e3 Relatedness of organisms < hierarchal, lumpers vs. splitters >

> Lyell's excellent view of geology, of each formation being merely a page torn out of a history, & the geologist being obliged to fill up the gaps. —Darwin.[1]
>
> The only reason we can indulge our penchant for discontinuous names at all is that we are spared sight of the extinct intermediates. —Richard Dawkins.[2]
>
> Charles [Tulasne (1816-1884)] created awe-inspiring three-dimensional depictions of fungi whose information content far exceeds that of any photograph ... Freed from the search for a single flawless [part] ... the illustrator can incorporate ... impressions of multiple individual specimens into the portrait of a particular organism, without having to contend with shadows that obscure parts of the structure in a photograph.
>
> With the same mastery ... Audubon (and, more recently, [D. A.] Sibley) profiled American bird species for serious ornithologists. —Nicholas P. Money.[3]

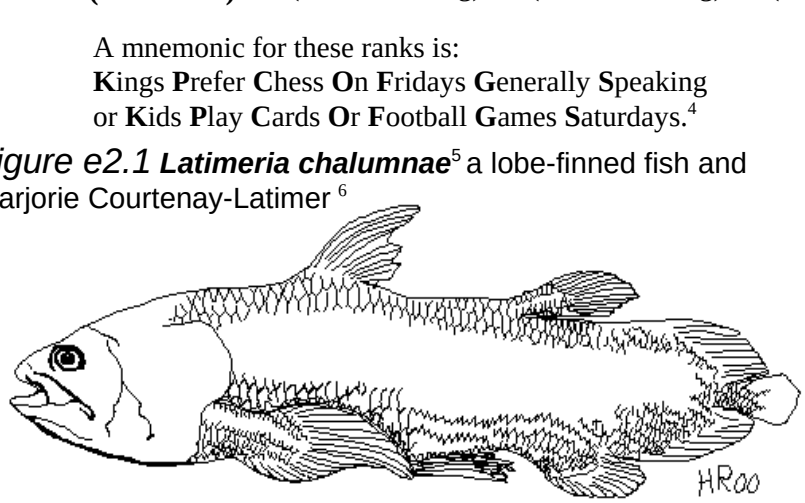
The *Linnaean* (also spelled *Linnean*) hierarchal classification of organisms is artificial but it is successful because in a gross way it accords to what can be predicted by the theory of evolution and genetics as regards distance in time to common ancestors (this finding would have surprised Linnaeus who believed species to be immutable). Thus, at each higher taxonomic level one must search lower (further back) in the fossil record to find the common ancestor. For example all humanity is one species as we are demonstrably related. But are we one species with other apes and monkeys? Demonstrably no. We, other apes, and monkeys are related as primates (a conservatively evolved group of mammals with adaptations suitable for locomotion in the trees even though some, including us, have returned to life on the ground). Apes and monkeys as primates are different from dogs and cats. However, all these are noticeably related as being mammals. Apes, monkeys, cats and dogs are related to fish only in that these are all vertebrates. Apes, monkeys, cats, dogs, fish are distantly related to insects in that insects are animals and not plants. And yes, animals and plants are remotely related in that they have some cell components in common such as mitochondria.

The hierarchal Linnaean scheme is illustrated, for example, by:

Kingdom	Animalia	Animalia	Animalia
Phylum	Chordata	Chordata	Chordata
Class	Mammalia	Mammalia	Osteichthyes
Order	Primates	Carnivora	Crossopterygii
Family	Hominidae	Canidae	—
Genus	*Homo*	*Canis*	*Latimeria*
Species (individual)	*Homo sapiens* (a human being)	*Canis familiaris* (a common dog)	*Latimeria chalumnae* (a modern coelacanth)

A mnemonic for these ranks is:
Kings **P**refer **C**hess **O**n **F**ridays **G**enerally **S**peaking
or **K**ids **P**lay **C**ards **O**r **F**ootball **G**ames **S**aturdays.[4]

Figure e2.1 ***Latimeria chalumnae***[5] a lobe-finned fish and Marjorie Courtenay-Latimer [6]



Note: Animals that have a common body plan (anatomical organization) are grouped as a phylum. Other ranks as applied are groups of species not always certainly with a common ancestor: such as "Articulata" (invertebrate animals with sequential body parts) that includes a variety of animals from different phyla, and some are intellectual constructs for convenience of discussion: "Vertebrata" refers to animals with a backbone (the smallest on record are: 6.2 mm long *Photocorynus spiniceps* anglerfish males (that must attach parasitically to female), free living female minnows, *Paedocypris progenetica*, 5.3-10.3 mm long, and 7 mm long, 1 milligram, male stout infantfish *Schindleria brevipinguis*;[7] and the largest on record is a 29 m long, 158 tonne female blue whale *Balaenoptera musculus*). The taxon Vertebrata can be ranked in the hierarchal classification scheme as a Subphylum of Chordata which includes all animals with a spinal nerve such as humans, dogs and fish with a backbone, and Tunicates with no spinal backbone.

Taxonomists can choose to expand the number of ranks with the prefixes: *sub-*, *super-*, and infra-, or whatever they deem necessary such as: *brigade, cohort, section, or tribe*, or most loosely a *group*. Botanists divide the plants into Divisions at the highest level below Kingdom.

Taxonomists themselves can be classified as "lumpers" [8] and "splitters" to account for much of where there is disagreement amongst them. For example, Ian Tattersall and Jeffrey H. Schwarts in *Extinct Humans*, 2000, reveal themselves to be splitters in their claim that same age Asian *Homo erectus* and African specimens belong to different species (in Africa: *Homo ergaster* and likely others). They assert that Asian specimens would not have interbred with African specimens if given the opportunity. Lumpers cherish an opposite belief. That "some paleoanthropologists ... were—bizarrely—heard muttering that there was not enough 'morphological space' between gracile australopiths [*sic*] and *H. erectus* to admit a third species" and others that there is "more than enough" gave Richard Dawkins to adjudicate that "arguments over whether there have been 15 species of extinct hominid or some other number are not worth the fuss." [2]

The hierarchal Linnaean scheme for a household cat in a major reference, such as Romer's *Vertebrate Paleontology*, is, for example:

Phylum (plural: **phyla)** ("chordates")
Class Mammalia ("mammals")
Subclass Theria ("therians")
Infraclass Eutheria ("eutherians")
Order Carnivora ("carnivores")
Infraorder Aeluroidea ("catlike")
Family Felidae ("cat family")
Genus (plural: **genera)** *Felis* (note: *Capitalized and italicized)* ("cats")
Species *Felis domesticus* (note: two words, *italicized*) ("domestic cats")

A ranking of organisms that have left a fossil record useful for stratigraphy is given in ***Table e3.1***:

The Darwinian theory of evolution (1859) had little immediate effect on taxonomy. This was because the trial and error methods of taxonomy based on comparative anatomy had already stumbled upon what was an essentially natural classification for macroscopic life. Nevertheless, the division of life into two Kingdoms, of plants and animals, is unsuitable for much microscopic life that came under increasing study:[9]

How does one rank an organism such as *Euglena* which has the characteristic of a plant's green coloration (the color of the light not absorbed), and yet has the animal characteristics of an eye spot and a flagellum for locomotion? What can be said of the fungi, which lack chlorophyll and so cannot photosynthesize as do green plants, and in a reverse manner to animals, digest their food externally (by putting enzymes and acids across their cell walls into the environment), and like plants absorb their nutrients through their cell walls? One thing that can be said is that evolutionary mimicry exists for even the fungi (***Footnote e3.1***). By the end of the 19th century, a third kingdom: the Protista, was proposed for single celled organisms of interest to both botanists and zoologists as these seemed to be the clear province of neither.

In 1798, Edward Jenner reported how he had noticed, over a period of years, that cow-pox provided immunity to smallpox, which formerly could be combated only by quarantine and variolation (inoculation in which people were deliberately infected with smallpox pus through skin incisions causing a milder form of the disease with only a 1 percent mortality rate, and immunity for survivors (although one percent acquired other diseases carried by the donor, such as syphilis) thereafter. This encouraged him to perform the first scratching "vaccination" of the "healthy boy" James Phipps on May 14, 1796, with cowpox from dairymaid Sarah Nelmes. Subsequently, (brave or cowed?) James survived repeated attempts to infect him with smallpox. What active substance was involved, none could say. In 1898, viruses as agents of disease that would pass through the finest filters were discovered but not until 1935 was the first purified virus obtained for study. As viruses are only known as parasites, which to reproduce must take over the host's protein-synthesizing mechanism, some biologists have denied that they, by any definition, are living. But how much have existing viruses been modified from ancestral forms that were, perhaps, not parasitic? [10]

In 1969, R. H. Whittaker proposed a five-Kingdom system of classification of life.[11] Woese in 1977 by comparing 16S ribosomal RNA sequences between two branches of organisms formerly considered to be bacteria, divided the Monera into 2 Kingdoms)[12] and in 1990 grouped the 6 Kingdoms into 3 domains.[13] In 2005, Sina Adl found for 6 Kingdoms.[14] (Of interest, no member of the hugely diverse domain Archaea is known to cause a disease.)[15]

1969 *Kingdoms*	*1977 | 2005* *Kingdoms*	*1990* *Domains*	
Monera	Eubacteria	Bacteria	viruses, bacteria (including: rickettsiae, cyanobacteria or "blue-green algae"), archaea
	Archaeabacteria	Archaea	
Protista	Protista	Eucarya	protophyta (unicellular algae), protozoa (unicellular animals)
Fungi	Fungi		mushrooms, molds, yeasts, slime molds
Plantae	Plantae		true algae, mosses, liverworts, ferns, connifers, flowering plants
Animalia	Animalia		sponges, corals, flatworms, flukes, tapeworms, wheel animacules, roundwormd, mollusks, arthropods, sea mats, arrowworms, lamp shells seasquirts, lancets, vertebrates

Informatics (the science of gathering and manipulation of information to facilitates its classification, storage, retrieval, and dissemination) and taxonomy are working together to realize H. C. J. Godfrey's suggestion in 2002 that "species descriptions, images and a platform for publication and debate should be provided on the web." Already there is: The 2002 *Catalogue of Life* (lists 260,00 species—860,000 names, including synonyms and common names), Global Taxonomy Initiative (GTI), *ZooBank* compiled by the International Commission on Zoological Nomenclature, *Encyclopedia of Life* (EOL) promises a curated "mashup" (i.e. a Web app with interactive user participation and a monster-of-Frankenstein-like manner in which it aggregates and stitches together third-party data)[16] all species catalogue, *PhyloCode* is a formal set of rules governing phylogenetic nomenclature,[17] and *Global Biodiversity Information Facility* (GBI). In this latter, taxonomic names are unique codes that unlock the library of knowledge about the named organisms but, as Kevin Thiele & David Yeates remind, "a taxon—the base unit of a taxonomy—is an hypothesis, not an observation or 'fact'... and as such should be as volatile as hypotheses in any other field—proposed, used, modified and then perhaps discarded as evidence dictates."[18]

Footnote e3.1 *Amanita caesarea*, is perfectly edible, whereas one cubic centimeter of equally palatable, and almost identical, death-cap mushroom *Amanita phalloides*, is "sufficient to kill the average thrill-seeking mushroom collector who attempts to distinguish between two," warns David Moore.[19] For animals: Batesian parasitic mimicry is when a prey species that predators reject (because it is poisonous, say) has its protection compromised by a toothsome-other evolving to look like it; and, Müllerian mutualistic mimicry is when both are unpalatable and spread out the cost to predation by naïve predators. To this latter, Graeme Ruxton and Michael Speed add the finding that individuals of two species with different defenses can gain more protection from mimicry than from simply increasing the population density of their own species.[20]

Table e3.1 A short classification of organisms that have left a fossil record useful for geological stratigraphy

KINGDOM	**ANIMALIA**	**KINGDOM**	**PLANTAE**
PHYLUM	PROTOZOA	DIVISION)	THALLOPHYTA
Class	Sarcodina	Subdivision	BRYOPHYTA
Order	Foraminifera		PSILOPSIDA
	Radiolaria		LYCOPSIDA
	PORIFERA		SPHENOPSIDA
	Spongia		FILICINAE
	Archaeocyatha		GYMNOSPERMAE
	Stromatoporoidea		Pinicae
	CNIDARIA		Gneticae
	Tabulata		ANGIOSPERMAE
	Rugosa		Magnoliopsida (Dicots)
	Scleractinia		Liliopsida (Monocots)
	BRYOZOA		
	BRACHIOPODA		
	Inarticulata		
	Articulata		
	MOLLUSCA		
	Pelecypoda		
	Gastropoda		
	Cephalopoda		
	Nautiloidea		
	Ammonoidea		
	Belemnoidea		
	ANNELIDA		
	ARTHROPODA		
	Trilobita		
	Chelicerata		
	Ostracoda		
	ECHINODERMATA		
	Crinoidea		
	Cystoidea		
	Blastoidea		
	Echinoidea		
	Asteroidea		
	HEMICHORDATA		
	Graptolithina		
	Dendroidea		
	Graptoloidea		
	CHORDATA		
	Conodontophora		
	Agnatha		
	Placodermii		
	Chondrichthyes		
	Osteichthyes		
	Amphibia		
	Reptilia		
	Aves		
	Mammalia