton Island is not identical with the true *nastes* of Labrador. It is a different insect on account of the presence of a band of antemarginal dark patches transversing the underside of both wings. *Moina* was referred to by Verity as a closer relative to *cocandica* than to *nastes* on the basis of the peculiarities of the reverse of the wings.

Another form of *nastes*, namely *streckeri* Gr. Gr., from the Rocky Mountains, deviates from the typical *nastes* and approaches *moina* on account of the increased size of the central patch of the underside of the hind wings. It has been also assigned to a closer relationship with *cocandica*. All these facts indicate a genuine kinship of the pair of boreal American *Colias* (*hecla* and *nastes*) to their palæarctic counterpart in Lapland, also represented by vicarious species in Central Asia. In my correspondence with Verity, sometime about 1910, I expressed my view upon the hybrids of *eogene* and *cocandica*. This opinion of mine is recorded in a quotation from my letter on Page 353 of Rhop. Pal., where the case of a "passage à hybrida" is discussed. Throughout this group we may expect with good reasons some phenomena of hybridization. One may also mention that in a synoptic chart prepared by Verity for the genus *Colias*, he places *boothi* between *nastes* and *hecla* although he maintains the specific independence for *boothi*. In the light of the facts available to science at present, the name *boothi* should be relegated to a crossbreed without any true limits of demarcation for this form, since it runs imperceptibly into the parental species. One should mention, however, that the intergradation, of the type known as *boothi* from original descriptions, runs

into a more uniform linkage toward *nastes* than in the direction of *hecla*. It is worth while noting that the same holds true in regard to the connections of intermediate forms between *oegene* and *cocandica*, where one can study all the shades of emergent orange coloration in very faint tints.

There may be an alternative theory in regard to this group of *Colias* stipulating that there are three species and that *boothi* is a specifically independent entity which hybridizes with either of the other two members of the group. Such an interpretation may be supported by the following considerations.

First; in the lot collected by Sutton there are scarcely a dozen *hecla*, whereas the number of the so-called *boothi* runs over thirty. It may seem somewhat doubtful that the hybrid would show such a preponderance over one of the hypothetical parents.

Second; the size of *boothi* is in the average slightly larger than that of *nastes gueneei*, and in several cases, exceeds even the size of *hecla* which is altogether larger than *nastes*.

Third; the underside of *boothi* never shows the development of antemarginal maculation on the hind wings as accentuated as in *nastes gueneei*.

There is no doubt that the material from Southampton demonstrates a most remarkable case of intergradation throughout this whole series, but the question of assigning an independent position to the intermediate form may be ultimately settled only through direct breeding, as has already been mentioned before.

In reference to the possibilities of hybridization within the genus *Colias* in general, instances to this effect were indicated not only by Groum-Grshimailo, as was quoted heretofore, but also by that keen student of palearctic Lepidoptera, the late Serge Alpheraky. He pointed out the significance of the orange tinge in the forms of *erate* called *chrysodona* and *helichta*. He considers that the latter is a true hybrid between *erate* and *edusa* (*croceus*). Although interbreeding was never verified in an experimental manner, it remains very probable for a considerable territory where both species fly together, namely the southern part of Russia. It was interesting, however, to find specimens with a distinct orange tinge among *erate* from Central Asia where no *edusa* were encountered. Thus the hybrid nature of such specimens from these districts is excluded and we have to look upon such specimens as true aberrations. This case should be kept in mind for a fair judgment about supposed hybrids between species of *Colias*, and calls for a certain reserve upon any final statements about the crossing of *nastes gueneei* and *hecla* on Southampton Island, as well as on the systematic position of *C. boothi* and *rossi*.

An explanation for the two plates of *Colias* is needed in order to understand the characteristics of the specimens which are represented and the purpose with which some comparative material from other regions outside of Southampton Island has been introduced. Plate XXVI has as its aim the illustration of type specimens, paratypes, and topotypes of the most important forms of the *nastes* group from the American territory. This plate permits one at a glance to compare the characteristics both of the upper and the undersides of these various races and to evaluate the peculiarities of these forms and relative degrees of validity of their separation under special names. Particular attention is drawn to the various degrees of development of the submarginal band of maculation on the hind wings and the variety in the dark irroration of scales in the discal and basal parts. Another point worth observing on the underside of the hind wings is the central whitish spot frequently doubled with the various forms of brownish red encircling—running in some cases in a characteristic point directed outwardly. The formation of this part of the pattern in the genus *Colias* is often one of the diacritical marks for separation.

The first two vertical rows of forms on Plate XXVII are assembled in such a fashion as to give a picture of the intergradation from the typical *nastes gueneei* toward *hecla* through a series of *boothi*. The vertical column of specimens from Nos. 1 to 10 showing the males is paralleled by the adjacent row from Nos. 11 to 20 representing a similar phenomenon of gradual transitions in the females. With the rich material collected by Sutton these rows of intergrading forms can be amplified into a perfect scale of gradual transitions from step to step. There remains only one break in the males in which although it approaches *hecla*, it still cannot be identified with that species and possesses the characters of *boothi* in the width of the band and the presence of a lemon yellow ground coloration. A reference to the plates of Verity supplements this series in the sense of representing two males of *boothi* which are still closer to *hecla* than the extreme individual in this regard shown under Fig. 9. Such is the specimen of *boothi* shown on Pl. 71, fig. 16, which is very close to a form represented under Fig. 22 as *hecla chrysothemoides* Verity. Bearing in mind this fact, it is apparent that it becomes increasingly difficult to break this row into separate units correlating them with the accepted systematic entities. *C. rossi* gradually emerges in this row from the normal *gueneei* by acquiring an increasing saturation of the orange. Although it would be easy to pick a typical *rossi* such as No. 3, for instance, nevertheless the specimen shown in Fig. 5 has an excessive brightness of color—a more accentuated definiteness of the dark margin of the hind wings, which suggests the characteristic traits of *boothi*. It is remarkable that in such specimens is observed a certain restriction of the antemarginal spots of the hind wings which are practically evanescent in the true *boothi*, and totally absent in *hecla*. In the light of this documentation the theory of hybridization acquires a convincing ground in accordance with the preceding exposition.

The three lower specimens of the third row, from Nos. 28 to 30, represent somewhat aberrant individuals among *boothi*. As compared with Fig. 28 the specimen shown under Fig. 29 is an exceptionally light individual with an almost complete loss of antemarginal pattern of the hind wings. Although the median black spot in the discus of the front wings is quite clear, it constitutes a certain analogy in the female of the aberration which has received the name of *chione* shown under Fig. 30 and corresponding closely to the type of this sport.

The upper part of the third row, from Nos. 21 to 27, portrays some of the most salient variations of *gueneei*. Fig. 21 is the whitest male in the series compared with one of the darkest shown under Fig. 22, which has somewhat the aspect of a form of *cocandica* from Turkestan, whereas the radiating light spots in the exterior part of the front wings, by their shape are reminiscent of those of *C. nebulosa*, *ladakensis*, and *tamerlana*. No. 23 with the somewhat rounder shape of the wings and the typically orange tint of the disc is almost indistinguishable from *christienssoni*, male, shown under Fig. 41, if it were not for the dark antemarginal maculation on the reverse which is absent in *werdandi* and *christienssoni*. If it will be proven that not only *boothi*, but *rossi* as well, is a product of mixed blood, it may be quite probable that *christienssoni* is a similar hybrid produced by the crossing of *werdandi* and *C. hecla sulitelma*. No. 24 is a rather aberrant specimen of *rossi* with an even suffusion of dark scale of the wings and is strikingly analogous to the specimen Fig. 43 representing a rare instance of *cocandica* with an orange tinge which is supposed to be the result of an inter-breeding with *C. eogene*. In fact this Southampton specimen seems to be like a diminutive version of its Asiatic counterpart. The specimens Nos. 25, 26, 27 show three extreme phases among females of true *gueneei*, No. 25 being extraordinarily white and deficient of pattern; No. 26 represents the utmost accentuation of dark marginal pattern with a greyish suffusion over the wing not unlike specimens of *cocandica*. No. 27 is remarkable on account

of an exceptional intensity of a bright lemon yellow tint and a clearly defined dark marginal portion with a row of large yellow spots. Some lepidopterists would be inclined to affix aberrational names for such specimens. In fact it would be easy to give any number of names to various individual specimens of the set brought back by Sutton, if any one would wish to indulge in burdening the entomological nomenclature as has been done so often in later times and with so little ground. The extreme specimens are indeed quite striking, but the intergradations demonstrate only the range of variability interconnected by gradual links. It might be mentioned that such a bright yellow example as the one in Fig. 27 has counterparts among the females of *C. cocandica*. Similar color phases occur rather frequently among *C. cocandica* from Tian-Shan, and in much rarer cases from Pamir. The undersides of specimens in the upper portion of the fourth row seem to be especially instructive, the first two, Nos. 31 and 32, show the range of variation in the development of the antemarginal black maculation in *gueneei*. Fig. 32 shows an extreme form as far as the development of the antemarginal maculation and the width of the brownish central marking of the hind wing are concerned. Such an aspect of the underside is typical for *gueneei* and is not found in local races of *nastes* on the American continent. It goes even further than the characteristics of the underside of *cocandica* which often displays a heavy antemarginal maculation, showing however as a rule a restricted reddish-brown area around the central spot. It is only *C. elwesi* which shows such a marked antemarginal maculation followed by a light external border, whereas the central spot has a still less conspicuous dark surrounding. If all the specimens from Southampton Island were to show such a characteristic development of the pattern on the underside this form would be always easily recognized and would never be mixed with its relatives of the mainland. Yet the phenomenon is more complicated, and it was considered advisable to show the most extreme forms in the opposite direction—namely, the underside of Fig. 36 which is comparable with the reverse of *subarctica* as shown under Figs. 6a and 7a of Plate XXVI. Fig. 31 has an exceptional restriction of the antemarginal pattern for a specimen from Southampton and could scarcely be distinguished from *moina* as the comparison with Figs. 14a and 15a on Plate XXVI clearly demonstrates. In the point of fact it is the predominance of strongly marked characteristics of the underside of the specimens from Southampton which do not permit one to identify them completely with *moina* and *subarctica*. Fig. 34 showing the reverse of *boothi* illustrates a restriction of the antemarginal maculations standing in this regard midway between *gueneei* and *rossi* on one side and *hecla* on the other, the latter being shown under Fig. 35. By observing the variance of the underside from Figs. 31 to 35 one can gather a clear visual conception of these intergradations from one extreme to another.

Fig. 36 represents *C. nastes* from Port Harrison, Hudson Bay, being still more extreme than the type from the point of view of the loss of the light maculation in the dark exterior band of the primaries. This dark exterior margin tends to form a solid band of the type characterizing the *hecla* group and should be compared with the remarkable aberrant specimen of *werdandi immaculata* Lampa which could be taken for a *sulitelma* without orange. Figs. 38 and 39 demonstrate the variation in the shape of two wings of *werdandi* which may be broad or more pointed, the latter characteristic being more typical for the American representatives of the group. Fig. 40 is a female of *melinos* which compares on the upperside rather closely with such representatives of the Southampton race as the one in Fig. 29 from which it differs decidedly on account of the uniformity of the reverse. Figs. 43 to 47 show certain forms of *cocandica* among which Nos. 44 and 47 closely approximate certain specimens from Southampton. Altogether the insects shown in the Figs. 37 to 49 are introduced

for the purpose of comparison of Arctic American Coliads with related species from the Old World.

A summary of the affinities within the group of *Colias* relating to *nastes* in a wide sense could be approached as follows, with an occasional repetition of some of the statements made in the preceding pages.

In a certain sense the whole group of *Colias nastes* and allied species is a homogeneous division within the genus *Colias*. To this section, besides *nastes*, belong *C. cocandica*, *melinos*, *elwesi*, *sifanica*, *nebulosa*, *phicomone*, *ladakensis*, and *montium*. The closest affinity within this group exists between *nastes* and *cocandica* through certain racial forms of these two species. The races of *cocandica* which have received the name of *maja* show a definite resemblance with the darker individuals of the American species. On the other hand the northern European subspecies of *nastes* bearing the name of *werdandi* is approaching considerably the Siberian *melinos*, especially the race *herzi* of the latter. Owing to the existence of such forms which could be construed as transitional connecting links one might look upon *melinos* as the Siberian representative of *nastes* and ascribe to it a conspecific position with the boreal species found in the Old and New World.

The two isolated species, *phicomone* in the Alps of Europe, and *montium* in eastern Tibet, denote a certain kinship with *melinos*, especially with its form *deckerti*. The area of distribution of these three species is discontinuous which accounts unquestionably for this specific hiatus dividing these three butterflies into independent systematic entities.

There exists a rather remarkable similarity between the race of *nastes* with a highly developed pattern of the underside of the hind wings, characteristic for Southampton Island, and *C. elwesi* of western Tibet. If it were not for the yellowish color of the fringes the female of the Tibetan *elwesi* would easily pass for a female of *nastes* from Southampton Island.

A type of *C. ladakensis* is on the whole more divergent from the characters of *nastes*, together with *nina* from southern Tibet, which has scarcely the right to be considered an independent species unless certain facts of simultaneous distribution in the district of Mt. Everest will be confirmed. Both occupy an eccentric position in the cycle of the *nastes* group in a broader sense. A striking peculiarity of *nina* is the fact that the females are more brightly colored than the males, tending toward the orange in *ladakensis* and toward the red of *berylla*. No white dimorphic females of these species have been ever found, whereas the females of all the rest of the species of the *nastes* group normally have whitish females.

This brief synoptic survey does not include *C. alpherakyi* from Bokara, Pamir, and Chitral, although the exterior aspect of the male is not unlike the darker representatives of the American *nastes*. The invariable pale yellow fringes of these species and the character of the underside of the hind wings indicate clearly their far more remote connection with the group in question than the outer facies might show. *C. sieversi* is still more divergent leading to the most paradoxical member of the Coliads, still preserving some vestiges of relationship with the *nastes* type, namely *C. christophi*, noted for its unusual russet color of the discus of the wings and the pure white antemarginal bands on both wings with almost white fringes.

Another point worth observing in connection with the systematic relationship of *nastes* and *cocandica* is connected with cases of alleged hybridization. It should be borne in mind that no positive biological proof in this regard has ever been obtained and no experimental testimony is available. Groum-Grshimailo, in the fourth volume of "Mem. sur Lep.," dis-

cusses at length the variations of coloration and pattern in *cocandica* and *eogene* which cannot be construed otherwise than as instances of hybridizing. The most extreme form of *eogene* possessing the coloration of a true *cocandica* has been later named by me as *oshanini*. Similar brown forms have been called *hybrida*, aptly indicative of the nature of such variations. Furthermore rather numerous *cocandica* have been secured with a brownish admixture to the green tint of the normal form. In my collection there were about fifteen transitional individuals between these two species from the Trans-Alai Mountains where both *cocandica* and *eogene* were plentiful and flying constantly together.

The orange form of *werdandi christienssoni* from Lapland was described as an aberration, but it may be easily surmised that such specimens are the result of crossing between the aforesaid races of *nastes* and *hecla sulitelma*. It may be worth mentioning that the vicarious species of *hecla* found in Siberia and called *viluensis*, flies together with *melinos*, and has never been known to produce any hybrids. It would be important to collect more material in this region since such a hybridization should be entirely probable. In view of these facts there is good reason to believe that the *hecla* and *nastes* of Southampton Island produce hybrids; *C. boothi* may be dismissed as an independent specific unit until more positive evidence will be collected and may be provisionally classed as a product of interbreeding between the two representatives of *Colias* on the Island.

The parallelism of two types of *Colias*, one orange, the other greenish, allied by a considerable similarity of the underside is exemplified in the Old World by the pairs of *werdandi—sulitelma* in Lapland, *cocandica—eogene* in Turkestan, *elwesi—stoliczkana* in Ladakh, and in the New World by *nastes—hecla*, this phenomenon has its counterpart in the alpine regions of South America where such a relationship is expressed by *dimera—mossi* found together in high altitudes of Peru and Bolivia. It is one of the puzzling and striking facts in the distribution of the genus *Colias* that two kinds of butterflies of that genus, exteriorly so unlike so far as the upperside is concerned, and on good grounds assigned to different sections of the genus, seem to have a similar destiny in their distribution over the globe. Some features of this problem have been already indicated by Groum-Grshimailo in 1884, although the facts concerning Ladakh and South America were not known to him. If we postulate the development of the orange and green Coliads from a single source, without complicating the question by a polyphyletic hypothesis, we are confronted with a phenomenon described sometimes as convergence, although such an issue invalidates to a considerable extent the whole scheme of a successive evolutionary descent. It seems to be more plausible to surmise that the two kinds of *Colias* so singularly similar are connected with certain ecological conditions favoring the simultaneous breeding of the types and causing their joint distribution, as well as their joint survival, in cases when a broader dispersion was restricted in the course of geological history to a more limited area. From this angle it would be of interest to observe to what extent the similarity of the pattern of the underside is preserved in the representatives of these two subdivisions of *Colias* found in the same region. In the first place we are driven to the conclusion that the prototype of these two groups as well as of the whole genus *Colias* had an antemarginal band of maculation on the hind wings corresponding to such intraneural markings found in a large variety of Pierids. It is an ancestral character peculiar to the whole family which may tend in certain cases to disappear. It would be difficult to postulate a re-emergence of a lost character as this negative rule seems to hold throughout the evolutionary history of living forms. It is reasonable to admit that the race of *nastes* found on Southampton Island is about the most primitive of the whole section of the green Coliads. It is also remarkable that the South American *mossi*

and *blameyi* have also maintained this archaic trait. Available facts favor the hypothesis of assigning the New World as the original home of the *nastes* cycle at variance with the theory of Groum who advocates the joint origination of the orange and green Coliads in Central Asia. In comparing the undersides of the two kinds of *Colias* from the same localities we observe that the antemarginal spots in the orange group are present in *stoliczkana* from Ladakh, *arida* from Chinese Turkestan, *miranda* from Sikkim—all three belonging in my opinion to one species and not conspecific with *eogene*, as is accepted by the majority of lepidopterists. One of the best proofs of the specific independence of the two latter Coliads is the fact of the simultaneous co-existence, side by side, of *eogene* and *stoliczkana* in the north of Kashmir, the only known territory where the areas of distribution of the two forms are overlapping. In continuing our enumeration of the spotted orange Coliads one should also mention *dimera* of South America. On the other hand the antemarginal maculations are present in the green group only in *cocandica* with its numerous forms and in the race of *nastes* from Southampton Island, as well as to a certain extent in a race of *nastes* from the Rocky Mountains. The very fact that such spots are observable on some continuant races of *nastes* in a less marked degree than the form from Boothia Felix and Southampton Island, excludes the possibility of envisaging it as an independent species, and warrants a sub-specific affiliation with *nastes*. There are some more divergent species of the yellow and green group kindred to *nastes* which also have the intraneural dark spots on the hind wings like *nebulosa*, the recently described *richthofeni* (thought to be related to *cocandica*, but in my opinion closer to *nebulosa*), *ladakensis*, and *nina*, but this case is immaterial in this conjunction on account of the relatively more remote systematic position of those species. The fact of importance, however, is that on Southampton Island the orange representative, namely, the typical *hecla*, has an even underside of the hind wings, whereas the vicarious form of *nastes*, the subspecies *gueneei*, shows the maximum development of the primitive markings. One can summarize this relationship in the following diagram:

	Presence of spots on the reverse in	
	<i>hecla</i> group Orange	<i>nastes</i> group Greenish Yellow
Southampton Island.....	—	+
Labrador.....	—	—
Alaska.....	—	—
South America.....	+	+
Lapland.....	—	—
Siberia.....	—	—
Turkestan.....	—	+
Ladakh.....	+	+
Tibet.....	+	+

References to original sources.

For purposes of clarity and convenience, it seems advisable, in references to the basic sources, to give a transcript of the original descriptions of some of the forms of *Colias* in question, namely, *nastes*, *hecla*, *boothi*, *chione*, *rossi*, and *cocandica*.

The article by Guenée appearing under the title "*Note sur quelques espèces du genre Colias*," was presented at the meeting of the Entomological Society of France, February 10, 1864, Ann. Soc. Entom. de France, 1864, 4 ser., 4, p. 197-200, a verbatim translation of which is as follows:

"Today I shall call the attention of the Society principally to two diurnals belonging to the genus *Colias*, concerning which much has already been said without as yet the ability to set forth the facts in a clear light. The bounty of Mr. Curtis and the friendship of Mr.

Doubleday have given me the opportunity to study the very rare specimens which have come to Europe. We are dealing with *Colias Hecla* and *Boothii*, which have been by modern entomologists either admitted, or denied, to be identical.

"The first was published, as is well known, in our Annals by my old friend, M. Alexandre Lefebvre as early as 1836, his description being founded upon some specimens which he had received from Greenland. But the insect for a long time was so rare that neither Duponchel in his Supplement, nor M. Boisduval in his *Icones* mentioned them, only in their Catalogs speaking of them as synonymous with *Boothii* (of which they had made no previous mention), presuming, I do not know upon what data, that M. Lefebvre had confounded the two although he positively states the contrary, first in the *Annales*, p. 383, and then in the *Errata* at the end of the volume.

"With the exception of Zetterstedt, who presented this species under the name of *Hecla* in his *Insecta Lapponica*, while rectifying its habitat, everyone confidently accepted the decision of MM. Boisduval and Duponchel, and of M. Herrich-Schaeffer, who in his great work figured the male of *Boothii*, giving as a synonym *Hecla* Lefebvre, without further verification.

"Finally M. Staudinger, in the Catalog which he has recently published, follows his predecessors, and his opinion is the more conducive to error, because he had himself collected *Colias hecla* in abundance during his journeys in the north of Europe.

"True *Boothii*, brought from the pole by Captain J. Ross, was published by Mr. Curtis a little before the article by M. Lefebvre, as well as a second *Colias* of the same region which he [Curtis] named *Chione*. This *Boothii*, of which only a few examples have reached Europe, has been and still is, much rarer than *Hecla*, especially the females, of which only two have been found.

"Now then, not only are *Colias Hecla* and *Boothii* two distinct species, but they are widely separated: *Hecla*, as aptly observed by M. Lefebvre, having a certain affinity to *Myrmidone*, while *Boothii* closely approaches *Nastes*. Here follows an account of their characteristics and their synonymy.

Colias Hecla Lef.

"Lefebvre, Ann. Soc. Ent., 1836, pl. 9, figs. 3-6.—Zetterst. Ins. Lap. p. 908.—*Boothii* Herr.-Sch., I, p. 103 and VI, p. 23. fig. 459, 460 (var. ♀ ?)—Staud., Catal., p. 3, No. 56.

"It has nearly the size of *Chrysotheme* and the color of *Myrmidone*, but in outline is different, the primaries being less triangular, more prolonged at the apex, with the outer border not nearly so straight. The marginal band is very sharply defined, with slight indentations on its inner margin, and interrupted by some yellow nervules at the apex, but is decidedly less expanded in this region than in the case of the two species cited above. The cellular spot is narrow, irregular, and the fringes are ordinarily quite feebly tinted with rose.

"On the under side this *Colias* does not resemble those which I have just cited. The primaries are pale orange powdered with some black atoms, the marginal band appearing green through transparency. The cellular spot is pupilled with white. So far as the series of blackish spots is concerned, it is often wanting and only the outermost can be perceived. The secondaries are wholly and strongly powdered with green, so that no orange is seen except near the marginal band. The cellular spot is small, rounded, rose-colored, and encircled by brick-red. The costal spot is blackish and scarcely visible.

"It inhabits Greenland, the North Cape, and northern Lapland.

Colias Boothii Curt.

"Curt., Voy. du cap. Ross.—Herr.-Sch., fig. 39, 40.

"It has the size of *Pelidne* and very much the same cut of wings. The ground-color is also somewhat the same, that is to say *greenish sulphur*, except that the primaries are lightly tinted with orange upon the disk, between the second inferior nervule and the internal margin. The marginal border is very narrow, on the inner margin indistinctly and poorly defined, very pale blackish, or it might be said greatly deadened in tint by yellow atoms; no yellow nervules at the apex; a greatly reduced cellular streak. The secondaries show no admixture of orange, except the cellular spot, and they are broadly powdered with black on the abdominal margin. The marginal border is still narrower and more poorly defined than on the primaries.

"The under side recalls that of *Nastes*, but it is throughout greenish sulphur. The fore wings have a little yellow pupil on the internal portion of the cellular spot, and a series of blackish spots parallel to the outer margins decreasing in size from the inner to the upper margin. The hind wings are wholly yellow olivaceous, with an oblong and pointed cellular spot, which is brick-red, marked anteriorly by a silvery point. Their marginal border far from being distinguished by its depth of color as in the case of *Hecla*, is on the contrary lighter, or less dusky than the body of the wing and parted from the disk by an accumulation of atoms, which in the case of some specimens go so far as to form spots of orange. There is no streak on the four wings. Internally the club of the antennæ is greenish yellow. The fringes are conspicuously and entirely pink on both sides.

"The female differs from the male by having the cellular spot larger on all four wings, the marginal border wider and interrupted on the four wings by a series of sulphur spots almost touching each other; but those on the secondaries tend to disappear before the anal angle. The orange tint is a little more pronounced. The under side is darker and greener than in the case of the male, and more closely approaches that of *Nastes*. In the case of my specimen the cellular spot is bipupilled with silvery.

"It has been found in the polar regions by Captain Ross.

Var. Colias Chione Curtis.

"This is a male entirely without the blackish marginal border and the cellular spot on the primaries. This spot appears on the under side in the form of a very thin blackish ring. This is evidently only a form aberrant from the type. However, it is curious as showing an increasing departure from the type of *Hecla*.

Colias Rossii Gn.

"An Var. *Nastes*?

"I received from Mr. Doubleday, together with the rare *Colias*, which I have just described, three individuals of another species of the same genus likewise taken on the expedition of Captain Ross, and which may perhaps only represent a local variety of *Nastes*, but which nevertheless display notable differences.

"It is of the size of *Nastes*, but the wings are perhaps a little more rounded. The male is distinguished on the upper side by the very light orange tint on the part corresponding to colored in *Boothii*. The nervules at this point are better defined being black upon a ground much less sanded with atoms than in the case of *Nastes*. Furthermore *the internal border is plainly more convex than in the case of Nastes* ♂,* thus causing the wing to appear broader;

*This is not a constant character. A. A.

the marginal border is wider than that of *Nastes* and interrupted by a series of seven sulphury or greenish spots, as sharply defined internally as exteriorly, and extending to the costa.

"The female is greenish white, but always a little more tinted with yellow than in the case of *Nastes*.

"The under side of the wings in both sexes is greenish white, more tinged with yellow, in the case of the male. On the fore wings the series of subterminal blackish spots is complete and well defined. On the hind wings this series is continued and so bounds the very dark part of the disk, marking off a sharp clear-cut border, which appears toothed or internally sinuate, because the spots are not all on the same line. The brick-red cellular spot has a large white pupil also sharply defined.

"I repeat that this *Colias* has a facies distinct from *Nastes*, especially that from Labrador, and if the differences which I have pointed out, should be reproduced in other specimens, I should not hesitate to believe it to be a valid species. It is still more remote from *Melinos*.

"I have given to this *Colias* the name of the celebrated explorer, who brought it from the Pole with *Boothii*."

Original description of *C. hecla* Lefebvre given in the Ann. Soc. Ent. France, Vol. V, 1836, pp. 384-387. (Translation)

***Colias Hecla*, Lefeb.**

"Alis supra fulvo luteis, limbo communi nigrescente; subtus virescentibus, anticis puncto ocellari nigro, posticis puncto unico albo. Fæminæ limbo supra maculis sulphureis signato.

(Expanse: 19—20 lines)

MALE

(Figs. 3 and 4).

"The upper side of the fore wings is reddish yellow, which becomes brighter and changes to silvery yellow along the costa of the upper wings as well as upon the anterior and abdominal border of the secondaries. Each wing is bounded by a black marginal border powdered with yellow and finely intersected by this color along the nervules. Furthermore on the disk of the primaries there is a small black crescent and upon the disk of the secondaries a small orbicular spot of orange-red. Finally the four wings at their bases are powdered with black, with yellow hairs, and the fringe, the base of which is sulphur-yellow, is washed with rose from the summit to the sixth nervule on the upper wings, and from the fifth nervule to the anal angle upon the lower wings.

"The under side of the fore wings is sulphur-yellow finely powdered with black, resulting in a greenish appearance, with the exception of the base of the upper wings which is pure yellow. These same wings have the costa bordered with rose, and their disk marked by a little black point pupilled with white, while upon the secondaries may be seen a small, irregular, ferruginous spot, surmounted with a yellowish white point. Furthermore along the terminal borders of the fore wings there appears a series of clear yellow spots which scarcely differ from the ground-color. Finally the fringes are half yellow and half rose as on the upper side.

"The antennæ are ferruginous red with the club brown, at the tip yellow above and ferruginous below.

"The hairs which mount the head and those of the collar are violet-rose. The remainder of the corselet and abdomen are black adorned with long whitish or yellowish hairs. The palpi and the lower side of the body are greenish yellow as well as the thighs. The legs and the tarsi are rose.

FEMALE.

(Figs. 5 and 6).

"The upper side of the primaries is reddish yellow powdered with black only along the costa and at the base, with the nervules black; the upper side of the secondaries is likewise reddish yellow, but powdered all over with black with the exception of the abdominal border which is sulphur-yellow. The four wings are terminated by a blackish marginal band marked with several spots of sulphur-yellow, to the number of seven upon the primaries and four upon the secondaries. There is besides upon the disk of the primaries a large black spot pupilled with yellow and on the secondaries a large irregular spot of vivid orange.

"The under side of the primaries is bright yellow, with the costa and the base greenish, or sulphur-yellow, powdered with black, and with a broad terminal band of the same color upon which may with difficulty be detected the same spots which appear on the upper side, of which the last is accompanied by a black point. The nervules are black and the disk is also marked as above with a black point, pupilled with yellow.

"The under side of the secondaries is entirely greenish or sulphur-yellow powdered with black, with a ferruginous discoidal spot, of which the upper part is occupied by a large white opaque spot followed by another which is smaller and scarcely visible.

"The fringe of the fore wings is entirely rose as on the upper side.

"The antennæ, the head, the palpi, the body, and the feet are as in the male.

"Of all the *Coliads* of the same group to which this species belongs *Chrysothème* is that which most closely approaches it, or rather which is least remote from it, for there exist between the two many differences which it would be tedious to mention here, and which furthermore are far easier to represent by the brush than in words. We confine ourselves to indicating the principal differences, which are as follows:

1. The under side of the fore wings is much greener than in *Chrysothème*.
2. Below, parallel to the terminal border in the case of *Chrysothème*, there is a series of black points, which are lacking in *Hecla*.
3. The discoidal spot of the secondaries of the female above is very large in *Hecla* and has an irregular form, while in *Chrysothème* it is composed of two twinned ocellate spots, of which one is much smaller than the other.
4. Finally, the same spot below is bordered by a single point of opaque white set off by ferruginous in the case of *Hecla*, while in the case of *Chrysothème* this spot consists of two silvery points, twinned as on the upper side.

This remarkable and well characterized species inhabits Iceland.

"NOTE: We had just sent this description to the printer, when M. Guérin handed to us a Memoir by Mr. Curtis of London, accompanied by a colored plate upon several new insects collected by the expedition under Captain Ross to the North Pole. Among them there are two *Coliads* of which one under the name of *Boothii* corresponds rather closely with the species here discussed; but upon comparing them attentively it may be observed that the differences which separate them are not less numerous than those which distinguished *Hecla* from *Chrysothème*. So we think that a synonym has not been created."

The description of *cocandica* appeared in a Russian publication, the translation of which reads as follows: Excerpt from p. 6, *Lepidoptera*.

"Travel in Turkestan" by Fedchenko, Vol. II, Zoographical Research, Pt. V, *Lepidoptera*, by N. Erschoff:

No. 13. *Colias Nastes* B.

"Icon. Historiq. des Lépidoptères, Tab. 8, fig. 4, 5; Herrich-Schäffer, Syst. Bearb., fig. 37, 38, 401, 402.

Var. *cocandica* nov. Ersch.

"The only specimen of a female secured by that expedition in the Chanate of Kokan, the figure of which is shown as mentioned above on Pl. I, fig. 3, is to such an extent like the typical *Colias nastes* B. from Labrador, that I hesitated for a long time whether it should be finally ascribed to a special variety. Nevertheless the immense distance lying between Kokan and Labrador, where *nastes* is not found, as well as certain although minute, but nevertheless sufficiently diacritical traits, have led me to recognize in this solitary specimen a new variety which I name *cocandica*. I shall not describe at length this specimen since it would be only a repetition of a description of *nastes*, but I will mention those slight characters which distinguish this individual from the ten specimens of *nastes* from Labrador, preserved in my collection.

"The upper side is darker than *nastes*; the shape of the wings is different, mainly more elongated. The marking in the middle cell near the transverse vein on the upper wings is the shape of a triangle pointing toward the exterior part of the wing. From below, the color of the wings is not yellowish green, but bluish green. The male is unknown; its discovery should demonstrate more clearly whether this is an individual species or is merely a variety.

"Caught June 24th on the mountainous slope near the glacier of Shtchourovsky.

"It may easily happen that this specimen belongs to *Colias eogene* Feld, a species of which at the present time only the males are known, and which has also been recorded by the expedition in the Chanate of Kokan . . ."

HETEROCERA.

BY CARL HEINRICH.

The specimens of moths collected by George Sutton on Southampton Island have been submitted for identification to the distinguished authority on American Heterocera, Mr. Carl Heinrich of the U. S. National Museum in Washington, who consented most kindly to pass judgment on this material. His identifications and descriptions of forms new to science are included in this review of the scientific results obtained by Dr. Sutton in the course of his explorations. The most sincere gratitude is herewith extended to Mr. Heinrich for his obliging courtesy and the willingness with which he undertook the task. A. AVINOFF.

Family NOCTUIDÆ.

SUBFAMILY AGROTINÆ.

Genus AGROTIPHILA Grote.

1. *Agrotiphila quieta* (Hübner) Pl. XXVIII, figs. 28-29.

Noctua quieta Hübner Schmett., Ent. Noct., 485.

Four males and four females, Southampton Island, July 18, 20, 22, 28, and August 5.

SUBFAMILY HADENINÆ.

Genus ANARTA Hübner.

2. *Anarta richardsoni* (Curtis) Pl. XXVIII, figs. 26-27.

Two females, Southampton Island, July 22 and August 1, 1930. The July specimen (fig. 26, plate XXVIII) is typical except that the terminal area of the fore wing is darker on both upper and under sides than in other specimens before me.

The August specimen (fig. 27, plate XXVIII) appears superficially quite different from normal *richardsoni* or any of its named varieties. The fore wing is suffused with black scaling obscuring all transverse markings to beyond the middle and leaving the obicular and reniform very faintly indicated. The subterminal dark spots are fused into a rather broad, black, transverse band, repeated on the under side of the wing as two fine, parallel black lines. The hind wing has a complete, strongly marked, blackish-fuscous post-medial line within and separated from the broad dark terminal border. This dark line is strongly repeated upon the under side of the wing.

I am convinced that this specimen is only an individual aberration and unworthy of a varietal name. It may be what Walker had from Repulse Bay and called *septentrionis* but that cannot be determined from his vague description.

There are no significant differences in genitalia between the above two specimens nor between them and typical females of *richardsoni*.

Family GEOMETRIDÆ.

SUBFAMILY GEOMETRINÆ.

Genus ASPILATES Treitschke.

3. *Aspilates orciferaria labradoriata* (Möschler) Pl. XXVIII, fig. 31.

Two males, Southampton Island, July 8, 27, 1930.

Family PYRALIDÆ.

SUBFAMILY PHYCITINÆ.

Genus POLOPEUSTIS Ragonot.

4. *Polopeustis annulatella* (Zetterstedt) Pl. XXVIII, fig. 34.

Six specimens from Southampton Island.

SUBFAMILY CRAMBINÆ.

Genus CRAMBUS Fabricius.

5. *Crambus trichostomus* (Christoph) Pl. XXVIII, fig. 35.

Six specimens from Southampton Island.

Family PTEROPHORIDÆ.

Genus PLATYPTILIA Hübner.

6. *Platyptilia petrodactyla* (Walker) Pl. XXVIII, fig. 40.

One female from Southampton Island, July 27, 1930.

Genus OIDÆMATOPHORUS Wallengren.

7. *Oidæmatophorus* sp.

One female from Southampton Island, July 28, 1930, in poor condition. Is near *brucei* Fernald and may possibly be a variety of that species.

Genus STENOPTILIA Hübner.

8. *Stenoptilia mengeli* Fernald.

One male from Southampton Island, July 28, 1930.

Family OLETHREUTIDÆ.

SUBFAMILY OLETHREUTINÆ.

Genus APHANIA Hübner.

9. *Aphania frigidana* (Packard) Pl. XXVIII, fig. 32.

One male, Southampton Island, July 28, 1930.

Genus *OLETHREUTES* Hübner.10. *Olethreutes inquietana* (Walker) Pl. XXVIII, fig. 30.

Four males, July 4 and 18, and August 1; four females, July 4, 28, August 1 and 5, Southampton Island. Variable as to size and pattern.

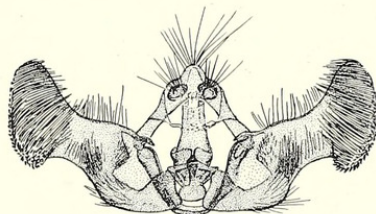
11. *Olethreutes mengelana* (Fernald) Pl. XXVIII, fig. 33.

Two males and one female, Southampton Island, July 5 and August 5, 1930.

SUBFAMILY EUCOSMINÆ.

Genus *THIODIA* Hübner.12. *Thiodia southamptonensis* Heinrich, sp. nov. Pl. XXVIII, fig. 38, type, 36 and 37 paratypes.

A bluish white species with strongly contrasted black markings. Palpus, face, head, and thorax, blackish fuscous with the ends of the scales white, the palpus paler and more heavily sprinkled with white. Fore wing with an incompleated dark basal patch indicated by a dark shade at extreme base and an outwardly slanting black bar beyond, extending from dorsum to top of cell; from middle of costa a slanting, somewhat irregular, transverse, black band extends to dorsum just before tornus; from middle of this dark band there is a somewhat paler (fuscous) band which forms a half circle over the ocelloid patch and reaches almost to tornal angle, on its upper edge it touches two black spots, which extend from outer third of costa; another similar black spot at apex; ocelloid patch of the bluish white ground-color with a very faint dusting of black in center; cilia pale fuscous; termen straight and slanting; veins 3, 4 and 5 separate at termen and nearly parallel. Hind wings pale gray, glossy; cilia paler, grayish white; veins 3 and 4 united.



southamptonensis
Male genitalia of type

Expanse: 18 mm.

Type: In Carnegie Museum.

Type-locality: Southampton Island.

Described from male type and two male paratypes all from the type locality (collected July 12, July 22, and August 1). The type is in good condition; but the two paratypes are badly rubbed and have the markings almost obliterated. The genitalia of all three are identical. It is a striking species, not to be confused with anything else. In pattern it is closest to McDunnough's *convergana* from Aweme, Manitoba.

Genus *GYPSONOMA* Meyrick13. *Gypsonoma parryana* (Curtis) Pl. XXVIII, fig. 39.

Two males, Southampton Island, July 12, and August 5, 1930.

EXPLANATION OF PLATE XXVI.

All specimens figured are in the collection of the United States National Museum except Figures 14-15 which are the property of the Field Museum of Natural History.

- FIG. 1. *Colias nastes* Boisduval, ♂, "type"; from Oberthür Collection (ex Coll. Boisduval).
 FIG. 1a. " " " " " under side.
 FIG. 2. *Colias nastes streckeri* Gr.-Gr., ♂, topotype, (compared by F. H. Benjamin with "type" in Strecker Collection, Field Museum).
 FIG. 2a. *Colias nastes streckeri* Gr.-Gr., ♂, topotype, under side.
 FIG. 3. *Colias nastes streckeri* Gr.-Gr., ♀, topotype.
 FIG. 3a. " " " " " " under side.
 FIG. 4. *Colias nastes* Strecker ab. *obscurata* Verity, ♀; Wilcox Pass.
 FIG. 4a. " " " " " " under side.
 FIG. 5. *Colias nastes* Strecker ab. *obscurata* Verity, ♀, Laggan, Alta.
 FIG. 5a. " " " " " " under side.
 FIG. 6. *Colias nastes subarctica* McD., ♂, paratype.
 FIG. 6a. " " " " " " under side.
 FIG. 7. *Colias nastes subarctica* McD., ♀, paratype.
 FIG. 7a. " " " " " " under side.
 FIG. 8. *Colias nastes rossi* Guenée, ♂, type; from Oberthür Collection (ex Coll. Guenée); (identical specimen figured by Verity, Pl. XLIX, fig. 25).
 FIG. 8a. *Colias nastes rossi* Guenée, ♂, type; under side.
 FIG. 9. *Colias nastes rossi* Guenée, ♂, (also ex Coll. Guenée).
 FIG. 10. *Colias nastes rossi* Guenée, ♀, type, (ex Coll. Guenée; figured by Verity, Pl. XLIX, fig. 28).
 FIG. 10a. *Colias nastes rossi* Guenée, ♀, type, under side.
 FIG. 11. *Colias boothi* Curtis ab. *chione* Curtis, ♂, type; from Oberthür Collection (ex Colls. Curtis-Doubleday-Guenée).
 FIG. 11a. *Colias boothi* Curtis ab. *chione* Curtis, ♂, type, under side.
 FIG. 12. *Colias boothi* Curtis, ♂, can probably be considered a type, from Oberthür Collection.
 FIG. 12a. " " " " " " " " " " " , under side.
 FIG. 13. *Colias boothi* Curtis, ♀, can probably be considered a type, from Oberthür Collection.
 FIG. 13a. " " " " " " " " " " " , under side.
 FIG. 14. *Colias nastes moina* Strecker, ♂, type; from Strecker Collection, Field Museum.
 FIG. 14a. " " " " " " " " " " " under side.
 FIG. 15. *Colias nastes moina* Strecker, ♀, type; from Strecker Collection, Field Museum.
 FIG. 15a. " " " " " " " " " " " under side.



EXPLANATION OF PLATE XXVII.

All specimens from Southampton Island except when otherwise indicated.

- FIG. 1. *Colias nastes* Boisd., *gueneei* Av., ♂, type.
 FIG. 2. *Colias nastes*, transitional to *rossi* Guenée, ♂.
 FIGS. 3-5. *Colias nastes rossi* Guenée, ♂.
 FIGS. 6-9. *Colias boothi* Curtis, ♂.
 FIG. 10. *Colias hecla* Lef., ♂.
 FIG. 11. *Colias nastes gueneei* Av., ♀, paratype.
 FIGS. 12-16. *Colias nastes rossi*, ♀.
 FIGS. 17-19. *Colias boothi*, ♀.
 FIG. 20. *Colias hecla*, ♀.
 FIG. 21. *Colias nastes gueneei*, ♂, light form.
 FIG. 22. " " " " suffused form.
 FIG. 23. *Colias nastes rossi*, ♂, transitional to *boothi*.
 FIG. 24. " " " " suffused form.
 FIG. 25. *Colias nastes gueneei*, ♀, light form.
 FIG. 26. " " " " dark form.
 FIG. 27. " " " " yellow form.
 FIG. 28. *Colias boothi*, ♀, transitional to *rossi*.
 FIG. 29. " " " extremely light.
 FIG. 30. " " ab. *chione* Curtis, ♂.
 FIG. 31. *Colias nastes gueneei*, ♂, under side extremely light, approaching *moina* Strecker.
 FIG. 32. " " " " under side extremely dark.
 FIG. 33. *Colias nastes rossi*, ♀, under side.
 FIG. 34. *Colias boothi*, ♂, under side.
 FIG. 35. *Colias hecla* Lef., ♂, under side.
 FIG. 36. *Colias nastes* Boisd., ♂, Port Harrison, Labrador.
 FIG. 37. *Colias werdandi* Zett., *immaculata* Lampa, ♂; Arctic Europe.
 FIG. 38. " " " ♂, Nyland Hangö, Finland.
 FIG. 39. " " " ♂, Nyland Hangö, Finland.
 FIG. 40. *Colias melinos* Ev., ♀; Sajon, Siberia.
 FIG. 41. *Colias werdandi christiensi* Lampa, ♂; Nyland, Finland.
 FIG. 42. " " " " ♀; Nyland, Finland.
 FIG. 43. *Colias cocandica* Ersch., ♂, form *hybrida* Gr.-Gr.; Karakoram Mountains, Schahidulla, India.
 FIG. 44. " " " ♂; Aksu, Chinese Turkestan.
 FIG. 45. " " " ♀; Trans-Alai Mountains, Pamir.
 FIG. 46. *Colias cocandica mongola* Alph., ♂; Schawyr Tannuola, Mongolia.
 FIG. 47. *Colias cocandica*, ♂, under side; Trans-Alai Mountains, Pamir.
 FIG. 48. *Colias elwesi* Röber, ♀; Tagalang Pass, Ladakh.
 FIG. 49. " " " ♂; Tagalang Pass, Ladakh.

NOTE: Figures 1-37 are from the Carnegie Museum Collection. Figures 38-49 are from the collection of A. Avinoff, deposited in the Carnegie Museum.



EXPLANATION OF PLATE XXVIII.

All specimens are from Southampton Island and in the collection of the Carnegie Museum.

- FIG. 1. *Brenthis frigga* (Thunberg), ♂.
 FIG. 2. " " " ♀.
 FIG. 3. " " " ♂, under side.
 FIG. 4. *Brenthis butleri* (Edwards), ♂.
 FIG. 5. " " " ♀.
 FIG. 6. " " " ♂, under side.
 FIG. 7. *Brenthis polaris* (Boisd.), ♂.
 FIG. 8. " " " ♀.
 FIG. 9. *Brenthis improba* (Butler), ♂.
 FIG. 10. " " " ♀.
 FIG. 11. " " " ♀, under side.
 FIG. 12. *Æneis arctica* Gibson, ♂.
 FIG. 13. " " " ♂.
 FIG. 14. " " " ♀.
 FIG. 15. " " " ♂, under side.
 FIG. 16. *Erebia rossi* (Curtis), ♂.
 FIG. 17. " " " ♀.
 FIG. 18. " " " ♀, under side.
 FIG. 19. *Chrysophanus feildeni* McLachlan, ♂.
 FIG. 20. " " " ♀.
 FIG. 21. " " " ♀, under side.
 FIG. 22. *Lycæna aquilo* (Boisd.), var. *suttoni* Holland, ♂.
 FIG. 23. " " " " " ♀.
 FIG. 24. " " " " " ♂, under side, type.
 FIG. 25. " " " " " ♀, under side.
 FIG. 26. *Anarta richardsoni* (Curtis), ♀.
 FIG. 27. " " " ♀.
 FIG. 28. *Agrotiphila quieta* (Hübner), ♂.
 FIG. 29. " " " ♀.
 FIG. 30. *Olethreutes inquietana* (Walker), ♂.
 FIG. 31. *Aspilates orciferaria labradoriata* (Möschler), ♂.
 FIG. 32. *Aphania frigidana* (Packard), ♂.
 FIG. 33. *Olethreutes mengelana* (Fernald), ♂.
 FIG. 34. *Polopeustis annulatella* (Zetterstedt), ♂.
 FIG. 35. *Crambus trichostomus* (Cristoph), ♂.
 FIG. 36. *Thiodia southamptonensis* Heinrich, sp. nov., ♂, paratype.
 FIG. 37. " " " " " ♂, paratype.
 FIG. 38. " " " " " ♂, type.
 FIG. 39. *Gypsonoma parryana* (Curtis), ♂.
 FIG. 40. *Platyptilia petrodactyla* (Walker), ♀.





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