

Science as process or dogma? The case of the peppered moth

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Summary

The example of the Peppered Moth (*Biston betularia*) is widely viewed and presented as a clear proof of evolution through natural selection. A study of the primary literature reveals a much more complex picture of the phenomena and of the process of scientific investigation. This example can teach us to be critical of «scientific proofs» and help us to view science as a process of interaction between the observer and the observed. This has significant implications for science education.

Zusammenfassung

Industrie-Melanismus und Birkenspanner (*Biston betularia*) gelten im allgemeinen als unumstößlicher Beweis dafür, daß natürliche Selektion die Evolution der Organismen steuert. Eine kritische Untersuchung der Primärliteratur zum Thema zeigt jedoch ein viel komplexeres Bild von den Phänomenen und Prozessen wissenschaftlicher Untersuchung.

Das Beispiel des Birkenspanners lehrt, sogenannten wissenschaftlichen Beweisen gegenüber kritisch zu bleiben, und es hilft, Wissenschaft als Interaktion zwischen einem Beobachter und seinem Untersuchungsgegenstand zu verstehen. Diese Einsicht hat bedeutende Folgen für den wissenschaftlichen Unterricht an Schulen und Universitäten.

The Story of the Peppered Moth

The peppered moth is used in high school and college biology courses, as well as in many textbooks, to illustrate evolution via natural selection. The story goes like this:

«The «peppered moth», *Biston betularia*, occurs in light and dark (melanic) forms, both of which are shown in Figure 1. The normal («original») form is a light, peppered color. A specimen of the dark type was first captured in 1848, near Manchester, England, just 11 years before the publication of the *Origin of Species*. In the years thereafter, in various parts of England, the relative frequency of the dark form was observed to increase until today, in some regions, only dark forms are found. Why the change?

The answer is almost self-evident from the photographs shown in Figures 1 and 2. In Figure A we see a tree trunk of the sort found in rural England far from



Figure 1
Light and dark forms of the peppered moth were photographed against the lichen-covered trunk of a tree in an unpolluted area of England. The light form is hard to see, the dark form is very conspicuous (from Kettlewell, 1959)

industrial centers: lichens covering the oak tree give it a variegated surface against which the lightly peppered moth is hard to see; the black form stands out prominently. By contrast, on trees growing in industrial areas (see Fig. 2), the lichens are killed and the trunk is blackened by soot; on such a tree it is the black moth that is protectively colored, the light moth standing out «like a sore thumb». Birds that prey on the moths have been observed and photographed catching moths, and it has been proved that they bring about differential mortality favoring the survival of the light forms in unpolluted woods and the dark forms in industrially blackened woods (*Hardin*, 1966, p. 183).»

This text was published in 1966. Newer accounts give a similar version of this classic story. Sometimes textbooks update the story: Since the 1960s clean air acts in Great Britain and the United States have led to markedly improved air quality around industrial centers and the numbers of dark moths have fallen significantly in the forests near such centers in Great Britain, while the light moth is again becoming