Microevolution

Atul Bhargava

Department of Botany
Mahatma Gandhi Central University
Motihari-845401, Bihar
INDIA

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- **Microevolution:** first used by botanist Robert Greenleaf Leavitt in the journal *Botanical Gazette* in 1909.
- Russian Entomologist Yuri Filipchenko used the terms "macroevolution" and "microevolution" in 1927 in *Variabilität und Variation*.
- Theodosius Dobzhansky: used the term in his book ***Genetics and the Origin of Species***.
- Microevolution: takes place in a small time scale- from one generation to the next.
- When the minute changes build up over the course of hundreds of years, they translate into evolution on a grand scale- macroevolution.

The processes of evolution

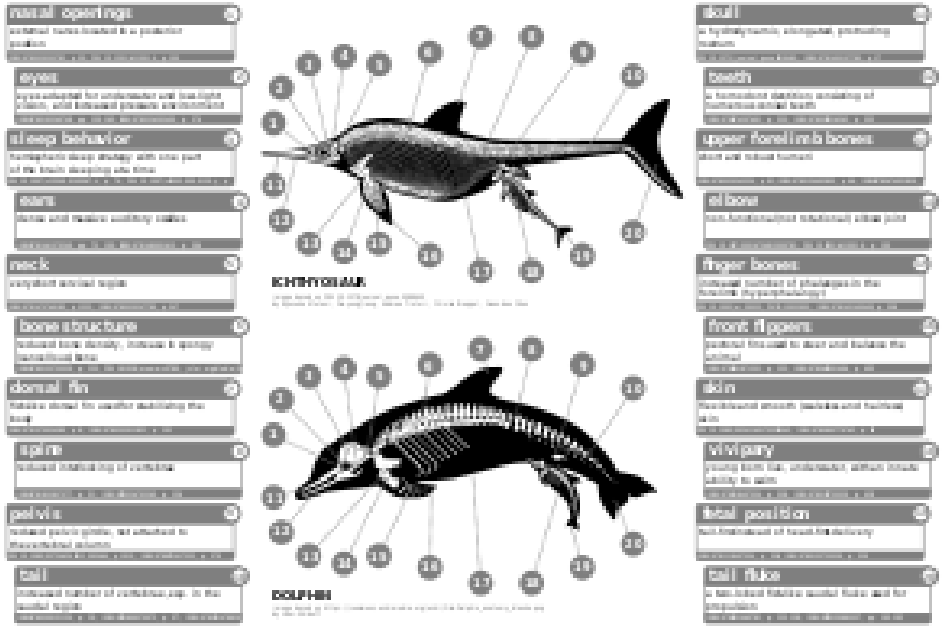
- Evolution: process by which modern organisms have descended from ancient ancestors.
- Evolution: responsible for both similarities and diversity of life forms.
- Fundamental to the process is genetic variation upon which selective forces can act in order for evolution to occur.
- Evolution focusses on:
  - Descent and the genetic differences that are heritable and passed on to the next generation;

- Mutation, migration (gene flow), genetic drift, and natural selection as mechanisms of change;
- The importance of genetic variation;
- The random nature of genetic drift and the effects of a reduction in genetic variation;
- How variation, differential reproduction, and heredity result in evolution by natural selection; and
- How different species can affect each other's evolution through coevolution.

Patterns in Evolution

Convergent evolution

- Unrelated species living in similar environments and facing similar environmental challenges sometimes evolve similar characteristics.



Dolphins and ichthyosaurs converged on many adaptations for fast swimming. (Image courtesy: Wikipedia)

Vertebrate wings are partly homologous (from forelimbs), but analogous as organs of flight in (1) pterosaurs, (2) bats, (3) birds, evolved separately. (Image courtesy: Wikipedia)

Convergent evolution in plants

- Prickles, thorns and spines: modified plant tissues that have evolved to prevent or limit herbivory, these structures have evolved independently a number of times.

- *Euphorbia* (family: Euphorbiaceae) of deserts in Africa and southern Asia, and the Cactaceae of the New World deserts have similar modifications.

- Palm trees form are in unrelated plants: cycads (from Jurassic period) and older tree ferns.

- Leaves have evolved multiple times. They have evolved not only in land plants, but also in various algae, like kelp.

- Some dicots (*Anemone*) and monocots (*Trillium*) in inhospitable environments are capable of forming underground organs such as corms, bulbs and rhizomes for prereservation of nutrition and water until the return of favourable conditions.

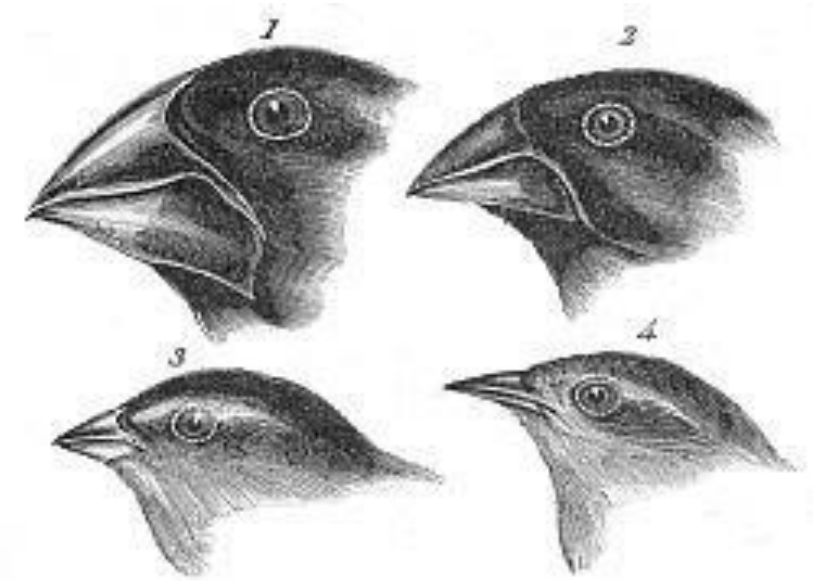
- Crassulacean acid metabolism (CAM), a carbon fixation pathway that evolved in multiple plants as an adaptation to arid conditions.

- CAM pathway:
  - Desert succulents
  - Epiphytes

Patterns in Evolution

Divergent evolution

- Term first used by American naturalist J. T. Gulick (1832-1923).
- Closely related species living in different environments and facing different environmental challenges sometimes evolve dissimilar characteristics.
- Examples:
  - Adaptive radiation of the finches of the Galapagos.
  - Color variations in populations of a species that live in different habitats such as with pocket mice and fence lizards



Finches from Galapagos Archipelago

Darwin's finches: an ancestral species radiates into a number of descendant species with both similar and different traits. (Image courtesy: Wikipedia)

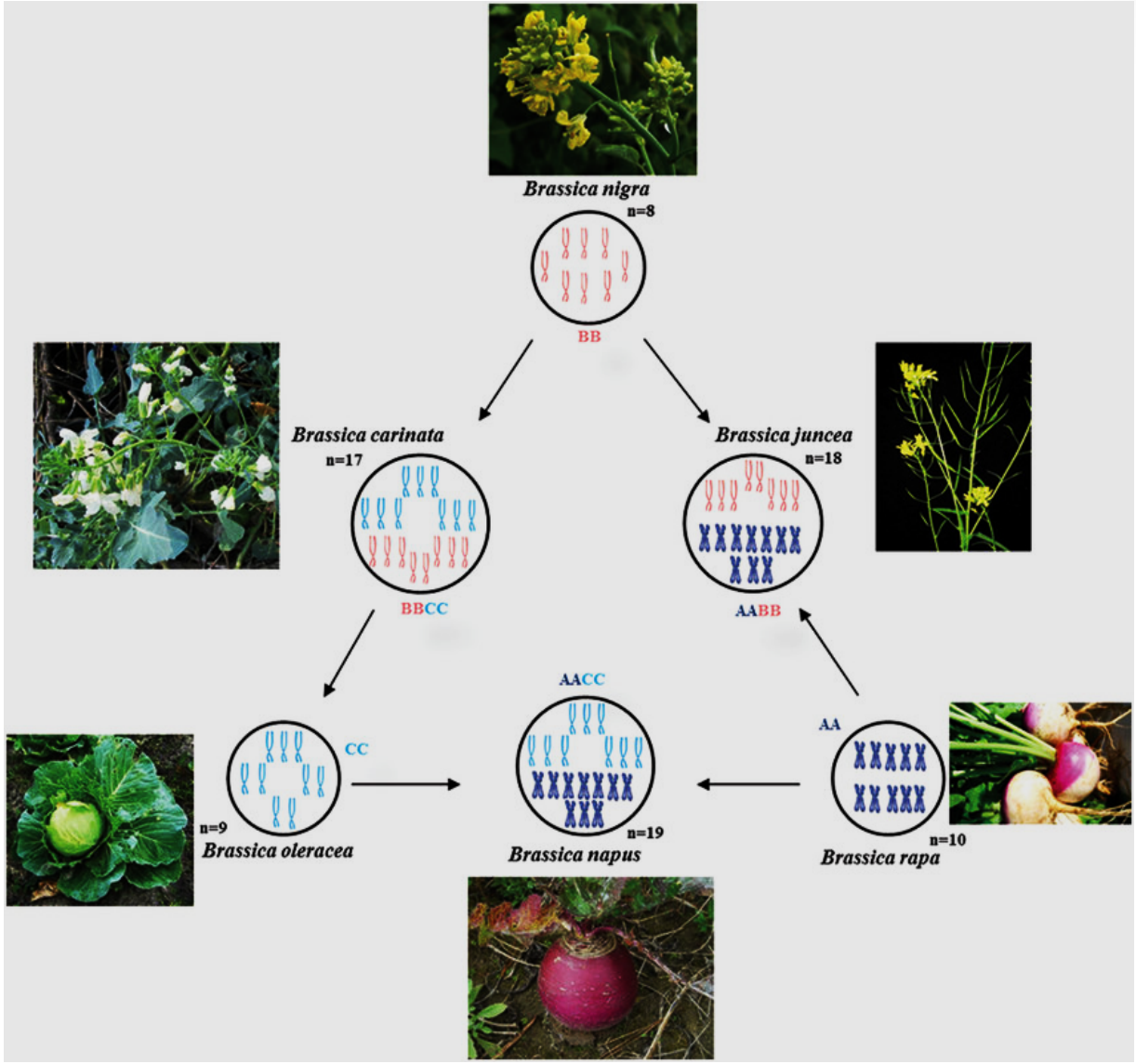
Divergent evolution in plants

Artificial selection of different cultivars (cultivated varieties) in the genus *Brassica* (family: Brassicaceae).

- Eurasian weed colewort (*Brassica oleracea*): ancestor of broccoli, brussels sprouts, cabbage, cauliflower, kale, and kohlrabi (rutabaga).
- All of these vegetables are considered to belong to the same species, but since the origin of agriculture, each has been selected for a specific form that is now recognized as a distinct crop.

Cactaceae and *Euphorbiaceae* in the Galápagos islands.

- 18 species and variety of cacti are found on the islands, and all are endemic.
- Of the 27 species and varieties of plants of family Euphorbiaceae, 20 are endemic.



Evolution in the genus *Brassica*

Patterns in Evolution

Adaptive radiation

A process in which organisms diversify rapidly from an ancestral species into a multitude of new forms, particularly when a change in the environment makes new resources available, creates new challenges, or opens new environmental niches.

Characteristics of adaptive radiation

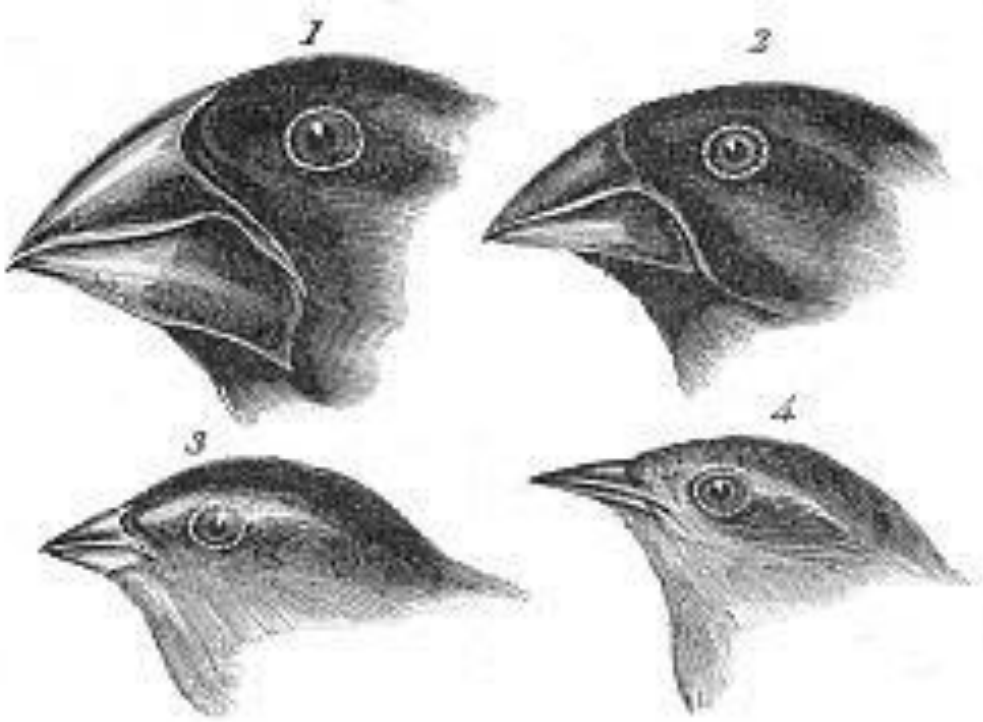
Four features can be used to identify an adaptive radiation:

1. A common ancestry of component species: specifically a *recent* ancestry.

2. A phenotype-environment correlation

3. Trait utility

4. Rapid speciation



Finches from Galapagos Archipelago

Fourteen species of Galapagos finches that evolved from a common ancestor. The different shapes of their bills, suited to different diets and habitats, show the process of adaptive radiation. (Image courtesy: Wikipedia)

Patterns in Evolution

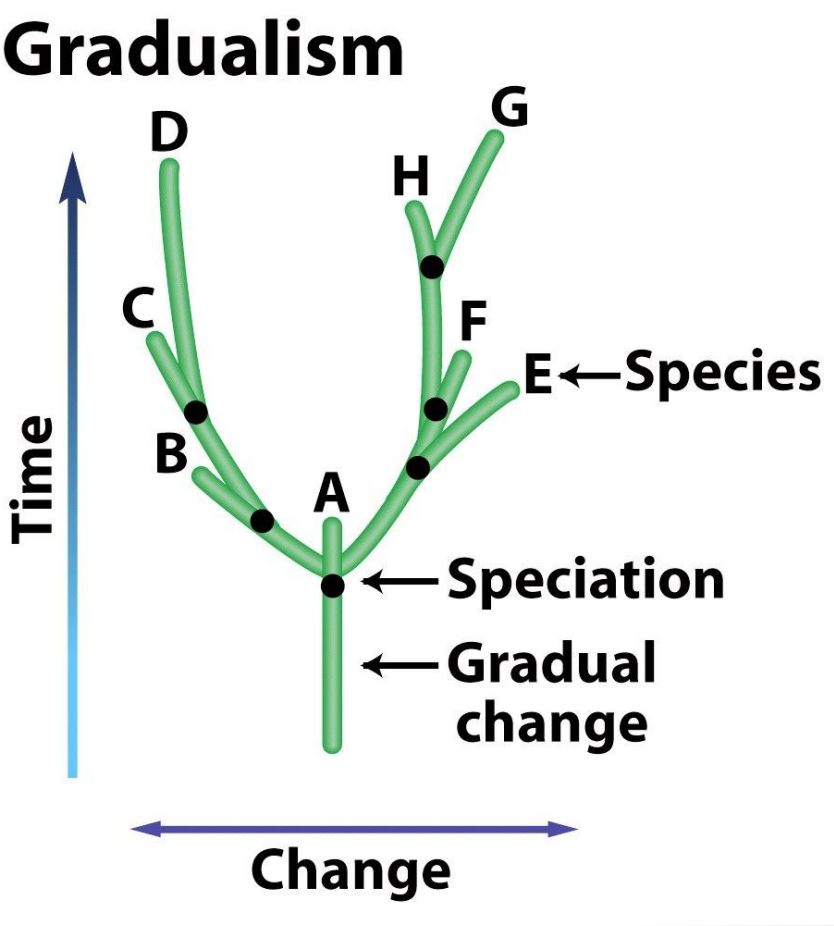
Coevolution

- **Evolution of one species affects the evolution of another species.**
  - **As predators evolve, prey evolves. As prey evolves, predators evolve.**
- **Example: Cheetahs feed on Thompson's gazelles**
  - **As the speed of one population of cheetahs improves so does the speed of the Thompson's gazelles.**

Patterns in Evolution

Gradualism

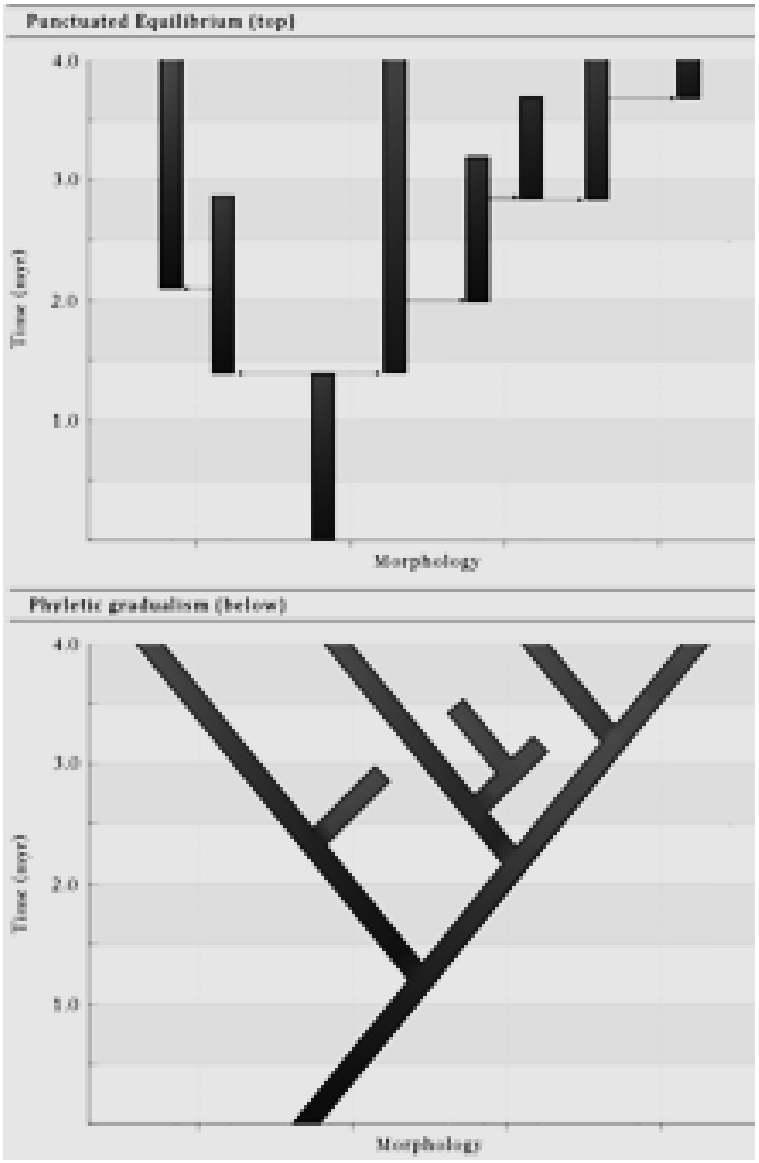
- Evolution may occur as a slow, gradual process of change.
- Proposed by James Hutton, a Scottish geologist in 1795.
- Theory favored by early evolutionists.



Patterns in Evolution

Punctuated equilibrium

- **Evolution may proceed with long periods of relatively little change (stasis) punctuated with short periods of intense change.**
- **Developed by paleontologists Niles Eldredge and Stephen Jay Gould.**
- **Commonly contrasted against phyletic gradualism.**
- **Examples:**
  - **House flies**
  - **Antibiotic-resistant bacteria.**



The punctuated equilibrium model (top) consists of morphological stability followed by rare bursts of evolutionary change via rapid cladogenesis. It is contrasted (below) to phyletic gradualism, the more gradual, continuous model of evolution. (Image courtesy: Wikipedia)

Results of evolution

- **Estimates on the number of Earth's current species range from 2-10^{12} million, of which about 1.74 million have been databased so far and over 80 percent have not yet been described.**

- **A study published by *PLoS Biology*, says a staggering 86% of all species on land and 91% of those in the seas have yet to be discovered, described and catalogued.**

Thank you