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THE NOMENCLATURE OF THE *COLIAS CHRYSOTHEME* COMPLEX IN NORTH AMERICA (LEPIDOPTERA, PIERIDAE)

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Genetic and population studies on the *Colias chrysotheme* complex of North America indicate that the group is divisible into two natural subgroups or races. One race is visibly differentiated from the other most easily by the presence of orange pigment on the upper surface of the fore wing; the other completely lacks the pigment in this location. Correlated with this character are several physiological differences relating to growth and diet; these phenomena will be considered in detail in other publications (see abstract, Hovanitz, 1942).

Owing to considerable interbreeding these two major groups exchange sufficient gene materials in some populations to be identical in morphological characters. Therefore, it is doubtful that the two groups should be designated as taxonomic species, but instead will be designated "orange race" and "yellow race," respectively.

The name *chrysotheme* refers to a Palaearctic species of *Colias* which is apparently identical in morphological characters with the North American forms. It may be found later, with additional information, that their classification as a unit should be reconsidered. The name has been revived for use for the North American forms by

Clark (1941); it had been in use by many of the early nineteenth century entomologists and by Godman and Salvin (1889) for the orange race. The author of *keewaydin*, W. H. Edwards, stated that "*keewaydin* = *chrysotheme* except that *chrysotheme* has not the extreme variability of *keewaydin*." *C. keewaydin* is a seasonal variation of the orange race. With the information available at present, *chrysotheme* seems to be a reasonable name for the yellow and orange races of North America.

The yellow race can be subdivided into five entities corresponding to five geographic zones. These blend one into the other so that specimens from intermediate locations can be designated by the name applying to one or the other adjacent geographical zone. The variation in the butterflies within a zone is tremendous, due to seasonal climatic effects on the phenotype of the adult butterfly as well as to genetic variations within the populations. Some populations are now in the process of genetic alteration owing to recent and present exchange of genes with the orange race. It is doubtful that a new name should be applied to these new products of genetic segregation. Instead, it is better to recognize the change which is taking place and to withhold naming the new race until such time as the alteration is apparently completed.

Variations in the orange race are plentiful but do not seem to have geographical significance in a genetic basis. The large, heavily orange-pigmented material from the Mississippi Valley may be genetic on an adaptational basis; but as these forms occur wherever the humidity and temperature conditions are high enough, no con-

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venient end is achieved in applying a Latin name to them.

The use of the binomial or trinomial name in this group must remain a matter of convenience depending upon the use to which the name is put. The orange race might more practically be designated *Colias eurytheme* by the economic entomologist when studying the destructive nature of this form on alfalfa. Since none

of the five geographical segregations of the yellow race are of economic importance, a general name to cover them all is not then immediately necessary. The usual taxonomic method would be to take the oldest name *philodice* and to subordinate the others under it. The following system has been adopted as being most practicable for general use and for showing genetic relationships:

NORTH AMERICAN RACES OF *COLIAS CHRYSOTHEME* ESPER

YELLOW RACE

Colias chrysothème philodice (Latreille)

SYNONYMS.—*C. alba* Chermock, *alba* Strecker, *albida* Chermock, *albinic* Skinner, *anthyale* Hübner, *ehrmanni* Chermock, *europome* Stephens (not Esper), *hybrida* Strecker, *inversata* Nakahara, *luteivincta* Wolcott, *melanic* Skinner, *minor* Chermock, *miscidice* Scudder, *nig* Strecker, *nigridice* Scudder, *nigrina* Strecker, *nigrofasciata* Reiff, *notatus*¹ Megerle, *pallidice* Scudder, *plicaduta* Nakahara, *raritus* Gunder, *rothkei* Reiff, *serrata* Chermock, *suffusa* Cockerell, *virida* Strecker.

GEOGRAPHICAL DISTRIBUTION.—Georgia to Labrador west through the eastern portion of the Mississippi Valley and north to Hudson Bay.

TYPE LOCALITY.—Virginia.

REFERENCE.—Encyclopédie méthodique, etc., IX, p. 100. 1819.

Colias chrysothème hagenii (Edwards)

SYNONYMS.—*C. autumnalis* Cockerell, *eriphyle* (auct., not Edwards), *laurae* Chermock, *nigricosta* Chermock.

GEOGRAPHICAL DISTRIBUTION.—Texas, New Mexico, Utah and eastern California north to Montana, Idaho and Washington.

TYPE LOCALITY.—"Southern Colorado to Montana and Dakotah," restricted by Barnes and McDunnough to Pueblo, Colorado. No one type specimen.

REFERENCE.—Papilio, III, p. 163. 1883.

Colias chrysothème eriphyle (Edwards)

SYNONYM.—*C. kootenai* Cockerell.

GEOGRAPHICAL DISTRIBUTION.—Northern Washington and Idaho, Rocky Mountains of Alberta, southern and central British Columbia.

TYPE LOCALITY.—Lake Lahache, British Columbia.

REFERENCE.—Trans. Amer. Ent. Soc., V, p. 202. 1876.

Colias chrysothème vitabunda, new subspecies

SYNONYM.—*C. kootenai* (auct., not Cockerell).

GEOGRAPHICAL DISTRIBUTION.—Alaska, Yukon Territory, Northwest Territories, northern British Columbia.

TYPE LOCALITY.—"Mt. McKinley National Park, Alaska."

Colias chrysothème guatemalena (Röber)

SYNONYM.—*C. philodice* (Godman and Salvin, not Latreille).

GEOGRAPHICAL DISTRIBUTION.—High elevations in Guatemala.

TYPE LOCALITY.—No types designated, locality clearly Guatemala.

REFERENCE.—In Seitz, Grossschmetterlinge der Erde, V, p. 91. 1907.

ORANGE RACE

Colias chrysothème eurytheme (Boisduval)

SYNONYMS.—*C. alba* Strecker, *amphidusa* Boisduval, *ariadne* Edwards, *californiana* Ménétries, *flava* Strecker, *fumosa* Strecker, *intermedia*

¹ *C. notatus* (Megerle), 1803, has been suggested by Clark and Clark (1941) as an older name of *philodice* with type locality in Georgia. However, it does not seem to have been validly published.

Cockerell, *keewaydin* Edwards, *pallida* Cockerell, *rudkini* Gunder, *unicitrina* Gunder.

GEOGRAPHICAL DISTRIBUTION.—Southern Mexico to southern British Columbia and Hudson Bay from the Atlantic to the Pacific oceans.

TYPE LOCALITY.—California.

REFERENCE.—Ann. Soc. Ent. France, II, p. 286. 1852.

Names applying to individual aberrants:

to white forms, to melanic forms, to seasonal forms, and so forth, have been placed in the synonymy under the sub-specific name applying to the geographical region from which the material came. This does not preclude their use by persons who find it convenient to use such names, provided the latter are available under the rules of nomenclature. The author finds no convenience in their use but rather a great inconvenience. Variations of the orange race are placed under that race; likewise, intermediates between the orange and yellow races are placed there.

The differences between the above races or subspecies with respect to combinations of genetic characters possessed by each will be covered thoroughly in another publication. The present revision of the nomenclature is essential before the population work can be adequately described.

***Colias chrysotheme vitabunda*,
new subspecies**

This is the northern representative of the yellow race of *chrysotheme* in North America. As such, it is characterized by its slightly smaller size, by its relatively narrow melanic border, by its rounded wings, by a heavy deposition of red pigment on the extremities, by a relatively light-colored hind wing cell spot, by a melanic suffusion on the under surface of the hind wing, by a reduction in size or complete disappearance of the submarginal row of spots on the under side of the hind wing, by a very high frequency of white females in the populations (95 per cent in Alaska, 71 per cent in Yukon Territory, Northwest Territories and northwestern British Columbia, 77 specimens employed), by a nearly complete obsolescence of the inner portion of the melanic border on the upper surface of the female and the entire border on the hind wings and by a high frequency of white females with a white rather than orange or yellow hind wing cell spot. The males have a rather heavy deposition of orange pigment on the under side of the hind wings and apices of the fore wings. There is a higher degree of intermediacy between the yellow and white females in this race than in other races.

The holotype female selected is white, as this genetic mutant is more abundant than the yellow. The variation in color of the hind wing cell spot (upper side) in the white females is from bright orange to pale yellowish white. The holotype is of nearly the whitest type. By analogy with the genetic results in the orange race, this possibly means that the individual was homozygous for the dominant gene controlling the white character. The pterine pigmen-

tion of the under side of the hind wings and apex of the fore wings is very light orange yellow. It will be shown later that these two characters are genetically correlated.

The allotype male differs from *eriphyle* mainly in its smaller size and the more complete reduction of the submarginal row of spots on the under side of the wings. From *hagenii*, in addition to the above, it differs in a heavier orange suffusion on the under side of the wings, in its rounder wings and narrower marginal band.

HOLOTYPE FEMALE AND ALLOTYPE MALE.—McKinley National Park, Alaska, July 18 to August 9, 1930, Frank Morand collector, J. D. Gunder Collection, in The American Museum of Natural History.

PARATYPES.—Twelve males same data as above; eleven males same locality but July 29, 1931, and "collector unknown"; four males July 15–20, 1931, "collector unknown," in Los Angeles Museum. Ten white females same data as holotype; four white females July 20–30, 1931, "collector unknown," in Los Angeles Museum; one white female August 9, 1930, "collector unknown," in Los Angeles Museum.

That portion of the following material which has been examined is indistinguishable from the above type material, but in order to avoid confusion in type locality it has not been designated as part of the paratype series.

ALASKA.—"Alaska," five males; Mt. Dewey, 5000 feet, three males; Eagle, Rampart, Kuskokwim River, Circle, Ft. Yukon, sixty-one males, one yellow female, ten white females; Circle, five males; Eagle, fourteen males, six white females; Chitine, one white female; Ft. Yukon, one white female; Skagway, ten males, five white females; Alfred Creek Camp, one white female; Mt. McKinley National Park, ten white, three intermediate and two yellow females.

YUKON TERRITORY.—Whitehorse, fifty-two males, three white females, three yellow females; Dawson, thirty-three males, three white females, one yellow female; Campbell Creek, Pelly River, one male; Pelly River near Hoole River, one male; Klotassin River, one male, one yellow female.

NORTHWEST TERRITORIES.—Great Slave Lake, three white females.

BRITISH COLUMBIA.—"Northwest B.

C.," two males; Atlin, one yellow female, one white female; Monarch Mountain, one specimen; Pike River, Atlin, five white females.

The name *kootenai* was applied, without much description, to *Colias* occurring in the vicinity of Kaslo, British Columbia, early and late in the season as compared with *eriphyle*, which is found in the summer. Barnes and McDunnough (1914) have been quite logical, therefore, in restricting this name for the spring or autumn form of *eriphyle* in southern British Columbia, even though there are no type specimens. The type locality of *eriphyle* (Lake Lahache) is close enough to Kaslo so that the populations at the two places may be considered as of the same subspecies. *C. kootenai* Cockle, therefore, must fall as a synonym of *eriphyle* if environmental modifications of the phenotype are not to have Latin

designations. Some authors (Barnes and McDunnough, 1914; Gibson, 1920; Clark, 1941) have used *kootenai* in the sense of a subspecies for the far northwest populations. Though it is true that the spring form from southern British Columbia is quite similar to the far northern material of the summer and only generation, they are not identical and the name should not be used for this purpose.

A form designated as *Colias eurhytheme alberta* was described by Bowman (1942) from Alberta, Canada. An examination of a paratype in the Los Angeles Museum indicates that the specimen is of a race of the *christina-astraea*-etc. complex with more orange pigment than others of that group but not a race of *chrysotheme*. Therefore, the name was omitted from the synonymy above.

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