



Industrial Melanism in Moths

A visual case study of natural selection and anthropogenic evolution.



The 1850s Baseline: Pre-Industrial Dominance

- In collections made in England during the 1850s (before widespread industrialization), white-winged moths vastly outnumbered dark-winged (melanised) moths.
- The environment provided a natural camouflage advantage to the lighter variant.



Lichens as Indicators: Lichens act as natural industrial pollution indicators. They thrive in clean air but will not grow in areas polluted by industrial smoke.

The 1920s Disruption: Post-Industrial Shift

- By 1920, the industrial revolution had blanketed the region in soot and smoke, killing off the natural lichen.
- Moth collections revealed a complete population reversal: dark-winged (melanised) moths now outnumbered the white-winged moths.

The Geographic Control: This reversed proportion was observed in collections from the exact same geographic area, isolating the environmental shift as the primary variable.





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The Camouflage Matrix

Survival relies entirely on the ability to hide in the background. As the background inverted, so did the survival rates of the pre-existing genetic variants.

Unpolluted Area (Lichen-Covered)

Polluted Area (Soot-Covered)

White-
Winged
Moth



Dark-Winged
Moth



The Mechanism: Predator Selection

The environmental shift did not magically transform the moths. Rather, predators (birds) easily spot and consume moths that contrast against their background. The background dictates which variant survives to reproduce.

Unpolluted Environment



Polluted Environment



Biological Nuance

No variant is completely wiped out. In rural areas where industrialization did not occur, the count of melanic moths remained low, and white moths continued to thrive. It is the proportion of the population that shifts.

Anthropogenic Action: Accelerating Evolution



Industrial Smoke →
Selects for Melanic Moths
(Timescale: Decades).



Excess Herbicides & Pesticides → Selects for
Resistant Weeds &
Insects (Timescale: Years).



Antibiotics & Drugs →
Selects for Resistant
Microbes/Cells
(Timescale: Months).

Common Misconception: Evolution is a directed process (determinism). Nature purposely mutates to solve problems.

Reality: Evolution is a stochastic process based on chance events in nature and chance mutations in organisms.

Key Takeaway

Natural selection is a stochastic (chance-based) process. Human activities dramatically alter environments, inadvertently acting as rapid selection pressures. These pressures do not “create” new traits on demand; rather, they reveal and select for pre-existing genetic variations within a mixed population.



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