

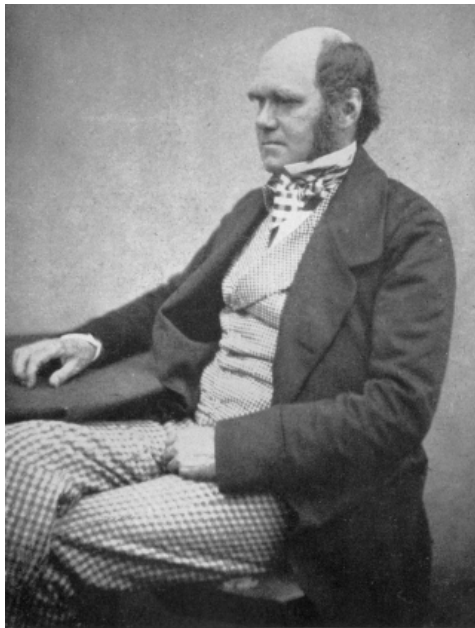
# Lecture 17

## Darwin on Artificial and Natural Selection

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Scientific Thought II  
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# Charles Darwin



**1809:** Born in Shropshire, England.

**1831–1836:** Sailed around the world on H.M.S. *Beagle*.

**1859:** *Origin of Species*, 1st ed.

~**1859:** This photograph taken.

**1882:** Died in Kent, England.

# Introduction

## The view generally accepted in 1859

- Each species was created separately, somehow.
- Species can be modified by the environment, but these modifications are limited and cannot produce new species.

## Darwin's theory

- The millions of species that exist weren't created separately but have resulted from modifications to one or a few primitive species.
- *Origin of Species* gives many arguments for this view. We'll look at a couple of them today and more in future classes.

# Analogy with artificial selection

## Artificial selection

Many species have been modified by breeders, e.g., cattle, sheep, dogs, flowers, vegetables. How it is done:

- The offspring of each generation vary. The differences may be so small that only trained breeder can detect them.
- Those that are more like what the breeder wants are selected for further breeding; the rest aren't allowed to breed.
- This is repeated.
- Eventually the small differences add up to a large change in the breed.

Darwin calls this process *artificial selection*.

## Natural selection

A similar process operates in nature.

- Individual organisms vary.
- Organisms reproduce at a geometric rate, so not all can survive. Hence those that aren't as well adapted as others will tend to die without reproducing.
- The result is selection like breeders use, but done by nature.
- It selects factors that favor survival and reproduction rather than traits desired by man.

Darwin calls this process *natural selection*.

## Darwin's argument

### *First part:*

- ① Artificial selection has produced large changes in species.
- ② There is a comparable process of natural selection.
- ③ So we should expect species in nature to be changed by natural selection.

### *Second part:*

- ④ Artificial selection does not seem to be limited in what it can do.
- ⑤ Natural selection can work more effectively and over much longer periods of time than artificial selection.
- ⑥ So it is probable that the modifications would eventually be so great that we would call the result a new species.

## Quotation (412)

*If man can by patience select variations useful to him, why, under changing and complex conditions of life, should not variations useful to nature's living products often arise, and be preserved or selected? What limit can be put to this power, acting during long ages and rigidly scrutinising the whole constitution, structure, and habits of each creature,—favouring the good and rejecting the bad? I can see no limit to this power, in slowly and beautifully adapting each form to the most complex relations of life. The theory of natural selection, even if we look no farther than this, seems to be in the highest degree probable.*

## The distinction is unclear (41)

*Certainly no clear line of demarcation has as yet been drawn between species and sub-species—that is, the forms which in the opinion of some naturalists come very near to, but do not quite arrive at the rank of species; or, again, between sub-species and well-marked varieties, or between lesser varieties and individual differences. These differences blend into each other in an insensible series.*



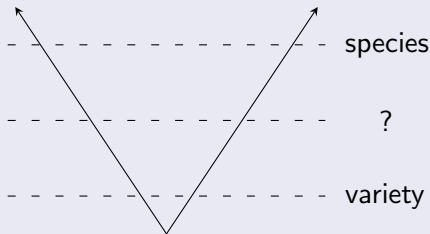
## Naturalists don't agree where to draw the line (37)

- *Compare the several floras of Great Britain, of France or of the United States, drawn up by different botanists, and see what a surprising number of forms have been ranked by one botanist as good species, and by another as mere varieties.*
- *How many of the birds and insects in North America and Europe, which differ very slightly from each other, have been ranked by one eminent naturalist as undoubted species, and by another as varieties, or, as they are often called, geographical races!*

Let  $U$  = the distinction between species and varieties is unclear,  
 $N$  = Darwin's theory that species arose by natural selection.

$U$  is expected given  $N$

- Individual differences accumulate to produce varieties.
- These varieties gradually diverge. At some point they become so different we call them different species.
- But they must pass through an intermediate stage where it isn't clear whether to count them as different species or not.



Let  $C$  = the theory of independent creation of each species.

### $U$ not expected given $C$

- There is a fundamental difference between species and varieties; only the former have been independently created.
- So there is no reason to expect that the distinction would be unclear.
- A creationist can say the creator wanted it this way, for some reason unknown to us. But  $C$  gives no reason to expect this.

### Application of the law of likelihood

- Since  $U$  is expected given  $N$ , but not given  $C$ ,  
 $p(U|N) > p(U|C)$ .
- So by the law of likelihood,  $U$  favors  $N$  over  $C$ .

# Comparison of these arguments

The argument from analogy with artificial selection goes from cause to effect.

- The cause is natural selection.
- Darwin is arguing that this cause is likely to produce new species.

The argument from the unclear species/variety distinction goes from effect to cause.

- The effect is the observed lack of a sharp distinction.
- Darwin argues that the cause is likely to be natural selection.

The law of likelihood is only useful for going from effect to cause.

- 1 One of Darwin's arguments that species have been produced by natural selection is based on the experience of breeders. State the argument.
- 2 The distinction between species and varieties is unclear. Does this fact favor natural selection over independent creation as the origin of species? Justify your answer using the law of likelihood.



Charles Darwin.

*On the Origin of Species.*

London, 6th edition, 1872.

[At darwin-online](#)

Numbers in parentheses are page numbers of this edition.