Does Natural Selection Have Creative Power?

Arguments of Evolution- Natural Selection has Limited Power

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Darwin and Natural Selection

- Darwin did not invent the idea of evolution.
- Long before him, other thinkers and scientists have proposed theories about how organisms arose naturally and changed over time.
- But nobody had suggested a mechanism for the change in species.

- Darwin claimed that all organisms descended from a <u>common ancestor</u> though a process of gradual evolution.
- He described his book *The Origin of Species* as "one long argument" for this theory of descent with modification.
- Ultimately, all organisms would have descended from a Universal Common Ancestor.

- Darwin suggested that *natural selection* acting on *random variations* had the power to produce modifications in organisms.
- Cumulative modifications over long time originated new species.
- Thus Darwin saw natural selection as the mechanism (cause) with creative power to change the living organisms.
- Neo-Darwinists agree and indicate that *mutations* are what Darwin called "random variations".

The Mechanism of Natural Selection

- According to neo-Darwinism, natural selection works in three steps:
  - Variation.
  - Heritability.
  - Differential reproduction.

Variation

- Darwin noticed that all organisms vary; they change, even in their lifetimes.
- Each new generation, though resembling the parents, possesses many distinctive characteristics.
- Darwin also experimented with pigeons, and through *artificial selection* he was obtaining varieties with particular traits not present or just scarce in the rest of the population.
- Darwin thought that these small changes were the basis of more significant changes in body patterns and structures.

- Neo-Darwinists think that random changes in DNA (*mutations*) are the type of variation that produces changes in organisms.

Heritability

- In his own experiments with pigeons, Darwin saw that many variations could be passed on from one generation to the next.
- This is *heritability*.
- Darwin applied this observation to the natural world at large, and claimed that variations would occur spontaneously and be heritable.

Differential Reproduction

- Finally, Darwin observed that life was characterized by a *struggle for survival*.
- He saw that some variations gave a competitive advantage to the organisms possessing those traits.
- He also noticed that some organisms have more offspring than others.
- He thought that the two things were related: possessing some variations gave the organisms some reproductive advantage.
- Over the course of several generations, the advantageous traits would prevail and the population would shift and look different from the original one.
- As this process happens with many different traits and continuously, species keep on changing gradually, something called *evolution by modification.*

Natural Selection

- Darwin and his modern followers believe that the three processes of natural selection (random variation, heritability, differential reproduction) can produce signifiant biological change.
- Cumulative small-scale changes (micro-evolution) over long time may bring about large-scale changes (macro-evolution).
- The origin of complex structures as the eye, the ear, or the circulatory system may be explained by cumulative small-scale changes that pass on from one generation to the next.
- Darwin did not have evidence for that.
- He extrapolated the results from *selective breeding* in artificial selection experiments to the natural world and to the past.

Artificial Selection

- Suppose a shepherd has a flock of sheep.
- He notices that some have especially thick wool.
- He mates the wooliest rams with ewes of another flock.

- After the lambs are born, the shepherd separates out the wooliest from the flock.
- He repeats the steps many times.
- Over several generations the characteristics of this flock will change toward animals with very thick wool.
- This process is called *selective breeding*.
- Darwin thought that this process also happen in nature without the intervention of humans.
- And that's what he called *natural selection*.

- Darwin reasoned that small-scale changes (micro-evolution) like this happening again and again through multiple generations would eventually change the species into another completely different (macro-evolution).
- What breeders do in a very short time, nature can achieve over a long time.
- For Darwin the power of natural selection was unlimited.

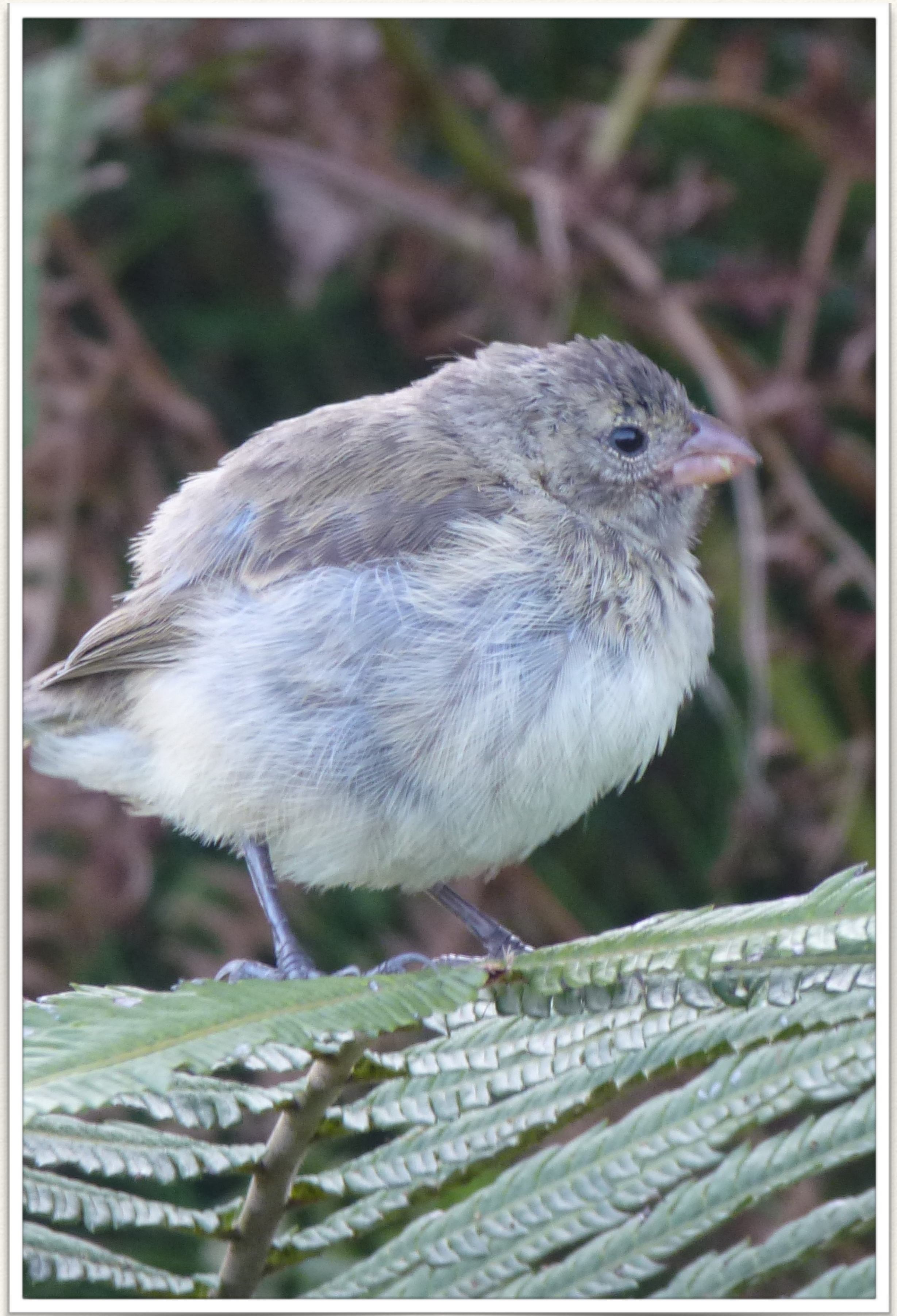
Natural Selection and Biology Textbooks

- Biologist textbooks cite two examples that seem to show that natural selection can produce microevolution in a short time.
  - The change in size of the Galápagos finch beaks.
  - The color of the peppered moths.

Galápagos Finches

- In 1977, biologists Peter and Rosemary Grant observed that one species of finches on the island Daphne Major was experiencing a change in the size of its beak.
- That year a severe drought affected the archipelago and 85% of the finches of that species died.
- The finches that survived were mainly those with large, thick beaks.

- Biologists postulated that the surviving finches were those capable of cracking open the hard-shelled seeds that had remained through the drought.
- These surviving finches had beaks that were 5% larger in average size than the normal pre-drought population.
- Biologists claimed that this was an example of small change in a short time (microevolution) of the type Darwin proposed as starting point for evolution.



- The Grants estimated that it could take about twenty severe droughts to increase the average beak size enough to produce a new species of finch.
- Microevolution happening in a small population could generate larger changes (macroevolution) over long periods of time, as suggested by Darwin and the neo-Darwinists.

Peppered Moths

- Evolutionary biologists point to a second example of natural selection producing microevolutionary change over a short period of time—the change in color in peppered moths.
- During the 1800s, the population of peppered moths in England shifted from consisting of light-colored moths to dark-colored moths.

White *Biston betularia*. https://upload.wikimedia.org/wikipedia/commons/1/11/Biston_betularia_male.jpg

Dark *Biston betularia*. https://upload.wikimedia.org/wikipedia/commons/1/11/Biston_betularia_male.jpg

- In pre-industrial England, light-colored moths were more numerous in trees covered with lichens.
- Their light color provided camouflage against the naturally light color of the lichens.
- The dark-colored moths were much less abundant because they were easily spotted by birds.
- But the Industrial Revolution changed the situation…

- Dust and ash from coal-burning factories darkened the tree trunks.
- Rapidly the population of light-colored moths decreased because now birds could spot them easily.
- Now the dark-colored moths were safe and their populations became more numerous.
- Neo-Darwinists claim that this is an example of natural selection in action: changes in the environment produce small changes in the characteristics of the moth population.
- They extrapolate that given sufficient time and numerous number of cumulative small changes (microevolution), new species and new forms (macroevolution) will be produced.
- For Darwin (1859), there was "no limit to the amount of change…which may have been affected in the long course of time through nature's power of selection."

- In the 1950s, H. B. D. Kettewell released both light and dark peppered moths onto tree trunks in both polluted and unpolluted areas.
- Kettwell observed that birds ate the more visible moths.
- Neo-Darwinists claimed that this was an example of natural selection in action: a combination of change in the environment and "selective predation" changed the composition of the moth population over a short period of time.
- It was an example of microevolution that could lead to macroevolutionary changes.

Galápagos Finches

- The average size of finch beaks increased after the drought in 1977 in the Galápagos Islands.
- Does this illustrate the creative power of natural selection over time?

- The first point is that nothing new was created.
    - No new information, organ, structure, or shape.
    - Beaks, both large and small, were present already before the drought, during the drought and after the drought.
    - What seems true is that the finches with the larger beaks within the population were more likely to survive the drought.
    - But that is not equivalent to saying that the population acquired larger beaks.
    - The only thing that changed was the *proportion* of big beaks to small beaks in that particular population.

- A second problem with using the case of the Galapagos finches to illustrate microevolution to macroevolution is that the beaks reverted to the pre-drought size after heavy rains in 1983.
- The alleged “evolutionary change” did not actually happen.
- Microevolutionary processes produce only minor changes within limits, and sometimes those changes do not become fixed or permanent in the population.
- Microevolutionary processes cannot produce new structures or organisms.
- In fact, after the rains returned, the Grants observed that several separate species of finches were interbreeding (Grant & Grant 2002)
- This means that not only were new species not emerging, but the existing ones were merging.

Peppered Moths

- Apparently the darker peppered moths became more abundant during the Industrial Revolution due to trees being covered with soot.
- However, some biologists question that entails large-scale change (macro-evolution), or even small-scale change (micro-evolution).

- Nothing new arose. No new structure, organ or body pattern.
- Both dark moths and light moths were present in the pre-industrial time, during the industrial period, and after the emissions from the factories were reduced.
- The proportion of light- and dark-colored moths in the population oscillated back and forth over time.
- No new species or even variety of moth emerged.
- It may be said that selective predation played a role in shifting the population temporarily towards the dark colored moths, but natural selection did not create anything fundamentally new.
- The peppered moths do not show that natural selection has creative power.

- But there are also fundamental problems with the methodology of this study.
- Scientists argue that the experiment itself is invalid for two reasons.
- First, peppered moths are night-fliers.
  - But to make observations possible, scientists released the moths during daylight time, when the moths normally sleep.
  - This does not tell us how the moths would behave in their normal conditions.

- Second, the moths were placed not in the normal place where they rest (high up in the tree canopy) but on the tree trunk.
- Thus the scientists released peppered moths that were sleepy and disoriented and placed them by hand on tree trunks, where they became unnaturally easy targets for predatory birds.
- These conditions are not natural or normal for the moths.
- The setting of the experiments determined the outcome and results, and thus the conclusions were flawed.

Natural Selection Has Limits

- Many scientists now acknowledge that natural selection has limits in what it can achieve.
- The reason is that it has been shown that it is unable to create (or design) any new structure.
- But the most important reason is that natural processes do not produce new information needed to form new forms of life.

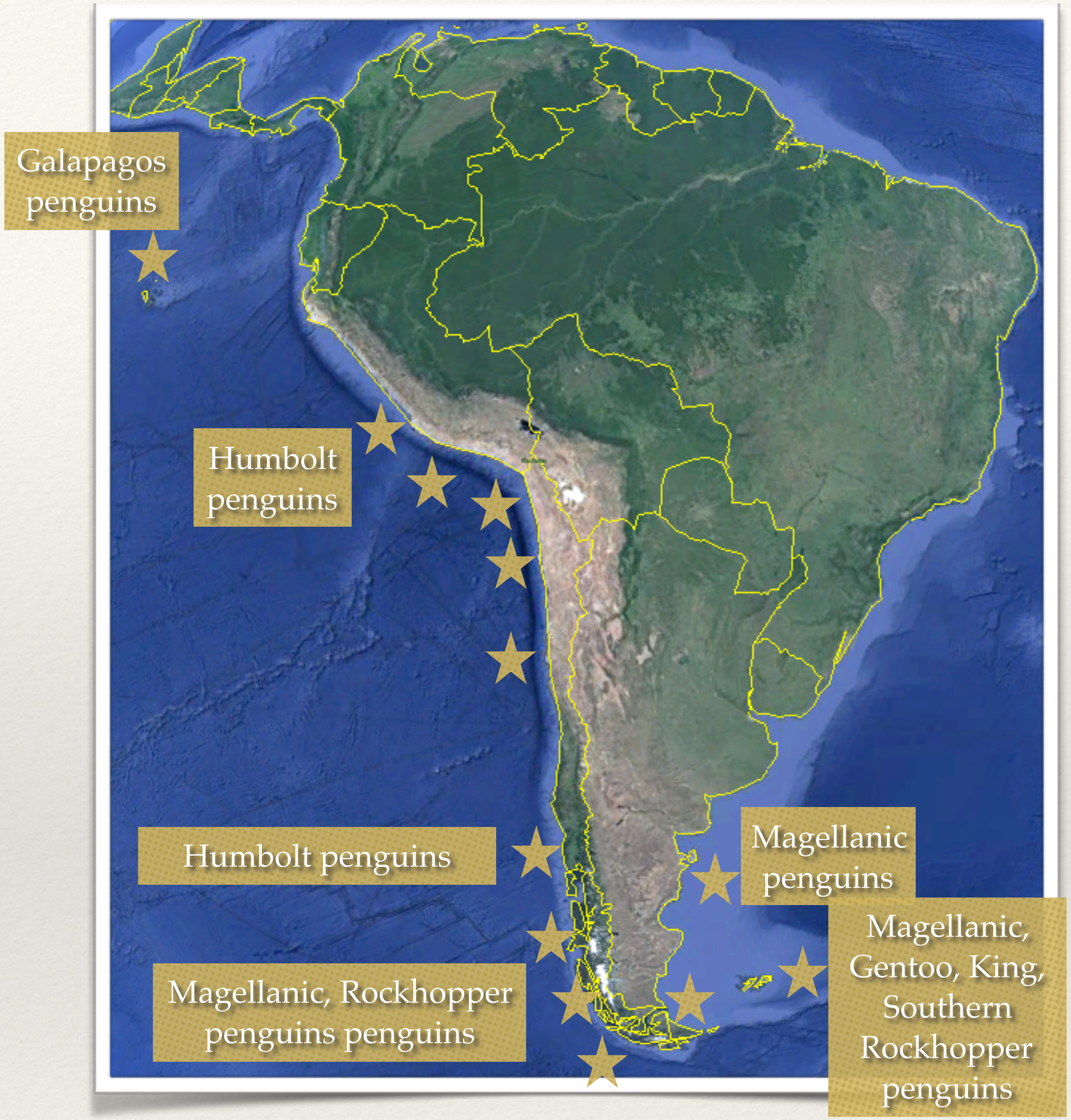
- New organs, structures or body plans need more than just more cells to function.
- They need more *kinds* of cells, and the information to make them function.
- These are specialized cells.
- Each new type of cell requires many new and specialized proteins to function.
- But to build new specialized proteins for those new features new cells with new genetic information are needed.
- New specialized cells need new specialized proteins which are formed with new genetic information.

Biological Information

- Biological information is stored in the molecule DNA.
- New information must also be stored in DNA.
- Where does new information come from?
- Critics of neo-Darwinism assert that artificial selection and microevolution do not add new information into the population.
- Also, mutations and natural selection only work on pre-existing genetic material, but do not generate new information leading to new organs, functions, or body plans.

- Selective breeding (artificial selection) avoids variability.
- Breeders restrict the size of the breeding population to a small size and with specific traits.
- By doing that they try to favor or enhance a particular trait they are interested in (like thick wool, larger fruits, etc.).
- This enhancement and selection has a cost: the restriction of the genetic variability results in loss of genetic information for certain traits in the population.
- Some of those traits might be needed for survival later.
- Thus the process of selective breeding limits the extend to which populations can vary, adapt and survive.
- This same problem occurs in microevolution in natural environments.

- Let's take an example of a population of penguins in South America, where they occur in many places.
- Let's say that two populations of 100 Humbolt penguins migrate to two islands and each become naturally isolated from a larger colony of 10,000 penguins.
- The two daughter populations will begin to drift, genetically speaking.



- One or several traits will begin to show up more frequently in the offspring of one or the two daughter populations.
- This will happen because the information for those traits is now carried by a larger percentage of the penguin population.
- But the opposite may also happen: some traits will appear less frequently or not at all.
- This is because the information for those those traits may be lost in one or both populations.

- Many scientists believe that this example illustrates the creative power of natural selection.
- But it doesn't.
- What is true in the first case?
  - Certain traits will be expressed more frequently in one of the populations.
  - As a result, the new daughter populations will look different from each other.
  - This is an example of limited microevolution.
- However, *these traits are not new*.
- The capacity to produce those traits was present all along, but it never manifested until the penguins migrated and became isolated from the parent colony.

- In the second case (loss of traits in the daughter populations) each daughter population loses genetic information needed for those traits.
- Overall genetic information decreases, which limits how much the population can vary and change.
- Ultimately, that makes the daughter populations more vulnerable to environmental stresses.
- For this reason, isolated populations are at greater risk of extinction.

- Thus both artificial and natural selection may lead to loss of biological (genetic) information, which is opposite to what evolutionary theory requires.
- Producing new organs or body plans requires more and new information, not less.
- That's why many scientists say that small-scale microevolution cannot be extrapolated to explain large-scale evolutionary innovation.
- It's seems illogical to claim that a process that may lead to loss of information can explain the origin of new types of plants or animals.
- In the words of Meyer et al (2007, p. 95) "natural selection works well as an editor, but not an author. It has a demonstrated capacity to weed out the failure from among what already exists, but it has not been shown to generate new biological information or structures."

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