History of Evolutionary Thought: Part I

brought to you by

Dr. Ben Waggoner

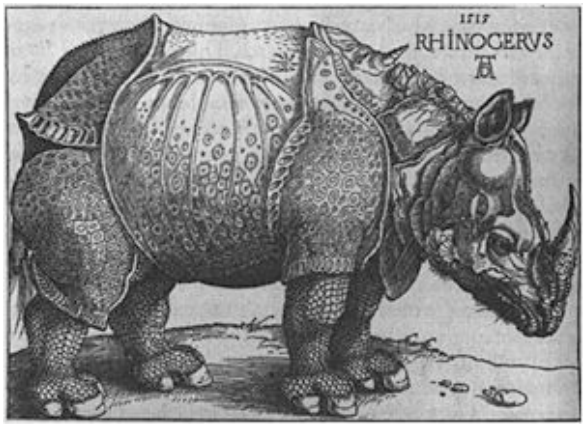
Christopher Columbus (1451-1506)

And now to introduce the single person who, in a historical sense, was most responsible for the growth of evolutionary biology. . .

Why *Columbus?*

- Columbus was no biologist, and he certainly didn't do it all himself. . .
- . . . but for my purposes, he is a convenient *symbol* for the radical changes in European thought and society that were consequences of the "Age of Exploration".
- Exploration of the Old World (Europe, Asia, and Africa) and the New World touched off a resurgence of the study of animals and plants.

Europeans began to realize that the world had much more biodiversity than they had ever realized, and that the animals and plants they discovered were even stranger than the mythical monsters of legend.



"No kingdom of nature was left unexplored. . . . . One after another phantoms which had haunted the world through ages of darkness fled before the light."

—Thomas Macaulay

Why did people start studying science and natural history so intensively?

- Commerce
- Medicine
- Natural theology
- Sense of wonder

Commerce: Plants and animals from the New World and Asia became important trade goods and food crops.

clove tree

nutmeg fruit

cinnamon tree

(Images borrowed from Gernot Katzer's Spice Pages)

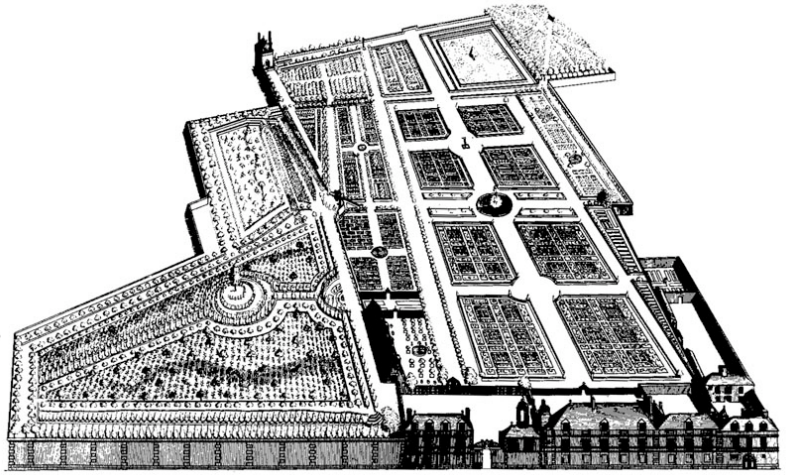
Remember that many of the great voyages of this time were made in the first place to find rare plants—spices such as cloves and nutmeg, grown in southeast Asia!

Replica of the *Batavia*, a Dutch spice trading ship from the 1600s

Medicine: Plants (and animals, to a lesser extent) were used medicinally.

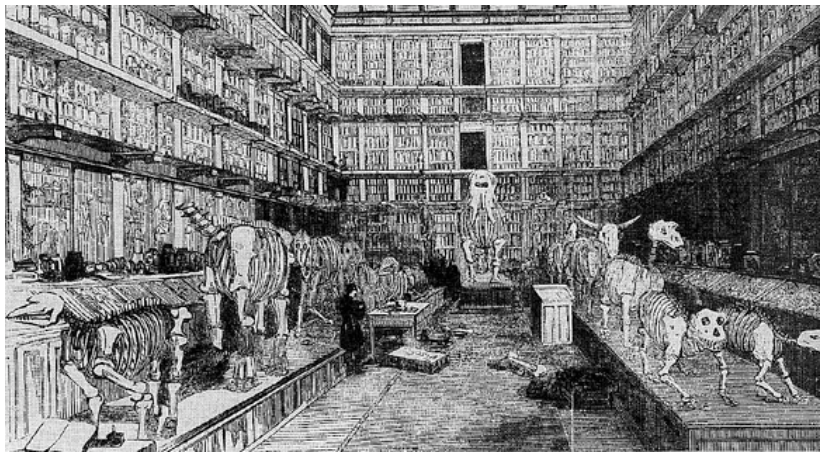
Cinchona tree (Peru; treatment for malaria)

Rhubarb (Central Asia; treatment for digestive disorders)



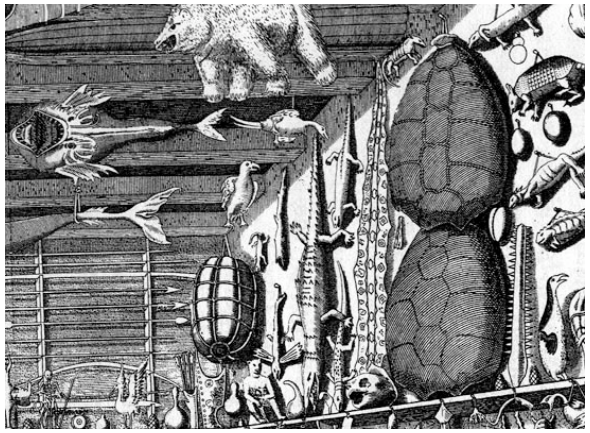
Medical schools imported plants and constructed botanical gardens. Every doctor and pharmacist had to learn botany! This is the Jardin des Plantes, in Paris, as it looked in the 1630s.

Comparative anatomy of animals was also important in medical training—and so medical institutions included collections of animal specimens, as well as human specimens. Here's the Museum of the Royal College of Surgeons, London, in 1854 (but founded earlier)

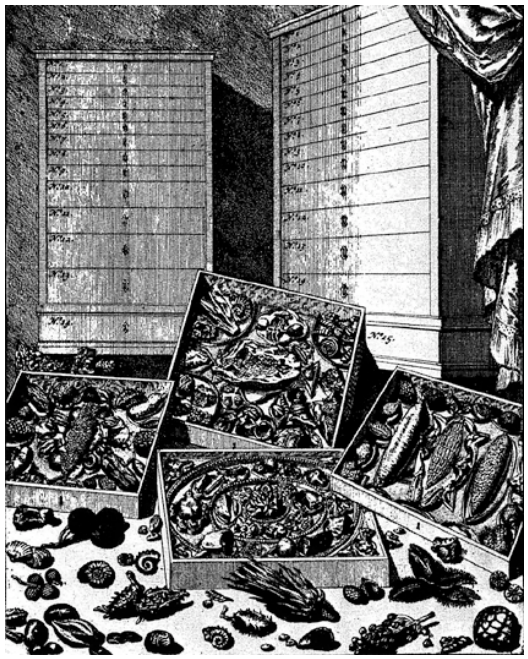


Wonderment! The wealthy collected rare specimens of animals and plants, *because* they were rare and exotic.

View of a private museum in Leiden, The Netherlands, in 1655



Close-up of that private museum: note the sea turtles, snake skins, stuffed penguin, alligator, iguana, polar bear, and armadillo. This stuff came from all over!



Another private museum—this one is a 17th-century nobleman's collection of rare seashells, or "cabinet of curiosities" as such things were called. . .

Along with the growth of natural history collections came the production of beautifully illustrated books depicting exotic animals and plants—like this tropical flower and butterfly from Surinam, drawn by the great artist Maria Sibylla Merian (1647-1717).

Natural Theology: By studying God's Creation, one might learn about God's power, goodness, etc.

John Ray (1628-1705)

There is for a free man no occupation more worthy and delightful than to contemplate the beauteous works of nature and honour the infinite wisdom and goodness of God.

But to study God's Creation in a way that was pleasing to Him, you had to look for yourself!

John Ray (1628-1705)
Here's a link to more on Ray. . .

Let it not suffice to be book-learned, to read what others have written and to take upon trust more falsehood than truth, but let us ourselves examine things as we have opportunity, and converse with Nature as well as with books.

For those who intend to discover and to understand, not to indulge in conjectures and soothsaying, and . . . plan to look deep into the nature of the real world and to dissect it — for them everything must be sought in things themselves.

Francis Bacon (1561-1626)

Natural theology actually *stimulated* the growth of science, and was influential in unexpected ways— as we'll see later on. . .

By the late 18th century, the Rev. William Paley was the leading exponent of natural theology. His book, called *Natural Theology*, was a best-seller of the time. . .

The marks of design are too strong to be got over. Design must have had a designer. That designer must have been a person. That person is GOD.

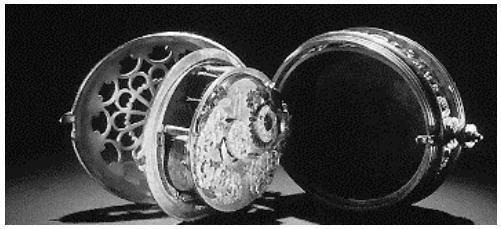
William Paley (1743-1805)

Paley used a metaphor which is still famous: God as a watchmaker, Nature as a watch.

But suppose I had found a **watch** upon the ground, and it should be inquired how the watch happened to be in that place. . . . the inference, we think, is inevitable, that the watch must have had a maker. . . . who comprehended its construction, and designed its use.

William Paley (1743-1805)
Here's a link to more on Paley.

If the existence of a watch demands the existence of a watchmaker, then how much more must the existence of something as complex as a living being demonstrate that there must be a Creator! Or so said Paley. . .



Don't worry. . . we'll gun this argument down later on in the course.

Anyway, the situation created a massive headache for everyone who had to keep track of it all!
Consider this wild rose. . .

. . . what should it be called so that botanists could be sure what flower they were talking about?

Rosa alba minor? Hundsrosen?

Rosa sylvestris alba cum rubore, folio glabro?

Rosa sylvestris inodora seu canina?

Rosa lacteola camerarii?

. . . what should it be called so that botanists could be sure what flower they were talking about?

Rosa alba minor? Hundsrosen?

Rosa sylvestris alba cum rubore, folio glabro?

Rosa sylvestris inodora seu canina?

Rosa lacteola camerarii?

. . . each country produces something especially useful; the task of economics is to collect [plants] from other places and cultivate [at home] such things that don't want to grow [here]. . .

Carl Linnaeus (1707-1778) was a Swedish physician, with professional and economic interest in plants. . .

Linnaeus's botanical garden at the University of Uppsala, in Sweden

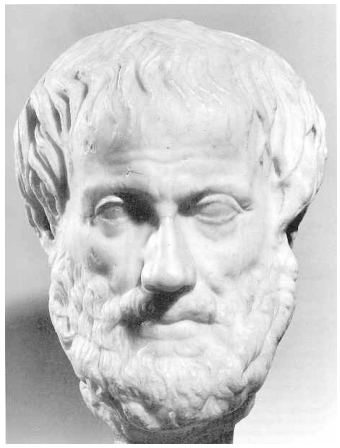
Here Linnaeus taught his students, tried (unsuccessfully) to grow bananas and coffee, and worked out his classification. . .

Link to more on Linnaeus

God has allowed him to see more of His created work than any mortal before him. God has endowed him with the greatest insight into natural knowledge, greater than any has ever gained. . . .

. . . and a healthy ego! He saw himself as having a divine mission to study and classify the natural world.

Linnaeus went back to the ancient Greek philosopher Aristotle, who had classified things in terms of what made a group of things alike (their *genus*) and what made the group's members different from each other (their *species*).



Genus: **Man** (all men have two eyes, a nose, two ears, etc.)

Species: **Aristotle** (has a bald spot, big nose and beard, goes around philosophizing, once had a gig as tutor to Alexander the Great, etc.)

Binomial nomenclature: One standardized Latin word for the genus and for the species

Rosa canina

~~*Rosa sylvestris alba cum rubore, folio glabro*~~

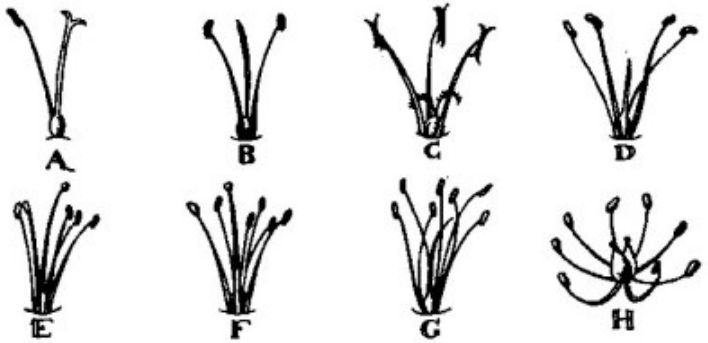
And here's how we do it now. . .

Kingdom Plantae
Division Anthophyta
Class Rosopsida
Order Rosales
Family Rosaceae
Genus *Rosa*
Species *canina*

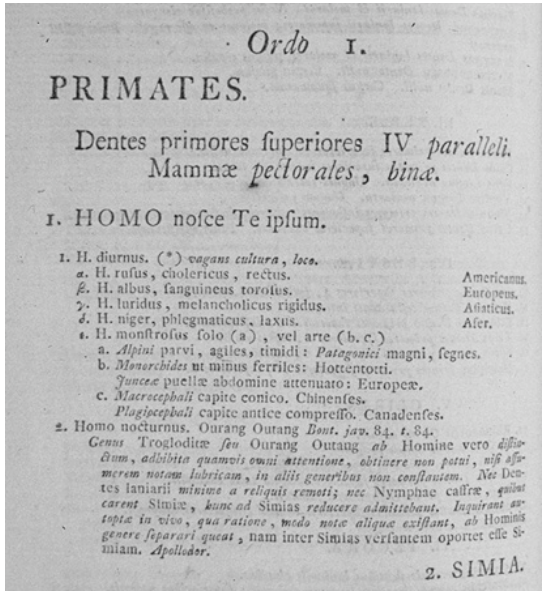
Ranked hierarchical nomenclature: Species were grouped into higher-level groupings, each of which had a *rank*. Here's how Linnaeus did it. . .

Regnum *Vegetabile*
Classis *Icosandria*
Ordo *Polygynia*
Genus *Rosa*
Species *canina*

"Artificial system" vs. "the natural system"



Diagrams representing eight of Linnaeus's classes, defined by the number of stamens (male organs). His "sexual system" was easy to use, but did not reflect "real affinities" (whatever *those* were. . .)



Ordo I.

PRIMATES.

Dentes primores ſuperiores IV *paralleli.*
Mammæ *pectorales*, *binæ.*

1. HOMO noſce Te ipſum.

1. H. diurnus. (*) *vagans cultura, loco.*
   - α. H. ruſus, cholericus, rectus. — Americanus.
   - β. H. albus, ſanguineus toroſus. — Europeus.
   - γ. H. luridus, melancholicus rigidus. — Aſiaticus.
   - δ. H. niger, phlegmaticus, laxus. — Afer.
   - ε. H. monſtroſus ſolo (a), vel arte (b. c.)
     - a. *Alpini* parvi, agiles, timidi: *Patagonici* magni, ſegnes.
     - b. *Monorchides* ut minus ferriles: Hottentotti.
       Junceæ puellæ abdomine attenuato: Europeæ.
     - c. *Macrocephali* capite conico. Chinenſes.
       Plagiocephali capite antice compreſſo. Canadenſes.

2. Homo nocturnus. Ourang Outang *Bont. jav.* 84. *t.* 84.
   Genus Troglodítæ *ſeu* Ourang Outang *ab* Homine vero *diffitendum, adhibita quamvis omni attentione, obtinere non potui, niſi aſſumerem notam lubricam, in aliis generibus non conſtantem. Nec* Dentes laniarii *minime a reliquis remoti; nec* Nymphae caffræ, *quibus carent* Simiæ, *hunc ad* Simias *reducere admittebant. Inquirant autoptæ in vivo, qua ratione, modo notæ aliquæ exiſtant, ab* Hominis *genere ſeparari queat*, nam inter Simias verſantem oportet eſſe Simiam. *Apollodor.*

2. SIMIA.

For vertebrates, Linnaeus focused on counting teeth and nipples, which also gave some odd results. . .

Nevertheless, despite its artificial nature, Linnaean taxonomy still is the basis for most subsequent biological taxonomy. We use a more “natural” system now. . .