INDUSTRIAL MELANISM: A POSSIBILITY IN BRITISH COLUMBIA

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ABSTRACT

Melanics of the Geometrid **Biston cognataria** Guenée have been recorded from the comparatively polluted Vancouver area of British Columbia. At present the genetic basis and evolutionary significance of this is unknown.

Industrial melanism has been studied extensively in the British Isles and Europe (Ford, 1945; Kettlewell, 1955a, 1955b, 1955c, 1956a, 1956b, 1958a, 1958b, 1961, 1965a; Clarke & Sheppard, 1963, 1966; Bishop & Harper, 1970; Cook *et al.*, 1970; Askew *et al.*, 1971) where the Geometrid *Biston betularia* (L.) occurs predominantly as the black form *(carbonaria)* in polluted industrialized areas, but is much less common in or absent from non-polluted agricultural or rural areas. Experiments by Kettlewell (1955b, 1956b) and Clarke & Sheppard (1966) have shown that there is differential survival of the morphs in different areas, bird predators preferentially selecting the form that does not match the background. Thus, in industrial areas where the lichen on tree trunks has been killed, the tree trunks are rather uniform black and hence melanic forms resting on such trunks in the daytime are not readily seen by predators, whereas normal pale forms are easily detected and preyed upon. In non-polluted aras, the tree trunks are covered with lichen and the normal forms are cryptically coloured and hence overlooked, whereas melanic forms are obvious to bird predators.

Kettlewell *(loc. cit.)* has demonstrated that the frequency of the melanic form can be correlated with the occurrence and intensity of industrial pollution. Further, recent work in England has also shown that in the Manchester and Liverpool areas, there has been an increase in the frequency of the typical pale form of *B. betularia* during the last decade, and this seems to correlate with the decrease in atmospheric pollution as a result of smoke control and the introduction of smokeless zones (Clarke & Sheppard, 1966; Cook *et al.*, 1970; Askew *et al.*, 1971).

In North America industrial melanism is also reported in *Biston cognataria* Guenée (Kettlewell, 1958b, 1961; Owen, 1961, 1962), and since this will interbreed with *B. betularia* (Kettlewell, 1965b), the two taxa may be conspecific. Owen (1961) notes that the melanic form of *B. cognataria* is common in the eastern part of North America, being reported in southeastern Pennsylvania as early as 1906 and the Pittsburg area in 1910; the earliest records for the Chicago area were in 1935 and for the Long Island region in 1954. In Washtenaw County, Michigan, Owen (1961) records the melanic of *B. cognataria* as having constituted 96.7 per cent of the population in 1959.

B. cognataria as a larva feeds on the leaves of many broad-leaved trees, and occurs from Nova Scotia and the Mattaganii River in the north, to New Jersey and Pennsylvania in the south, and reaches from California and Oregon to British Columbia in the west. It also occurs in the eastern Palaearctic from northern India to Japan. Owen (1961) reports that the melanic form is not known to occur in China and Japan, and no records of the melanic form are available from the western U.S.A. Dr. W C. McGuffin informs me *(in litt.)* that in Canada the melanic form is known only from southern Ontario and the eastern township of Ste. Clothilde in Quebec.

Recently, I have come across two melanic specimens of *B. cognataria* in the collections of the University of British Columbia. Both specimens were taken on August 8, 1957 in Vancouver by the late Prof. G. J. Spencer; normal pale specimens were also taken at the same time. Within the last few years, additional melanic specimens have been taken in the lower mainland of the province by Mr. John Gordon. Unfortunately, light traps have not been run in a continuous manner in the region. It is thus not known if the melanic form occurs in appreciable numbers at the present time. Nevertheless, it is of interest to report that I have not taken the melanic form of this moth in light traps run at various times at Westwick Lake, near Williams Lake in the interior Cariboo region of British Columbia. Williams Lake is 200 airmiles north of Vancouver. In these traps, run during the summer in the years 1964 to 1970, no melanics were

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captured, but the normal pale form was taken commonly. At Westwick Lake there is virtually no industrial pollution.

Our future research will determine the present proportions of the melanic form of *B. cognataria* in populations in the Greater Vancouver area and lower mainland. It is certain that industrial pollution in the region is relatively high, especially in the New Westminster area. Thus, one may suspect that pollution in the Vancouver area in 1957 and since, has been high enough to lead to natural selection favouring the melanic form of this moth, in much the way that it has in Europe and eastern North America. However, it should be stressed that melanism may arise from time to time for very different reasons, aerial crypsis and heat absorption being two such possibilities.

Klots (1964, 1966, 1968a, 1968b) has reported melanism in a number of moths in Connecticut and considers that here the melanism is not related to industrial pollution, but perhaps to darker environments brought about by reforestation. In *Phigalia titea* (Cramer), Sargent (1971) suggests that the melanics that occur in rural areas may have a physiological superiority over the normal pale form, effects of industrialization other than environmental darkening perhaps being involved. Further, the melanics reported in Shetland by Kettlewell & Berry (1961, 1969) seem also not related to industrial pollution. Nevertheless, in *B. betularia* and *B. cognataria* observations to date suggest strongly that melanism in these taxa is usually associated with industrial pollution in some form or another.

Kettlewell (1961) has noted that while industrial melanism and relict or geographic melanism is usually inherited as Mendelian dominants, semilethal melanics can also occur as rarities, possibly at about mutation-rate in certain species, and in these the method of inheritance is recessive. Thus, it is important to determine the frequency of melanics in *B. cognataria* in the Vancouver area, and imperative to breed these forms so as to determine the genetic basis of the black coloration.

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METRIC CONVERSION

Contributors of papers on laboratory studies should use the metric system exclusively. Use of the metric system in reporting the results of field studies is a desirable ultimate objective. Since it is difficult to replace immediately such standard concepts as lb/acre by the unit kg/hectare, yards by meters, or miles by kilometers, the following table of conversion factors is presented.

1 in.=2.54 cm	1 ft^3=28.3 dm^3	1 cm=0.394 in
1 yard=0.914 m	1 acre=0.405 hectares	1 m=3.28 ft=1.094 yards
1 mile=1.61 km	1 lb/acre=1.12 kg/hectare	1 km=0.621 mile
1 lb.=453.6 g	1 lb/in^2(psi)=70.3 g/cm^2	1 kg=2.2 lb
1 gal (U.S.)=3.785 liters	1 lb/gal (U.S.)=120 g/liter	1 liter=0.264 gal (U.S.)
1 gal (Imp)=4.546 liters	1 lb/gal (Imp)=100 g/liter	1 liter=0.220 (Imp)

1 dm^3=0.0353 ft^3
1 hectare=2.47 acres
1 kg/hectare=0.89 lb/acre
1 g/m^2=0.0142 psi
1 g/liter=0.83 lb/100 gal (U.S.)
=1000 ppm
1 g/liter=1 lb/100 gal (Imp)