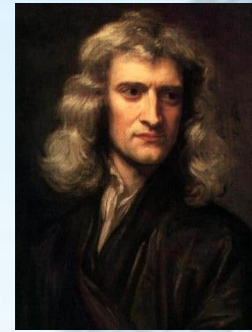
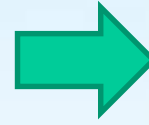
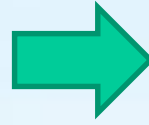


Science in Classics 经典中的科学

Charles Darwin
On the Origin of Species



Part I



- World
 - Two worlds: visible + intelligible (Plato)
 - ⇒ One world: celestial + terrestrial regions (Aristotle)
 - ⇒ One world: two regions unified by physical laws (Newton)
- Understanding
 - Philosophical
 - ⇒ Empirical (跟据经验的) + mathematical

Do you have a dream?



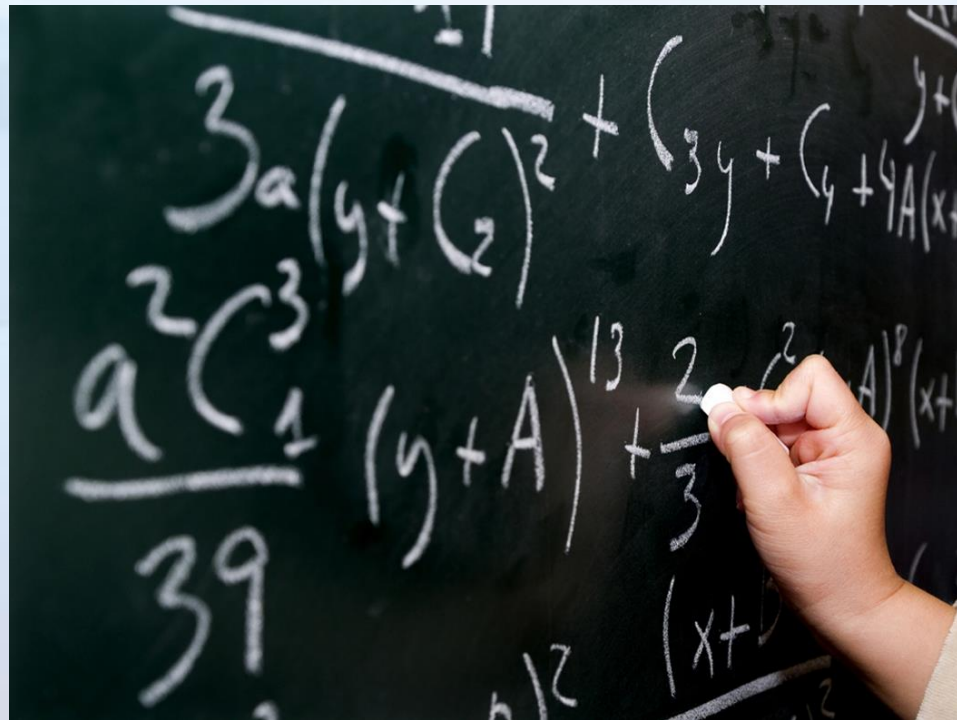
Martin Luther King delivering his “I Have a Dream” at the 1963 Washington D.C. Civil Rights March.

... because I have a dream that my four little children will one day live in a nation where they will not be judged by the color of their skin but by the content of their character.



What does a physicist dream of?

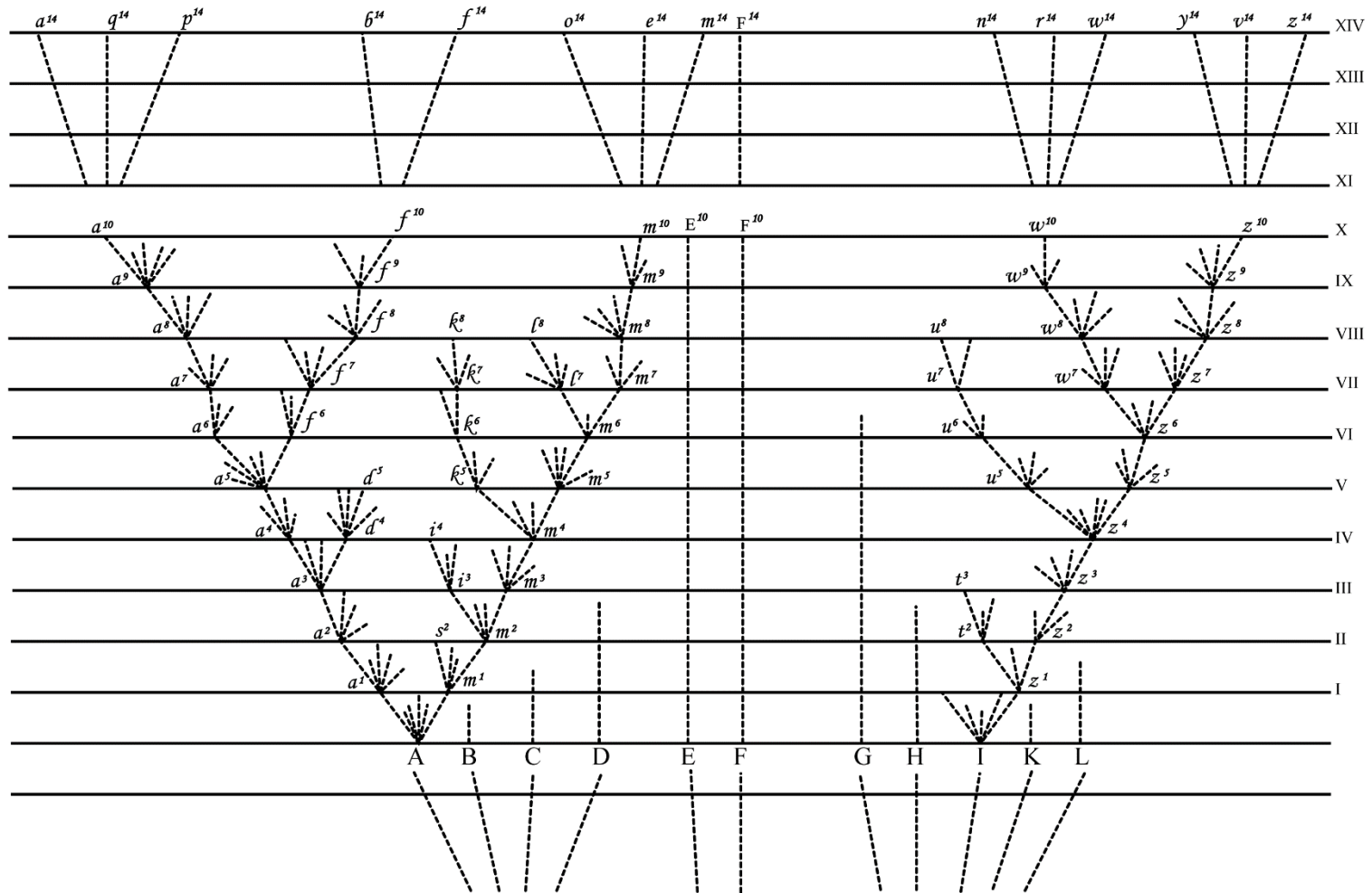
- Discovery of physical laws expressed in symbols?



What does a biologist dream of?

- Discovery of laws expressed in symbols?
- This?
 - If a cat behaves like this, then
- Or this?
 - If species A behaves like this, then ...

You will see Darwin's dream



Question 1

- Peter was hurt. The wound gradually scarred over (结疤). Will his son inherit (继承) his scar?
 - A. Yes.
 - B. No.

Question 1

- Peter was hurt. The wound gradually scarred over (结疤). Will his son inherit (继承) his scar?
 - A. Yes.
 - B. No.

Question 2

- Can a lion mate with a tiger to produce a hybrid (混合的) species (种) (Tigon 虎狮 or Liger 狮虎)?
 - A. Yes.
 - B. No.

Question 2

- Can a lion mate with a tiger to produce a hybrid (混合的) species (种) (Tigon 虎狮 or Liger 狮虎)?
 - A. Yes.
 - B. No. (There will be a tigon/liger, but it is not a species.)

Core Question

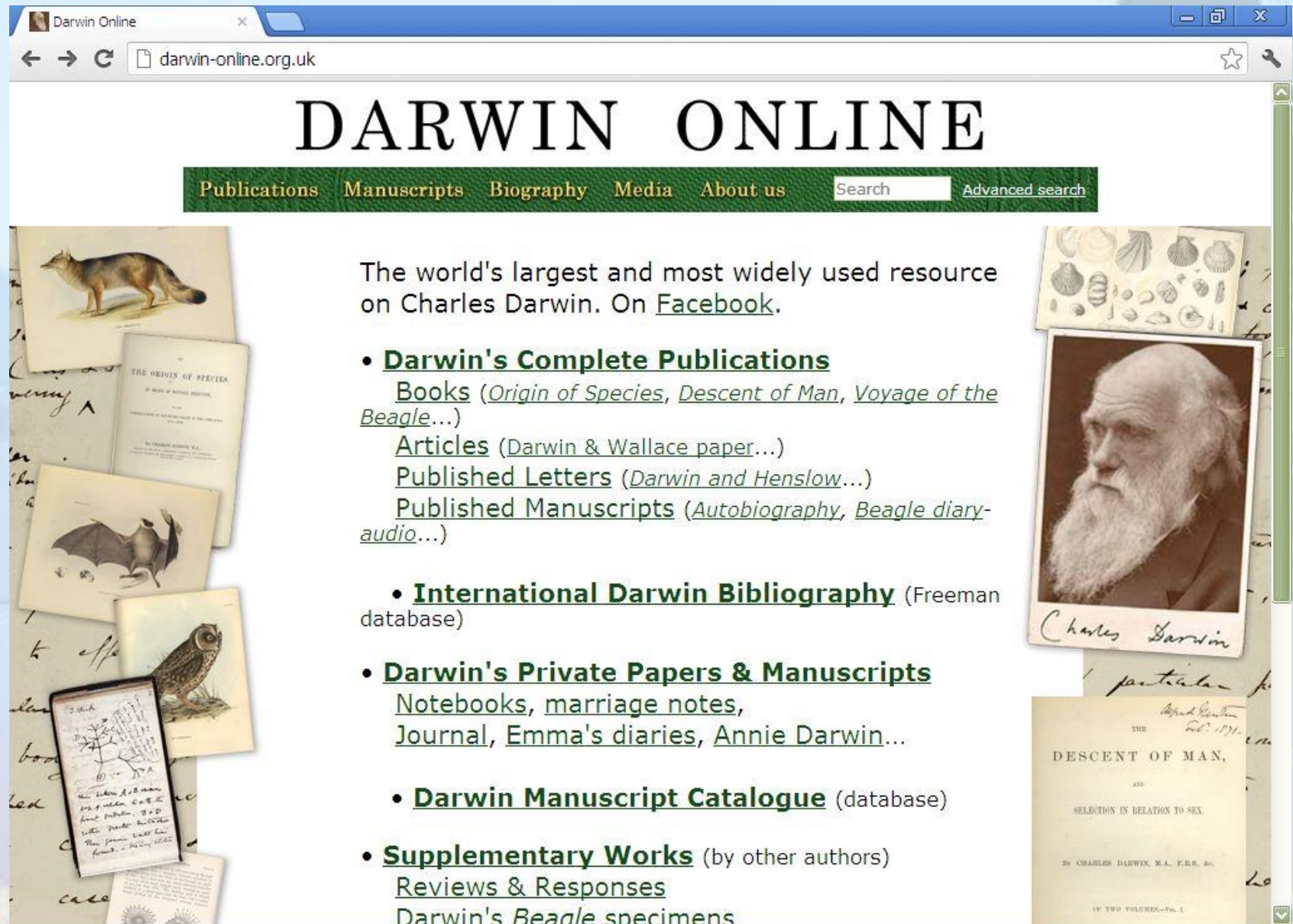
What are the laws of life?



Text

- Charles Darwin, *On the Origin of Species*,
First Edition (1859).
 - 1st – 5th editions: *On the Origin of Species*
 - 6th edition: *The Origin of Species*
- Read: Chapter 4 (Natural selection),
Para. 1-18, 39-46, 50-63, 68-71.

<http://darwin-online.org.uk>



Darwin Online

darwin-online.org.uk

DARWIN ONLINE

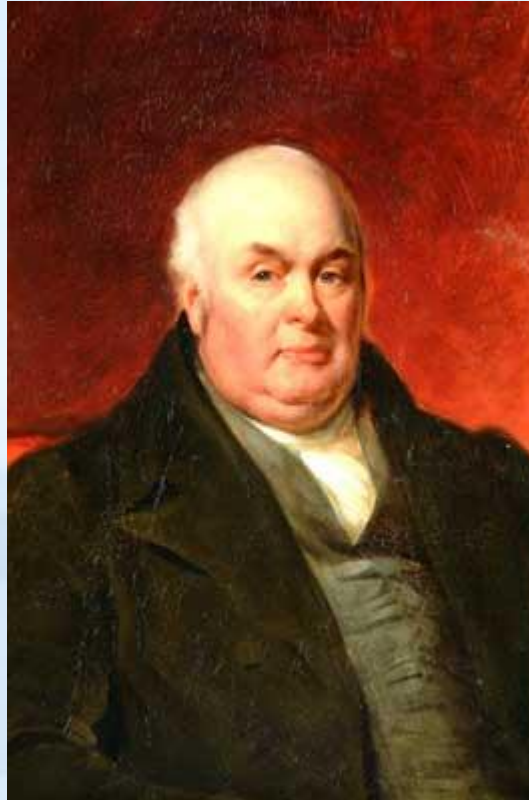
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The world's largest and most widely used resource on Charles Darwin. On [Facebook](#).

- **Darwin's Complete Publications**
 - Books (*Origin of Species*, *Descent of Man*, *Voyage of the Beagle*...)
 - Articles (Darwin & Wallace paper...)
 - Published Letters (Darwin and Henslow...)
 - Published Manuscripts (Autobiography, *Beagle diary*-audio...)
- **International Darwin Bibliography** (Freeman database)
- **Darwin's Private Papers & Manuscripts**
 - Notebooks, marriage notes,
 - Journal, Emma's diaries, Annie Darwin...
- **Darwin Manuscript Catalogue** (database)
- **Supplementary Works** (by other authors)
 - Reviews & Responses
 - Darwin's *Beagle* specimens



Erasmus Darwin
(Grandfather)
Polymath (博学家)
1731-1802



Robert Darwin
(Father)
Physician (医生)
1766-1848

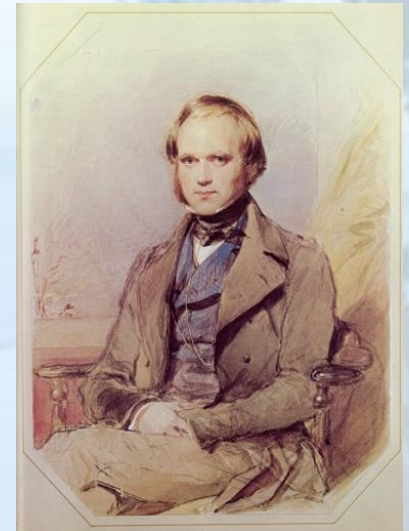


Charles Darwin

1809-1882

Charles Robert Darwin

- 1809-1882, English naturalist
- Grandpa (Erasmus): polymath.
- Father (Robert): physician
- Mother (Susannah Wedgwood): died when Charles was eight.
- His family was quite rich.



(drawn in 1840)

A handwritten signature of Charles Darwin in cursive script. The signature is written in dark ink on a light-colored background.

WEDGWOOD
ENGLAND 1759

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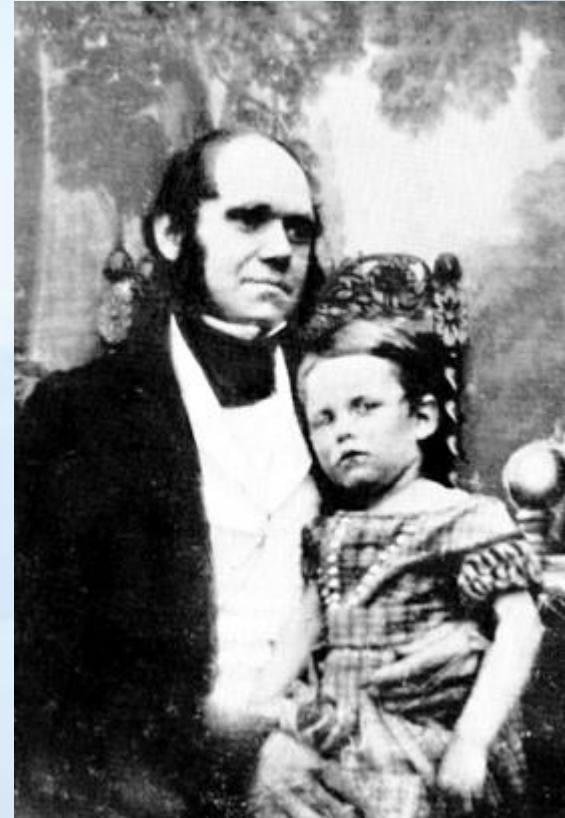
TEAWARE & TEA

Fabulously indulgent and elegant teaware designs that are perfect for afternoon tea or drinks with friends. Complemented by our Wedgwood tea collections. The finest teaware deserves the finest tea.





Charles Darwin (age 7) in 1816.



Darwin (age 31) and his son William (age 4) in 1842.

His life

- Oct. 1825 (16 years old): studied medicine at University of Edinburgh, but later lost interest.
- 15 Oct. 1827: studied theology (神学) at Christ's College, Cambridge University.



Christ's College



Darwin's Beetle Box

He was crazy for beetles ...

But no pursuit at Cambridge was followed with nearly so much eagerness or gave me so much pleasure as collecting beetles. It was the mere passion for collecting, for I did not dissect them and rarely compared their external characters with published descriptions, but got them named anyhow. I will give a proof of my zeal: one day, on tearing off some old bark, I saw two rare beetles and seized one in each hand; then I saw a third and new kind, which I could not bear to lose, so that **I popped the one which I held in my right hand into my mouth. Alas it ejected some intensely acrid fluid**, which burnt my tongue so that I was forced to spit the beetle out, which was lost, as well as the third one.

The Autobiography of Charles Darwin 1809-1882

http://darwin-online.org.uk/EditorialIntroductions/Freeman_LifeandLettersandAutobiography.html





- While studying theology, he became a naturalist, followed botanist (植物学家) and geologist (地质学家) J. S. Henslow.
- Finished his study in April 1831.
- Henslow encouraged him to travel on HMS Beagle (猎犬号), went for a 5-year voyage with Captain Robert Fitzroy.



John S. Henslow
(1796-1861)

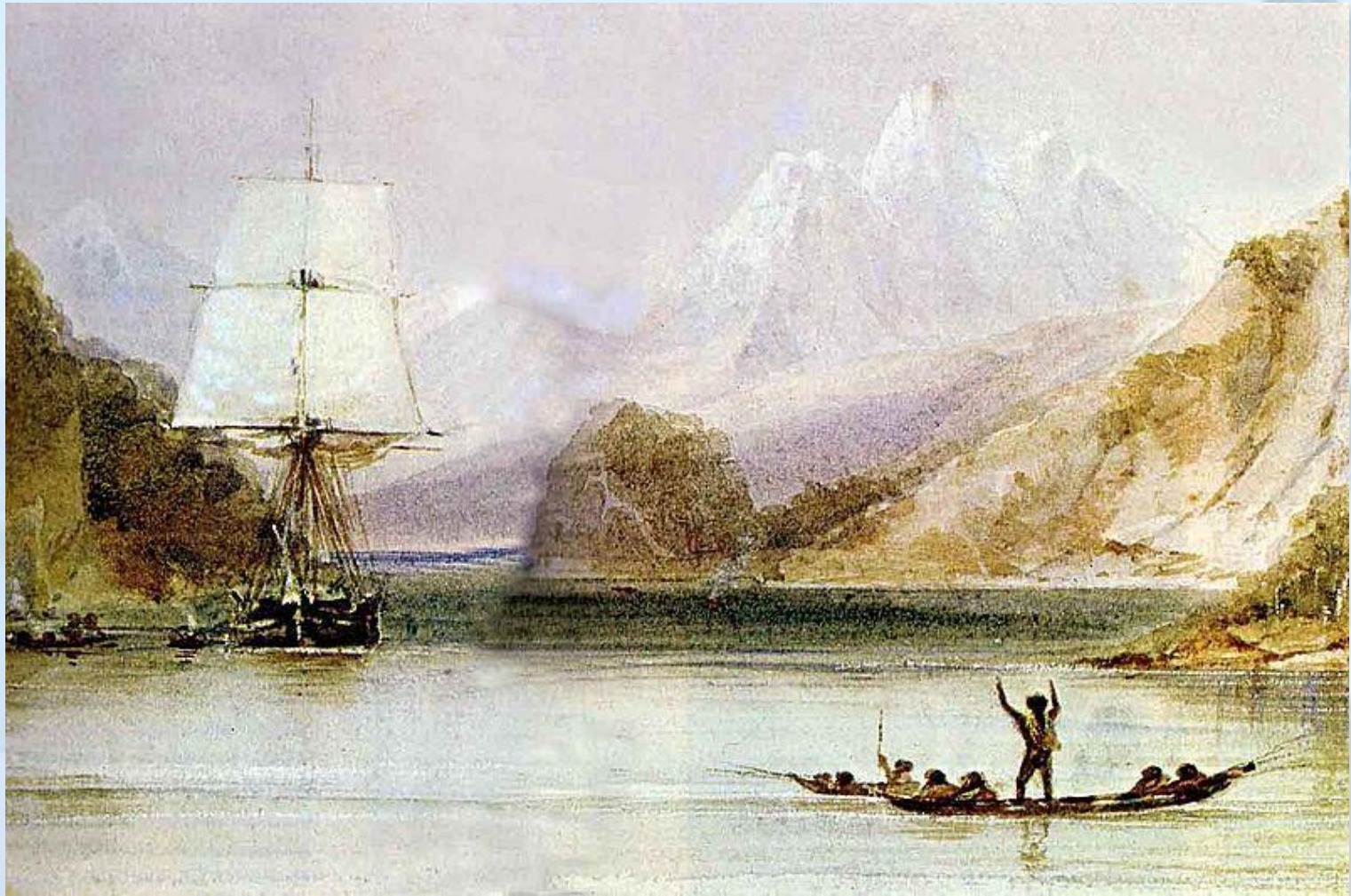


2nd Governor of New
Zealand (26 December 1843 -
18 November 1845)



Vice-Admiral Robert Fitzroy RN, 1805-1865





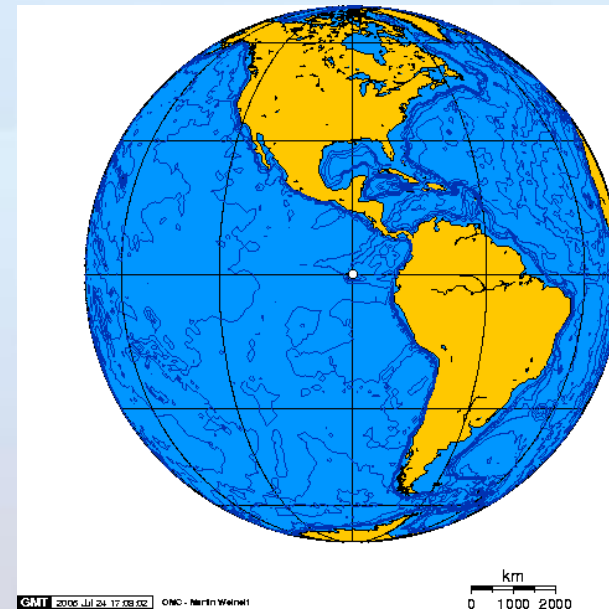
HMS Beagle at Tierra del Fuego (Spanish for “Land of Fire”.火地群島. Now part in Chile and part in Argentina.) painted by Conrad Martens during the voyage of the Beagle (1831-1836).

- on land for only 2/3 of the time in these 5 years.
- performed geological and zoological (动物学的) observations especially in South America, Galápagos (加拉帕戈斯) islands and Pacific islands.
- His diary was then compiled and became the book *Journal of Researchers* (1839) (later known as *Voyager of the Beagle*).



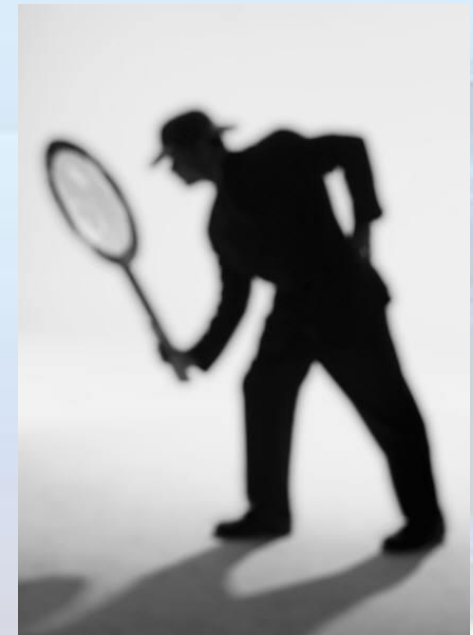
Galápagos Islands

- A UNESCO (联合国教育科学暨文化组织) World Heritage Site
- Now a province of Ecuador (厄瓜多尔).

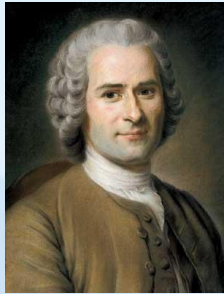


A detective story

now begins ...



Humanity in classics



Rousseau (卢梭)
(A friend of
Malthus's father)



Thomas Malthus
(1766-1834)

Humanity in classics



Malthus (马尔萨斯)

- Rousseau was too optimistic about the future of society.
- Population grows geometrically like 2, 4, 8, 16,
- Food and resources grow arithmetically like 1, 2, 3, 4,
- Continual population growth \Rightarrow poverty, famine, ...

Extinction.—This subject will be more fully discussed in our chapter 39
on Geology; but it must be here alluded to from being intimately connected
with natural selection. Natural selection acts solely through the preservation of
variations in some way advantageous, which consequently endure. But as from
the high geometrical powers of increase of all organic beings, each area is already
fully stocked with inhabitants, it follows that as each selected and favoured form
increases in number, so will the less favoured forms decrease and become rare.
Rarity, as geology tells us, is the precursor to extinction. We can, also, see that
any form represented by few individuals will, during fluctuations in the seasons or

Summary of Chapter.—If during the long course of ages and under 68
varying conditions of life, organic beings vary at all in the several parts of their
organisation, and I think this cannot be disputed; if there be, owing to the high
geometrical powers of increase of each species, at some age, season, or year,
a severe struggle for life, and this certainly cannot be disputed; then, considering
the infinite complexity of the relations of all organic beings to each other and to
their conditions of existence, causing an infinite diversity in structure, constitution,



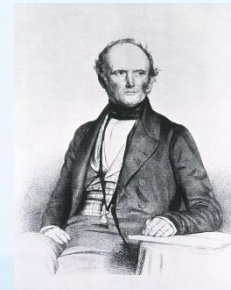
Science in classics

Lyell

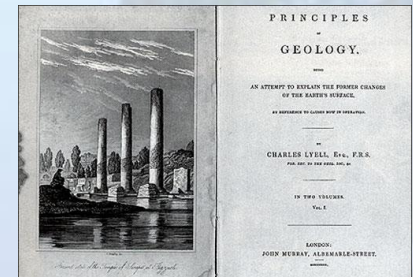
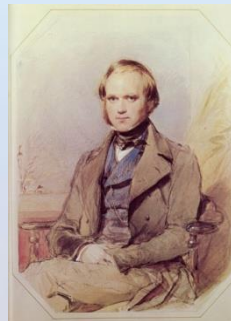
- the earth was shaped by slow-moving forces still in operation today.
(uniformitarianism 均变论 vs. catastrophism 灾变论)



The various Galápagos Mockingbirds Darwin caught resembled the Chilean Mockingbird *Mimus* Thenka, but differed from island to island.



Charles Lyell
(1797-1875)



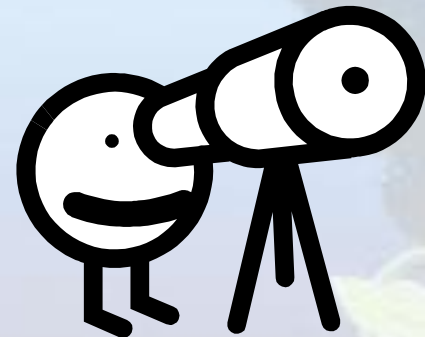
Science in classics

I am well aware that this doctrine of natural selection, exemplified in the above imaginary instances, is open to the same objections which were at first urged against Sir Charles Lyell's noble views on "the modern changes of the earth, as illustrative of geology;" but we now very seldom hear the action, for instance, of the coast-waves, called a trifling and insignificant cause, when applied to the excavation of gigantic valleys or to the formation of the longest lines of inland cliffs. Natural selection can act only by the preservation and accumulation of infinitesimally small inherited modifications, each profitable to the preserved being; and as modern geology has almost banished such views as the excavation of a great valley by a single diluvial wave, so will natural selection, if it be a true principle, banish the belief of the continued creation of new organic beings, or of any great and sudden modification in their structure.

A detective story follows ...

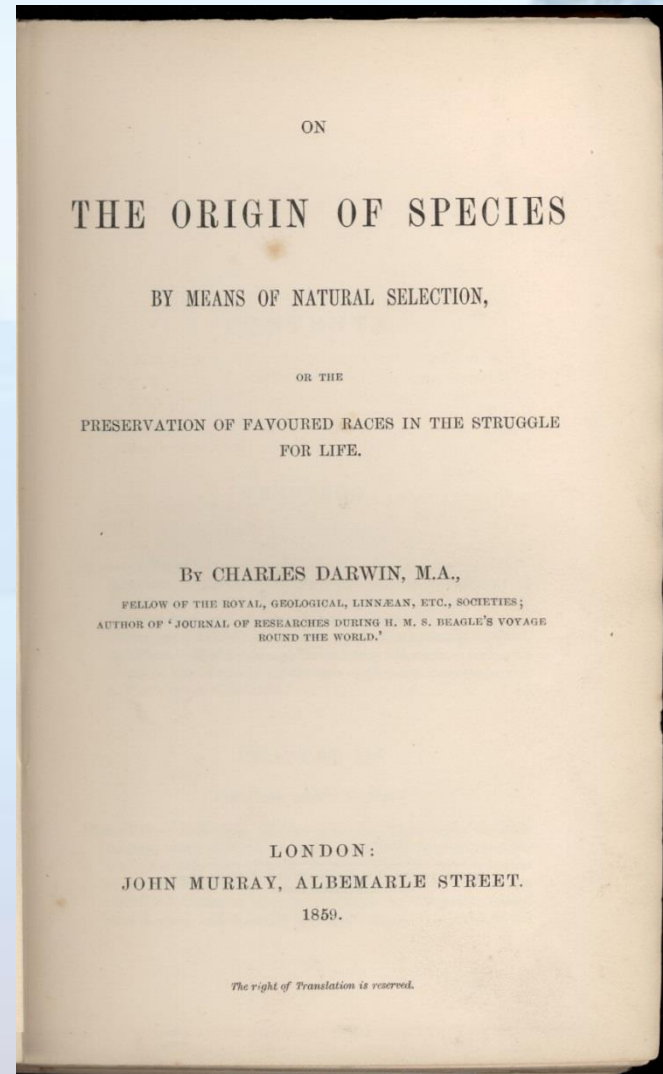
- A slowly changing Earth.
- Different habitats (栖息地), different features of species.
- Population growth $>$ growth of resources.
- ...

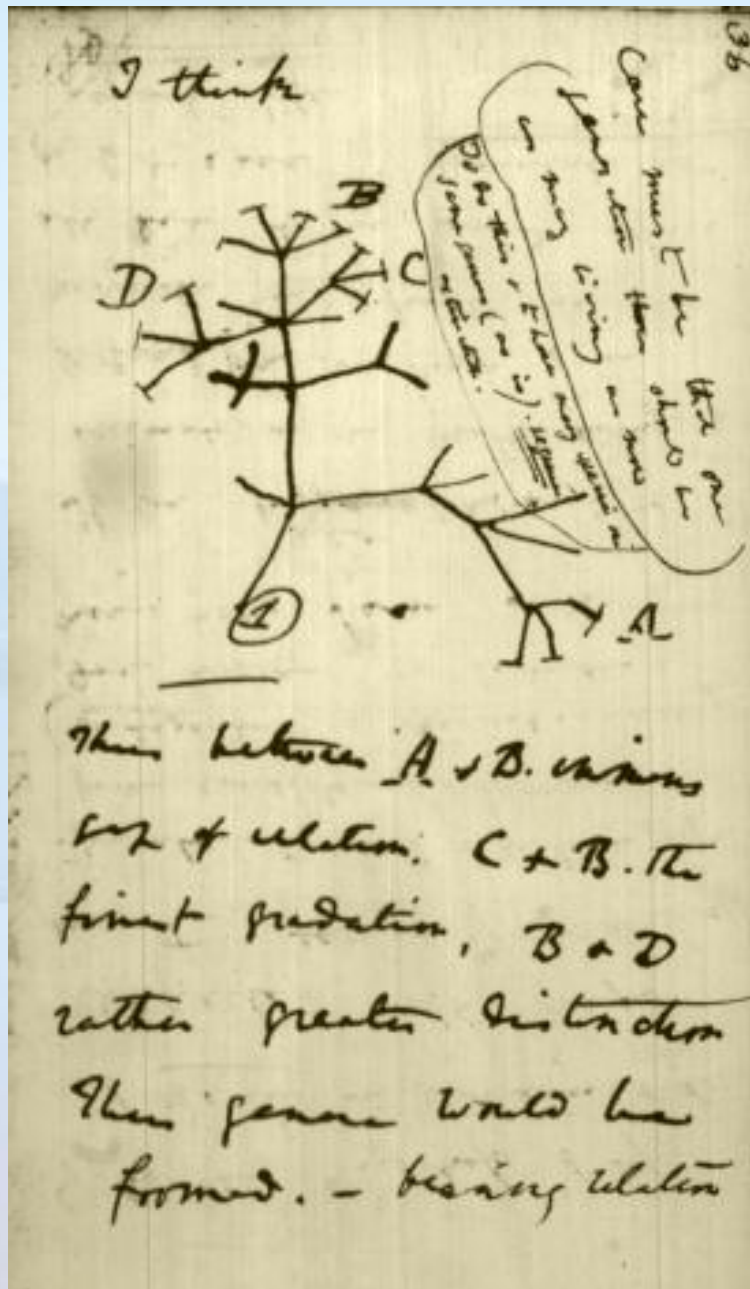
What happened with the lives in the past?



On the Origin of Species

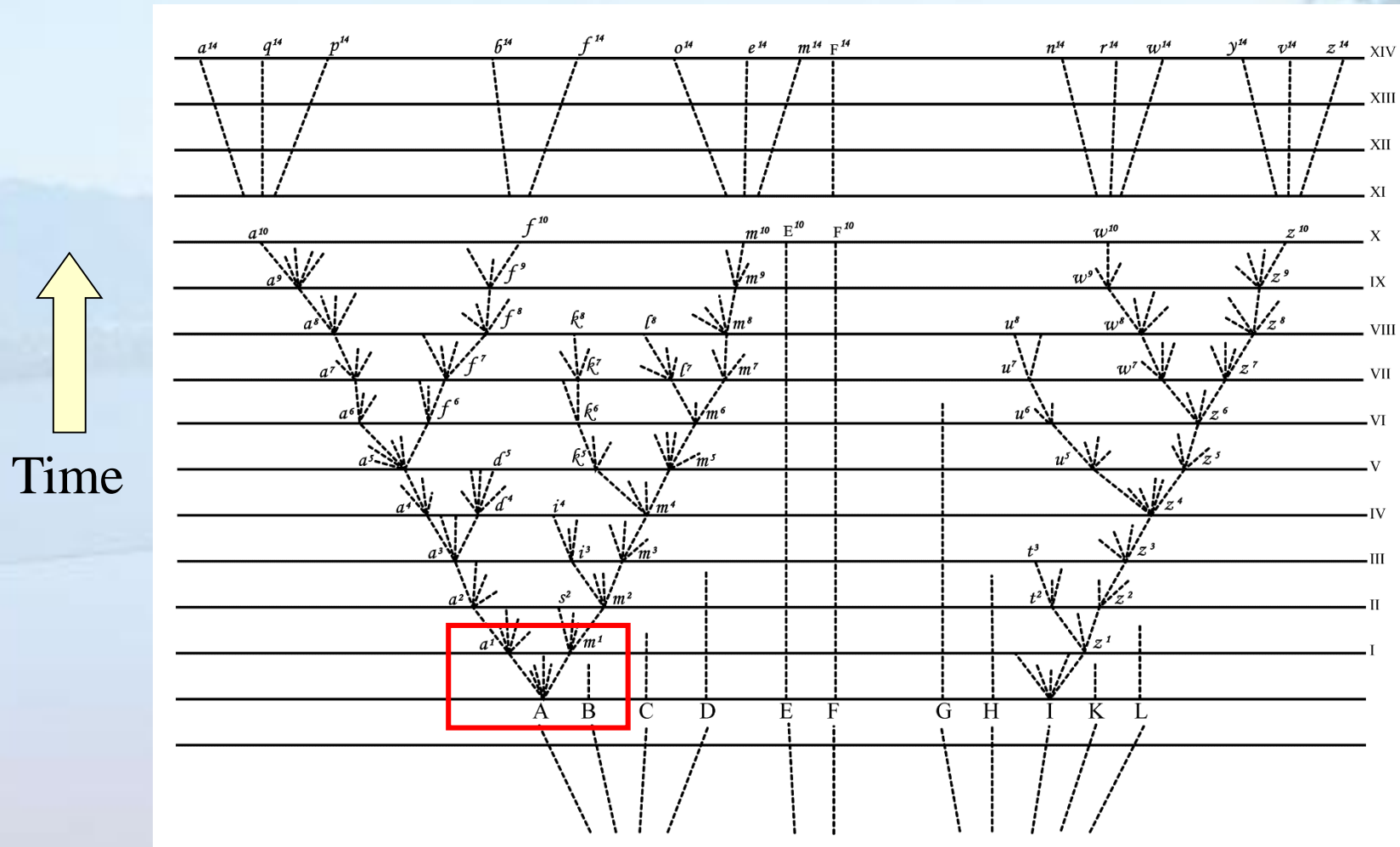
- The first edition was published in 1859 (~23 years after the voyage).
- In the voyage, he discovered relations between species and their habitations.
- After going back to England, he developed the concept of “evolution” (演化)— all species have a single common ancestor (祖先).





Tree of life (or Darwin's tree):
 Drawn in 1837 (~1 year after the
 voyage) at the top of p. 36 of
Notebook B, available from
Darwin Online (see the link
 below).

Take a closer look ...



↑
Time

→ Different species

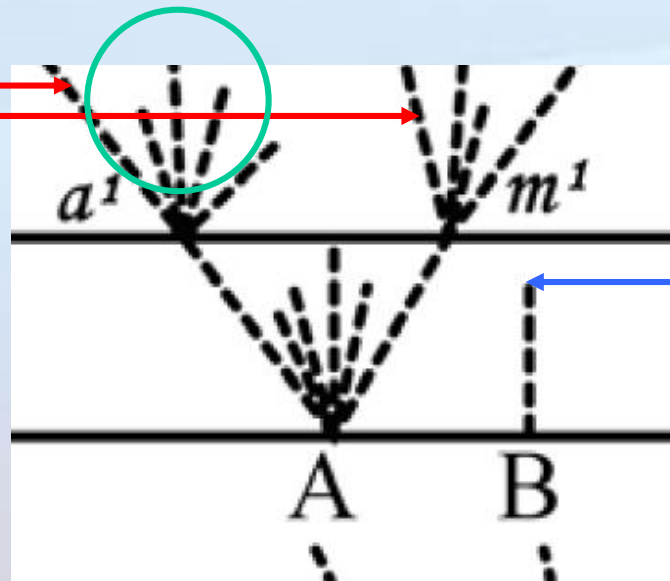
Three important concepts

After the foregoing discussion, which ought to have been much amplified, we may, I think, assume that the modified descendants of any one species will succeed by so much the better as they become more diversified in structure, and are thus enabled to encroach on places occupied by other beings. Now let us see how this principle of great benefit being derived from divergence of character, combined with the principles of natural selection and of extinction, will tend to act.

50

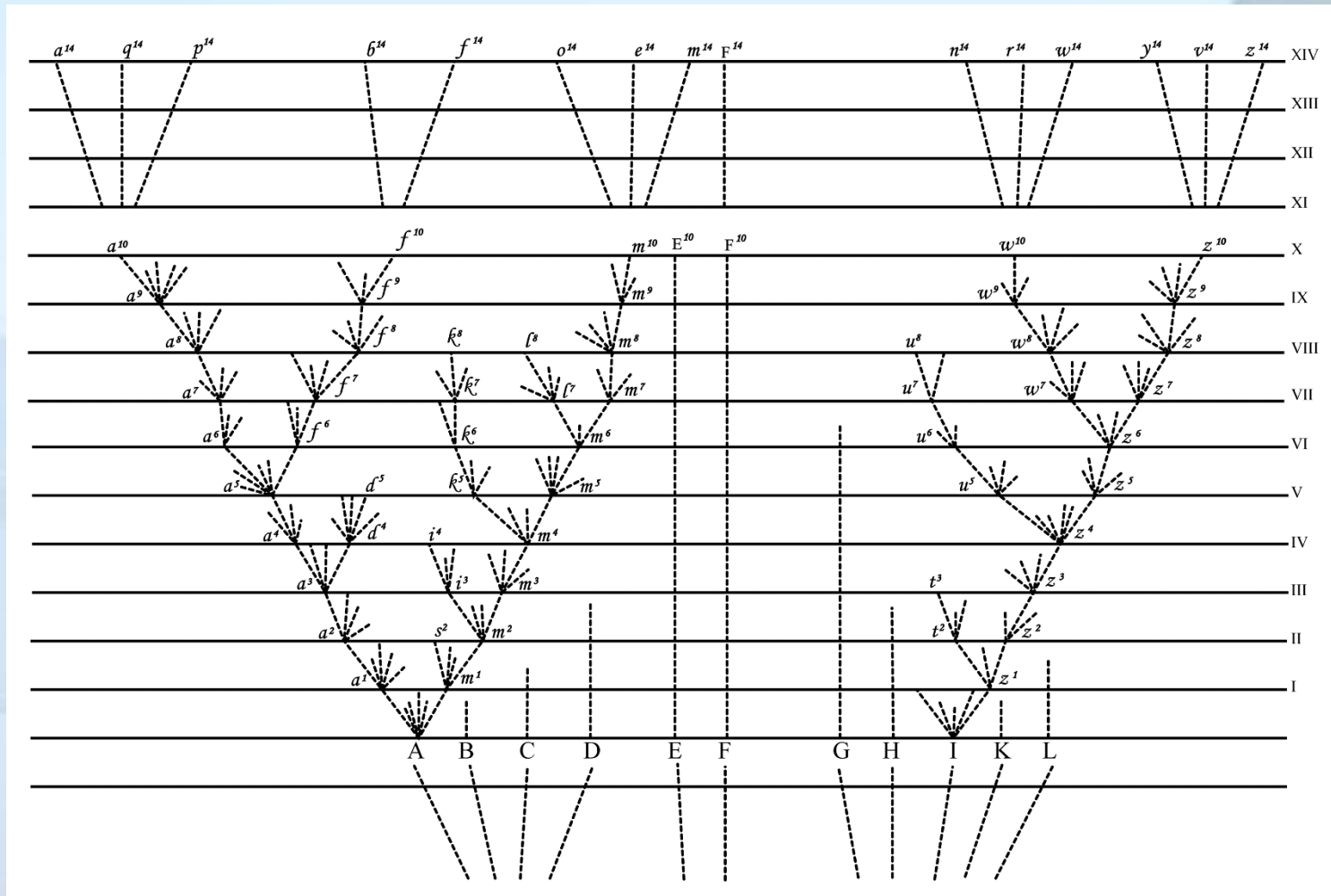
Extinction (灭绝) occurs

Naturally
selected



Vertical line: no
divergence of
character (性状分歧)

Different species from a single species A



A single parent?



Thus it is, as I believe, that two or more genera are produced by descent, with modification, from two or more species of the same genus. And the two or more parent-species are supposed to have descended from some one species of an earlier genus. In our diagram, this is indicated by the broken lines, beneath the capital letters, converging in sub-branches downwards towards a single point; this point representing a single species, the supposed single parent of our several new sub-genera and genera.

63

Sexual selection (性选择)

10

Sexual Selection.—Inasmuch as peculiarities often appear under domestication in one sex and become hereditarily attached to that sex, the same fact probably occurs under nature, and if so, natural selection will be able to modify one sex in its functional relations to the other sex, or in relation to wholly different habits of life in the two sexes, as is sometimes the case with insects. And this leads me to say a few words on what I call **Sexual Selection**. This depends, not on a struggle for existence, but on **a struggle between the males** for possession of the females; the result is not death to the unsuccessful competitor, but few or no offspring. Sexual selection is, therefore, **less rigorous than natural selection**. Generally, the



Summary of Chapter.—If during the long course of ages and under varying conditions of life, organic beings vary at all in the several parts of their organisation, and I think this cannot be disputed; if there be, owing to the high geometrical powers of increase of each species, at some age, season, or year, a severe struggle for life, and this certainly cannot be disputed; then, considering the infinite complexity of the relations of all organic beings to each other and to their conditions of existence, causing an infinite diversity in structure, constitution, and habits, to be advantageous to them, I think it would be a most extraordinary fact if no variation ever had occurred useful to each being's own welfare, in the same way as so many variations have occurred useful to man. But if variations useful to any organic being do occur, assuredly individuals thus characterised will have the best chance of being preserved in the struggle for life; and from the strong principle of inheritance they will tend to produce offspring similarly characterised. This principle of preservation, I have called, for the sake of brevity, Natural Selection. Natural selection, on the principle of qualities being inherited at corresponding ages, can modify the egg, seed, or young, as easily as the adult. Amongst many animals, sexual selection will give its aid to ordinary selection, by assuring to the

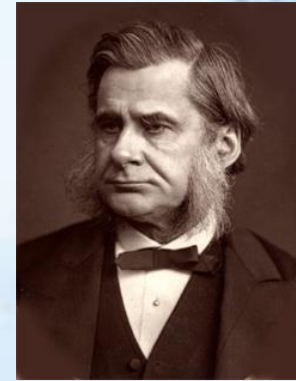
Why sexual selection?

- Why did he propose the concept of sexual selection?
- Is there anything that natural selection cannot explain?

Reactions

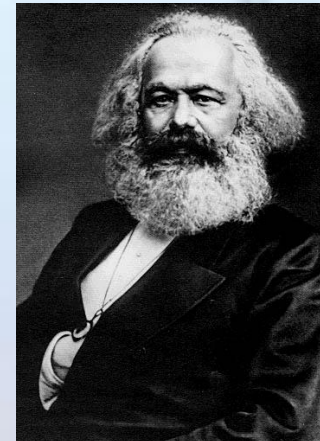
‘How extremely stupid not to have thought of that!’

Thomas Huxley (1825-1895), English biologist



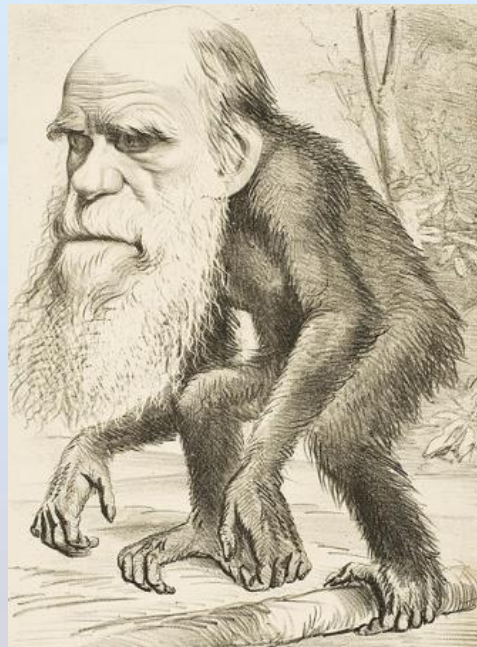
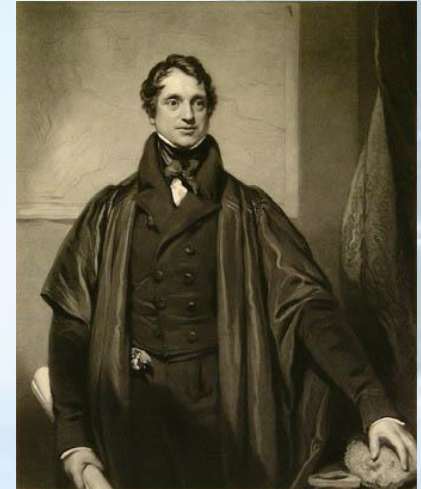
‘It is remarkable how Darwin rediscovers, among the beasts and the plants, the society of England with its division of labour, competition, opening of new markets, “inventions” and Malthusian “struggle for existence”.’

Karl Marx (1818-1883), German political theorist



‘I have read your book with more pain than pleasure. Parts of it I admired greatly; parts I laughed at till my sides were almost sore; other parts I read with absolute sorrow, because I think them utterly false and grievously mischievous.’

Adam Sedgwick (1785-1873), English geologist



Common misconception: Lamarckism

- Jean-Baptiste Lamarck (1744-1829).
- Lamarckism: an organism can pass on to its offspring acquired (获得的) characteristics:
 - stronger muscles.
 - suntanned skin.
- Rejected by experiment.

Taxonomy of species

- Carlolus von Linné, 1707-1778, Sweden biologist.
- He proposed: *Genus* (属) + *species* (种)
- *Homo habilis* (能人)
- Sometimes, *subspecies* (亚种) has to be specified.
- *Homo* (人属) *sapiens* (人种) *sapiens* (智人亚种): 智人
- *Homo sapiens neanderthalensis* (尼安德图人亚种):
Neanderthals (安德图人)

Now we have ...

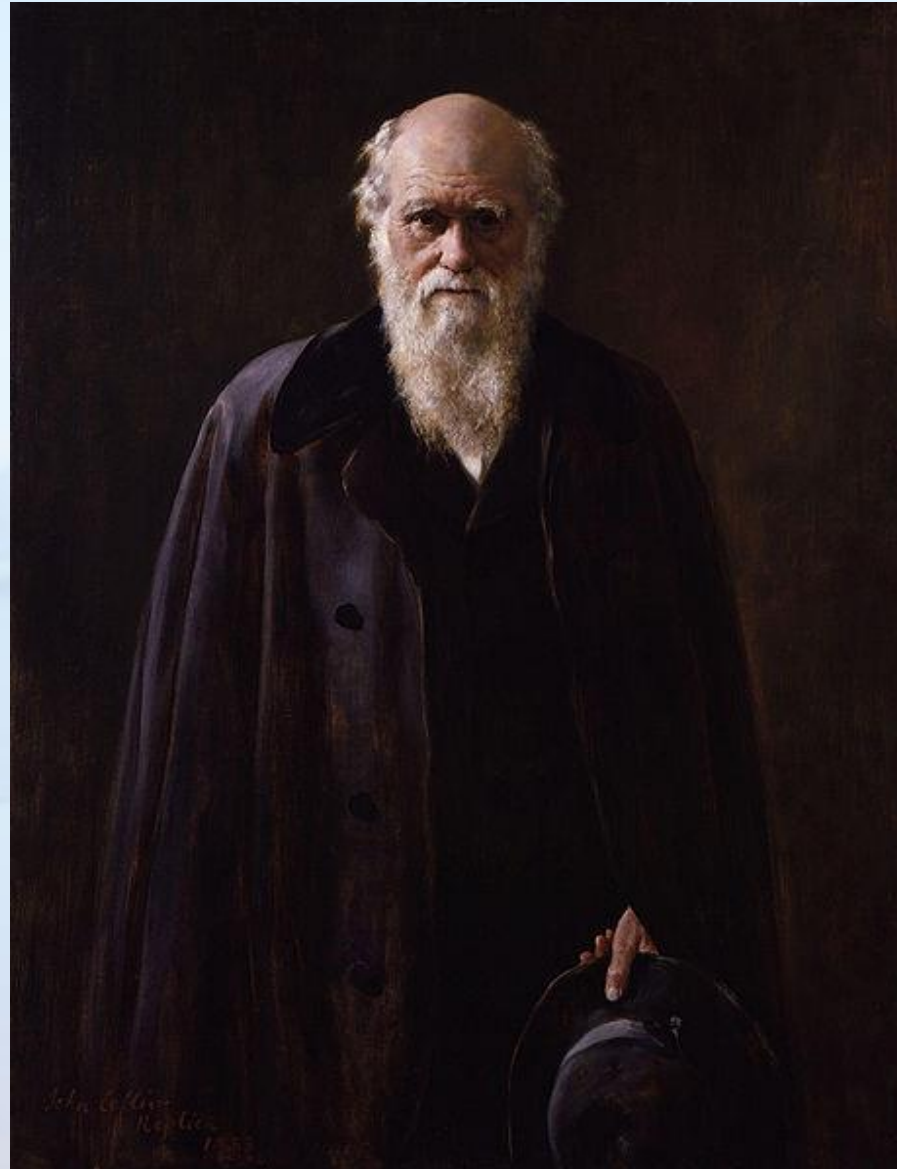
- kingdom (界)
- phylum (门)
- class (纲)
- order (目)
- family (科)
- genus (属)
- species (种)

Who are we?



Homo sapiens sapiens is...

| | |
|---------------------------|---------|
| Kingdom Animal | 动物界 |
| Phylum Chordata | 脊索动物门 |
| Subphylum Vertebrata | 脊椎动物亚门 |
| Class Mammalia | 哺乳动物纲 |
| Subclass Theria | 真兽亚纲 |
| Infraclass Eutheria | 真哺乳动物下纲 |
| Order Primates | 灵长目 |
| Suborder Anthropoidea | 类人猿亚目 |
| Superfamily Hominoidea | 类人超科 |
| Family Homindae | 人科 |
| Genus <i>Homo</i> | 人属 |
| Species <i>Sapiens</i> | 智人种 |
| Subspecies <i>Sapiens</i> | 智人亚种 |



Darwin in 1881 (1 year before death)

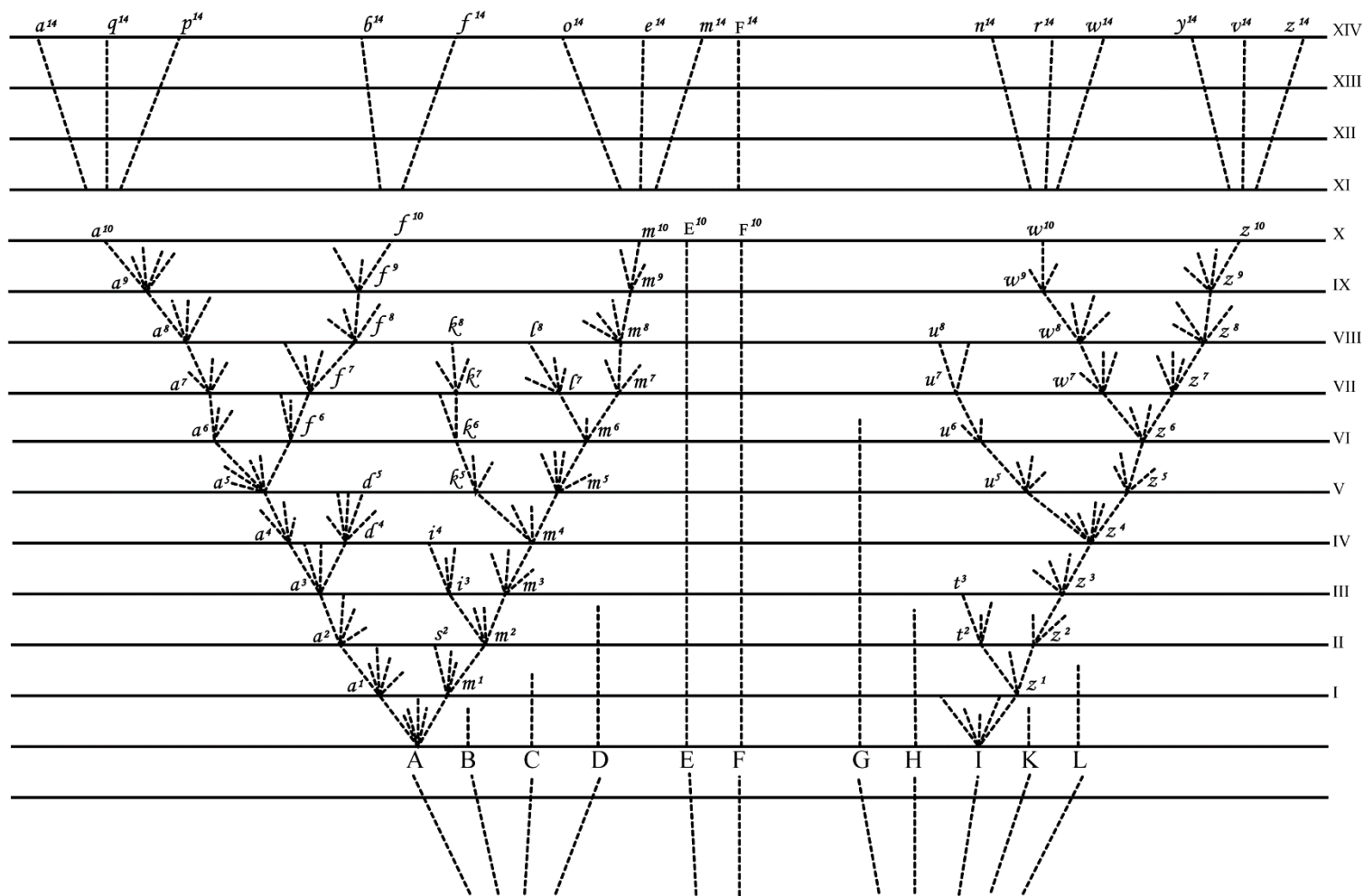


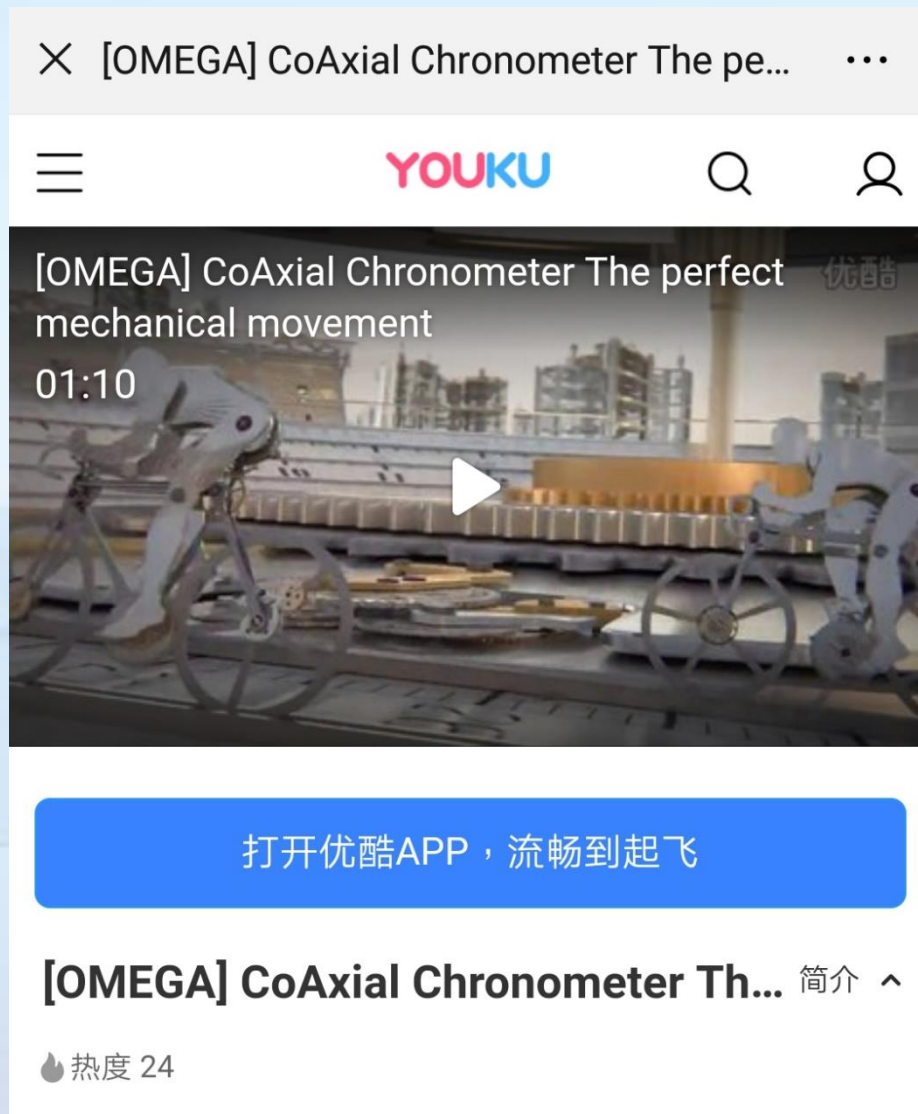
Darwin's study room at Down House shortly after his death in 1882.



Now restored

Darwin's dream





https://m.youku.com/video/id_XNjc4MjMyMDI4.html?source=&ishttps=1&sharetype=2&from=singlemessage



Darwin's "sandwalk" at Down House was his usual "Thinking Path". 52



A photograph of a gravel path in a park. The path is made of light-colored gravel and curves from the foreground towards the background. On either side of the path is a lush green lawn. Large, mature trees with dense green foliage are scattered throughout the scene, casting shadows on the grass and path. The overall atmosphere is peaceful and natural.

Where is your thinking path?

End