

FLUORESCENCE IN THE COLORS OF CERTAIN LEPIDOPTERA OBSERVED UNDER ULTRAVIOLET LIGHT

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

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

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

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

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

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

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

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

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

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

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

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

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

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

The following species of tropical and exotic Papilionidæ are extraordin-

ary in their brilliance of fluorescence; when viewed under ultraviolet, they actually glow like the light of a fire-fly:

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

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

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

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

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

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

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

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

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