History of Evolutionary Thought

Part IV: Those Darned Pigeons!

BIOL 4415: Evolution
Dr. Ben Waggoner

Putting everything together, Darwin got his grand idea. . .

". . . I determined to collect blindly every sort of fact, which could bear any way on what are species. . . . I am almost convinced (quite contrary to opinion I started with) that species are not (it is like confessing a murder) immutable."

—Letter to botanist J. D. Hooker, January 11, 1844

Natural Selection, I:

- Individuals *vary*, in any population of any species.
- Variation is *inherited*—individuals somehow transmit their variant traits to any offspring they have.
  - This is now understood in terms of modern genetics, but remember that this was not understood in Darwin's time.

Even without an understanding of genetics, it's obvious that individuals do vary, in populations of every species from people to poppies to *Polistes* paper wasps—and that variation is inherited, with offspring showing parental traits.

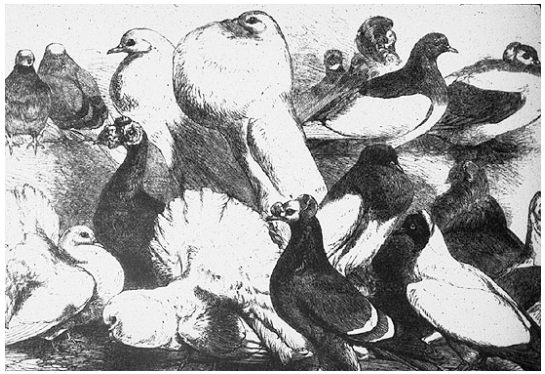
Natural Selection, II:

- Any species is theoretically capable of increasing its population exponentially and indefinitely.
- But we don't see this indefinite increase in nature. Populations tend to hold roughly constant, or at least to stay within certain limits.
- Conclusion: Not all offspring produced can survive.
- Conclusion: There is a metaphorical "*struggle for existence*" constantly going on in any species.

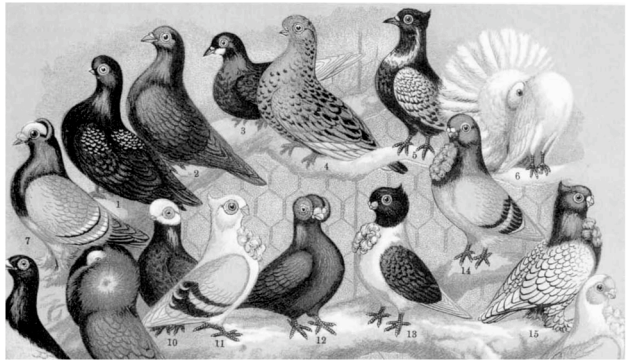
Natural Selection, III:

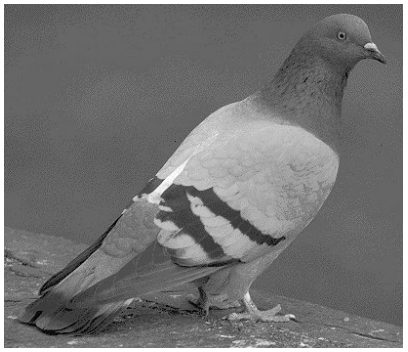
- Some individuals in any population will happen to vary in ways that increase their changes of survival and reproduction. Others vary in ways that decrease their chances.
- Conclusion: Over several generations, some traits in a population will become common, and others will become rare or disappear.
- Given enough time, separate populations may become so different from each other that they may be considered different species.

Darwin used *artificial selection*, practiced by animal breeders, as an analogue for natural selection. He ended up raising fancy pigeons. . .



"Believing that it is always best to study some special group, I have, after deliberation, taken up domestic pigeons. I have kept every breed which I could purchase or obtain. . . . The diversity of the breeds is something astonishing." -- *Origin of Species*, ch. 1

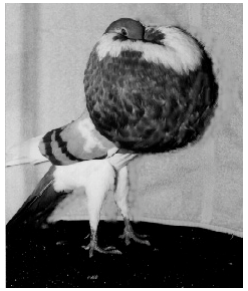




From the wild rock pigeon, breeders had produced a huge variety of very different pigeon breeds—by selecting individuals with traits they liked, encouraging them to breed, and repeating the process over many generations.

This still goes on today. . .

Bokhara Trumpeter



English Pouter

And on. . .

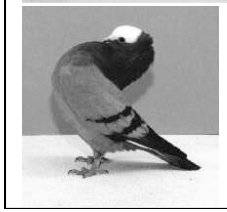
English Barb

Frillback

And on, and on, and on, and on. . . .

Fantail

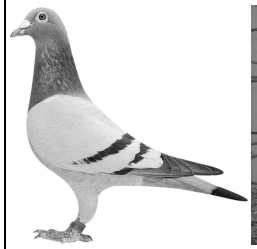
Nun



Mookee

Swallow

Not only physical features, but even behavior patterns and intelligence have been modified in domestic pigeons, through many generations of artificial selection.



Homing Pigeon
(can navigate home from as far as 1100 miles, avg. 50 mph)

English Short-Faced Tumbler
(turns flips in midair)

Parlor Roller
(turns somersaults on the ground)

If you want a non-animal example, look at *Capsicum annuum* (which Darwin himself didn't mention). Wild *C. annuum*, known as the chiltepín, is a bushy plant native to Mexico and the adjacent US. . .

Here are some of its descendants, produced over several thousand years of artificial selection: bell peppers, cayenne peppers, Feher Ozon peppers, Nosegay peppers. . .

Or consider tomatoes: from the wild currant tomato, breeders have developed. . . well, look at 'em!

Darwin didn't invent the idea of artificial selection—it had been practiced for thousands of years. Even so-called "primitive" peoples were well aware of how artificial selection worked.

In the spring, when I came to plant beans, I was very careful to select seed for the following points: seed should be fully ripe; seed should be of good color; seed should be plump, and of good size. . . Did I learn from white men thus to select seed? [*Laughing heartily*] No, this custom comes down to us from very old times.

Maxi'diwiac (Buffalo Bird Woman)
of the Hidatsa tribe, interviewed in 1912

So what?

- But Darwin argued that natural processes did exactly what breeders did: exert control over which varieties of animal or plant reproduced. Given millions of years, natural selection could create the enormous diversity of life from a few simple predecessors.
- The usual objection at this stage is to say, "Wait a minute! Selection can generate new breeds of pigeon, but it can't create anything really new — it can't create new *kinds* of living things!"
- But what, exactly, is a "kind"?

Consider these similar species. . .

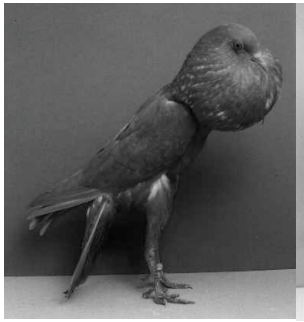
Rock pigeon
Columbia livia
Europe and western Asia;
introduced to Americas

Pink-necked fruit dove
Ptilinopus porphyreus
Indonesia

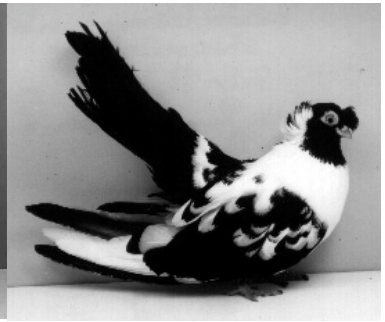
These two birds are classified as different species. . .

. . . but which are more different from each other : these two wild species. . .

. . . or these two breeds of fancy pigeon, produced by artificial selection?



Yellow Brunner Pouter

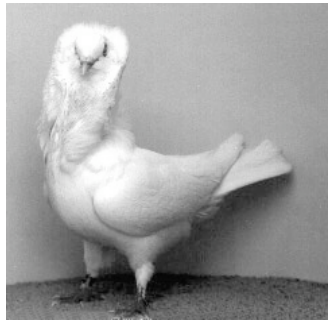


Akermann Tumbler

Try it again: compare these two wild species, *Columba livia* the rock pigeon (left) and *Gallicolumba luzonica*, the endangered bleeding-heart pigeon from the Philippine Islands (right). . .

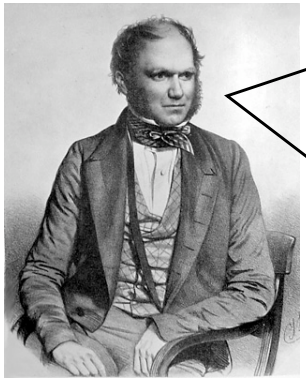
. . . with *these* two fancy pigeons! All fancy pigeons are descended from the common rock pigeon—but it sure can be hard to tell just by looking. . .

Black Fantail



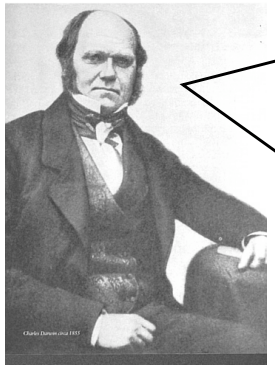
Old Dutch Capuchine

And that's Darwin's point: there's *no* real difference between "natural" species and "artificial" varieties.



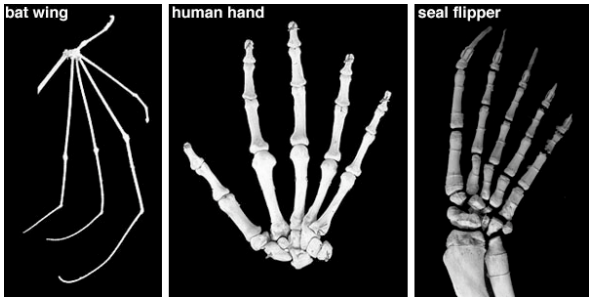
Altogether at least a score of pigeons might be chosen, which if shown to an ornithologist, and he were told that they were wild birds, would certainly, I think, be ranked by him as well-defined species. Moreover, I do not believe that any ornithologist would place the English carrier, the short-faced tumbler, the runt, the barb, pouter, and fantail in the same genus. . .
—*Origin of Species*, Chapter 1.

Evolution by natural selection seemed to explain a lot of *other* biological facts as well!

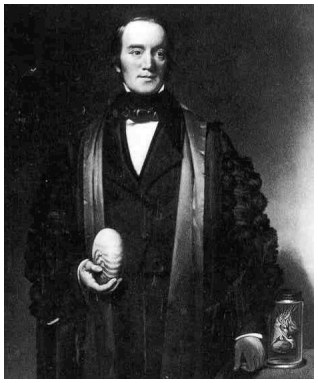


In considering the Origin of Species, it is quite conceivable that a naturalist, reflecting on the mutual affinities of organic beings, on their embryological relations, their geographical distribution, geological succession, and other such facts, might come to the conclusion that each species had not been independently created, but had descended, like varieties, from other species.
—*Origin of Species*, Introduction

Comparative Anatomy

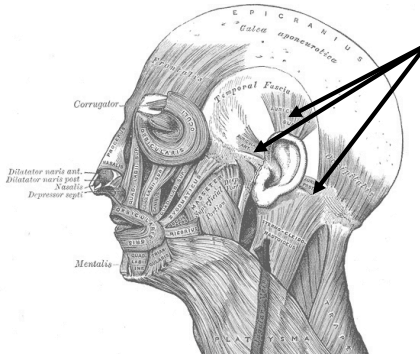


Why should structures as different in function as a bat's wing, a human hand, and a seal flipper be built using identical arrangements of bones?



The anatomist Richard Owen (1804-1892) had already written that all vertebrates were variations on one "archetype" or common plan, because they all shared the same basic structural plan (although it might be highly modified for different functions). Owen coined the word *homology* to mean this kind of deep similarity of structure. But how to explain it?

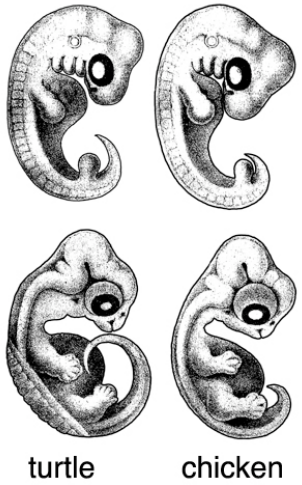
Vestigial Structures



Example: Mammals have muscles that move their external ears. You do, too, but most people never learn to use them, and ear-wiggling doesn't make any difference to your survival. . . so what are the muscles doing there?

Biogeography

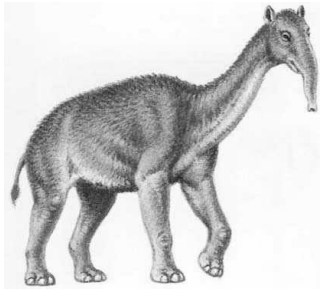
Why should young islands such as the Galápagos have so many species unique to themselves—but at the same time similar to those of the mainland?



Embryology

Scientists like Karl von Baer and Louis Agassiz had already pointed out similarities between the embryos of species that looked very different as adults. In some cases, embryos of "more advanced" species had features that looked like those of adults of "less advanced" species. Why should these similarities exist in the first place?

Paleontology



Darwin had already noted that some fossils, such as this South American beast *Macrauchenia*, seemed to blend characters of what would be considered very separate groups today. And fossils sometimes bore an odd resemblance to the living forms in the same place. . . how to explain all that?

Darwin didn't go public right away. . .

- Dominant philosophy of science at the time placed most value on gathering facts, not on hypothesizing
- Conservative political and religious climate meant that Darwin was risking a lot. . .

Fact-gathering. . .

Darwin spent over twenty years gathering facts that might have some bearing on how species originated. He wrote two manuscripts laying out his theory of "descent with modification" (in 1842 and in 1844), but they were not published in his lifetime.