more *pragmatic*. This is not to adopt the *antirealist* or *nominalist* position that there are no real differences between groups of animals for science to discover, but rather a "promiscuous realism," which rejects the essentialist suggestion that the existence of such differences entails that there is only one correct way of answering questions of biological classification. In this view, defended by John Dupré among others, nothing scientists discover could possible answer a question such as "are whales fish?" because terms like "fish" have both a technical scientific sense (viz. cold-blooded aquatic vertebrate with gills) as well an equally legitimate and realist everyday or "ordinary language" sense (according to which aquatic mammals might count as fish), fixed by conventional use. Thus, whether or not we are to count whales as fish depends on which sense of "fish" we are interested in, much like whether or not we wish to call a tomato a vegetable or a fruit depends on whether we are practicing botany or making a fruit salad (it is interesting to note, in this context, that in 1893 the Supreme Court of the United States ruled that the tomato was a vegetable and, therefore, subject to import taxes). The promiscuous realist is also happy to allow that scientific discovery may well come to change our ordinary (folkbiological) concept of a fish (if it has not, to some extent, done so already), perhaps even making it the case that the two definitions will overlap, but he will insist that there is no reason to think that it *must*, or that until it does (or did) our everyday notion is in some way deficient. Biology cannot tell us what a fish is (what its *essence* amounts to) because "fish" is not a biological category. In this view, nothing in nature can determine whether or not there is such a thing as a "mammalian fish."

The view that how we choose to classify an organism depends on our interests can easily also be applied to the issue of human-animal relationships. If we wish to emphasize the similarities between humans and various (other) animals we may chose to do so by saying that human beings are animals too. If by contrast we wish to highlight general dissimilarities between humans and (other) higher order animals—perhaps while also emphasizing similarities between the latter and lower order animals—we might find it effective to do so by reserving the term "animal" for nonhuman creatures. Yet a person who at one time takes the first approach and at another time the second need not be contradicting herself because it is of interest and also important to come to terms with why both the similarities and differences have evolved.

Further Resources

Dupré, J. (2002). *Humans and other animals*. Oxford: Clarendon Press.

Hacking, I. (1983). *Representing and intervening*. Cambridge: Cambridge University Press.

Mayr, E. (1942/1999). *Systematics and the origin of species from the viewpoint of a zoologist*. Cambridge, MA: Harvard University Press.

———. (1975). *Population, species, and evolution*. Cambridge, MA: Harvard University Press.

Constantine Sandis

Classification
The Scala Naturae

The Origins of the *Scala Naturae*

The *Scala Naturae* ("Natural Scale" or "Great Chain of Being") is a philosophical view of nature attributed to Aristotle from the third century BCE. According to Aristotle, nature could be arranged on a graded scale of complexity, perfection, and value. Inorganic

objects, such as rocks, occupy the lowest levels of the scale. Plants lie just above inorganic objects. Thereafter the scale moves up from "lower" animals (invertebrates) to "higher" animals (vertebrates), to humans, who occupy a position above all other life forms. In many versions of the scala naturae metaphysical beings, such as angels, occupy a position above humankind and just below god at the pinnacle.

The scala naturae is not just an organizational scheme of nature. It is also a scale of worth. What is higher on the scale is viewed as more valuable than what is lower because, according to Aristotle, the "principle of form" is more advanced in higher organisms than in lower ones. Describing the life forms as one moves up the scala naturae, Aristotle stated that "one after another shows more possession of life and movement." Aristotle saw the scale as eternally fixed with no organism able to move to another level over time. Therefore, the scala naturae engendered a world view that saw god as perfect and all other creatures, including humans, as progressively less perfect semblances of god. Humans, however, occupied a special status in the hierarchy as the most "advanced" species and therefore closer to god than any others.

The scala naturae view of nature might have remained an historical oddity, much the same as the flat-earth theory, had it not been readily passed down by successive generations of scientists, philosophers, and others. Just before the emergence of Charles Darwin's theory of natural selection, another biologist, Jean Lamarck, put forth the idea that nature represented progressive levels of "perfection" in nervous system organization and that as one moves up the hierarchy, new psychological capacities emerge as nervous systems become more "perfect." Although Lamarck may be best known for his abandoned theory of "inheritance of acquired traits," his scala naturae notions about the brain and intelligence remain present in modern thinking.

The Scala Naturae in Modern Times

The scala naturae became known as the "phylogenetic" or "phyletic scale" in modern post-Darwinian times. The phylogenetic scale has an air of scientific legitimacy because it appears to reflect evolutionary relationships among organisms. Yet, like the scala naturae, the phylogenetic scale is a hierarchical scheme that promotes the idea that organisms on a higher level of the scale than others are more "evolutionarily developed" and that, in general, the organisms on the scale represent an evolutionary line of gradation from less evolved to more evolved forms. The notion of the phyletic scale is based on comparisons across modern species. For example, the phylogenetic scale would classify modern teleost fish "below" modern mammals despite the fact that modern fish and modern mammals do not have an ancestor-descendent relationship. Modern fish and mammals, as is true of all contemporary species, are surviving representatives of specific evolutionary lineages. Therefore, the phylogenetic scale confuses biological *relatedness* with *unilinearity* or *descent*.

By the mid- to late-twentieth century scientists possessed a sophisticated understanding of evolution that incorporated molecular genetics. Evolution came to be commonly expressed as a change in the frequency of gene forms (called *alleles*) over generations. Likewise, definitions of evolution reflected our understanding of the dynamic, rather than fixed, properties of nature. Yet the notion of the phyletic scale continued to have a profound influence in many modern scientific fields such as comparative psychology. Many definitions of animal intelligence, for instance, were entirely consistent with the Lamarckian (and hence Aristotelian) view espoused well over a century earlier. For example, in a 1958 paper on the evolution of learning, the highly influential psychologist Harry Harlow (1958) wrote:

> [S]imple as well as complex learning problems might be arranged into an orderly classification in terms of difficulty, and that the capabilities of animals on these tasks would correspond roughly to their positions on the phylogenetic scale. (283)

In 1964 the authors of a popular comparative psychology textbook characterized the evolution of behavior according to the following scala naturae stance:

> As one climbs the scale from fish to primates the principle seems best stated as follows: The higher the phyletic level the greater the multiple determination of behavior. (Ratner & Denny, 1964, p. 680)

As late as the 1970s the phylogenetic scale was given new vigor by the wildly popular book and television documentary *The Ascent of Man* by Jacob Bronowski. Bronowski's book title, along with chapter titles such as "Lower Than Angels" and "Ladder of Creation," is clearly rooted in scala naturae thinking. Therefore, well into the last decades of the twentieth century the scala naturae continued to be highly influential in shaping scientific thought, educational agendas, and the public understanding of nature and our place in it.

In the twenty-first century our understanding of the nature of biological evolution is elucidated by revolutionary methodologies in genomic research. The present model of biological evolution is that of descent with modification. All modern species—sparrow, human, sponge, etc.—are extant representatives of that process. Ancestor-descendent relationships exist between earlier organisms and later forms, but no modern species are directly ancestral to any other. Our current model of nature rejects the validity of the scala naturae. On an *explicit* or public level this is indeed true. However, on an *implicit* unspoken level, the scala naturae remains a powerful idea that continues to bias our thinking about nature and evolution.

Impact and Implications of the Scala Naturae

The scala naturae continues to shape our deep, implicit assumptions about the relationship between humankind and the rest of nature. One of the forms these assumptions take is that of the teleological view. Teleology is the study of ends, purposes, and goals. Teleological thinking is based on the proposition that humankind is the inevitable goal of the evolutionary process. Accordingly, for all other species, evolution is the process of becoming more and more similar to humankind. Teleological thinking supports the misconception that other species are less perfect, less intelligent, or incomplete versions of humans. This idea is elegantly expressed by the great poet Ralph Waldo Emerson:

> Striving to be man, the worm
> Mounts through all the spires of form.

The scala naturae view promotes the idea that humans occupy not only the highest biological position in the hierarchy but also a unique position that amounts to a discontinuity from the rest of nature. Therefore, according to this view, humans are not only the "highest" beings (save for angels and deities) but they are also of a qualitatively different *nature* than other biological beings. In most scala naturae schemes humans are thought of as part animal and part spiritual. The scala naturae says that humans are different in *nature* than other species despite the evidence that we are *all animal*.

It should be noted that a rejection of the scala naturae is not tantamount to rejecting the notion that there are discontinuities across species. Discontinuities exist across

all species and are a natural part of the biological world. For example, dolphins are capable of echolocation, a highly sophisticated use of sound echoes to form mental representations. Humans do not have this sense, plain and simple. This is a discontinuity. But it does not make humans or dolphins different *in nature,* only in some features. Likewise, if humans are the only species to possess a syntactically driven communication system (and we do not know this yet), then there is a discontinuity between humans and other animals in terms of this specific feature but not in the actual nature or character of what a human being or other species is. In terms of anatomy, physiology, and neurobiology there is no evidence that humans are any more distinctive in nature from a lion or an aardvark as a lion and an aardvark are from each other. Yet to this day, the scala naturae influences both our scientific thinking as well as how we think about issues of animal welfare.

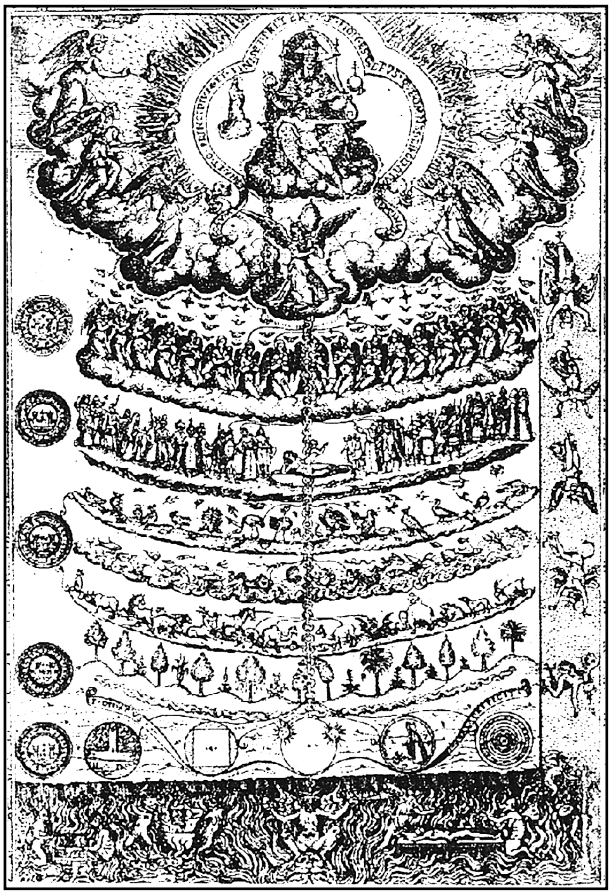
Scientific Reasoning

One of the most difficult problems in the field of science has been that of interpreting nonhuman animal behavior. A longstanding stricture in the field of animal behavior testing is to give animals' performance the most parsimonious explanation possible, that is, the simplest explanation that explains the greatest number of observations. This principle is known as Morgan's Canon, which itself has been heavily influenced by scala naturae beliefs. In its pure form Morgan's Canon does not preclude complex explanations for animal behavior when most parsimonious, but in actuality, it is almost universally interpreted as stating that we should not attribute "higher" faculties to an animal if the same behavior can be interpreted as the outcome of a simpler or "lower" level process. Therefore, the scala naturae imposes a unidirectional restriction on Morgan's Canon. But sometimes parsimony as interpreted in this way is false and can lead us astray in terms of our scientific thinking about animal behavior. There are many cases in the comparative psychology literature of humans and nonhumans performing equivalently on various convergent tests of cognition in the realms of self-monitoring, social interactions, learning, and memory. Yet scala naturae beliefs would require two explanations for the same phenomenon—a simpler one for the nonhuman and a more complex one for the human. This invokes two neurobehavioral mechanisms for a single phenomenon when there may be, in fact, a single explanation. For instance, both humans and great apes recognize themselves in mirrors when tested in very similar paradigms. The scala naturae view would have us invoke two neurobiological mechanisms for this single cognitive phenomenon. Morgan's Canon, in its pure form, would suggest that the same behavior under the same circumstances in two phylogenetically closely related species with similar brains is most parsimoniously explained by a shared mechanism. Likewise, many scientists have pointed out that the most parsimonious explanation is often the one that recognizes not only the continuity but the functional equivalence of brain and behavior across humans and nonhumans.

Animal Welfare

In addition to how we reason about scientific phenomena across species, the scala naturae view has profound consequences for how we treat other animals. As long as we view other animals as "less than" or "qualitatively different from" us then we may not feel the same moral responsibility for them as we do to each other. Part of this relates to the conclusions drawn from scientific research as mentioned above. Another part relates to the fact that the scala naturae view sometimes overrides scientific evidence. For instance, despite the fact that most mammals react similarly in similar arousing situations and possess the same neurological structures and neurochemicals underlying

emotion, there are still many who question whether animal emotions are as "real" as human emotions or whether other animals have emotions at all. The scala naturae view of these reactions in other species is that they are either *lesser* emotions or just *look* like emotions but are something rather different. Therefore, as long as the scala naturae view holds sway, it provides a justification for treating animals as less valuable than humans. Scientific evidence, however, provides no such justification. Yet, the way in which our society uses other species for food, entertainment, clothing, labor, while providing relatively little protection against neglect and abuse, belies the fact that the scala naturae has been rejected in the modern day.



1579 drawing of the great chain of being from Didacus Valades, Rhetorica Christiana. Courtesy of the Dover Pictorial Archives.

Summary

The scala naturae, or great chain of being—the view that humans sit atop a hierarchy of "lower to higher" organisms—has had a strong and lasting influence on thinking in scientific realms as well as in how we view ourselves in relation to other animals. The scala naturae notion has been buttressed by various scientists and thinkers throughout the centuries despite advancements in our understanding of evolution in the post-Darwinian world and genetics in the twentieth century. Although the scala naturae is today rejected on a public level, it continues in a more insidious, and therefore in a less extractable, form. Evidence for the fact that scala naturae is alive and well today is found in our scientific views of human and animal intelligence and in the myriad of ways we treat and mistreat other species.

A deep paradigm shift would be required to finally end the influence of scala naturae on modern thinking. This shift would result in a truly objective view of ourselves in relation to other species and, despite the differences, a fundamental acceptance of the higher order continuity in the *nature* of humans and other species. When this occurs, the scala naturae will go the way of other strange and misconceived theories from the past.

See also

Bonding—*Chimpanzee and Human Relationships*
Culture, Religion, and Belief Systems—"*Dolphin Mythology*"
Human Perceptions of Animals
Literature—*Human Communication's Effects on Relationships with Other Animals*

Further Resources

Campbell, C. B. G., & Hodos, W. (1991). The Scala Naturae revisited: Evolutionary scales and anagenesis in comparative psychology. *Journal of Comparative Psychology, 105,* 211–21.

Hodos, W., & Campbell, C. B. G. (1969). Scala Naturae: Why there is no theory in comparative psychology. *Psychological Review, 76,* 337–50.

Marino, L. (2003). Has scala naturae thinking come between neuropsychology and comparative neuroscience? *International Journal of Comparative Psychology, 16,* 28–43.

Lori Marino

■ Classification
Species Concept

A species is a biological classification that is lower than a *genus* and higher than a *variety*. Species, as the name suggests, indicates something *specific,* a group of living beings that possess some set of characteristics in common to make them distinct from other groups. The most popular definition of species today indicates an exclusive interbreeding group, the members of which are capable of passing along their characteristics to their offspring, but there is, generally speaking, no universally accepted definition of the term. Some claim that species are real (in the sense that they are natural groups existing in the real world), while others claim that they are human constructs (in the sense that such groupings are not naturally occurring but are, instead, a result of some human need to order the world). Whether real, constructed, or something else altogether, our concept of species speaks directly to the way in which we see ourselves, animals, and the relationships among us.

It is unclear the degree to which there are universal kinds in nature. Folk taxonomy is of little help. For example, which of the following seems most out of place in relation to the others: a pine tree, an oak tree, a cactus, or a daisy? For a botanist, the answer would be the pine tree, for pine trees are *gymnosperms,* whereas all the others are *angiosperms*. Similarly, science recognizes no such groups as *fish* or *flowers*. Trying to base a natural kind on common sense or on how much certain things look the same or share a similar form (morphology) is unhelpful for a scientist. Species are supposedly based on some deeper connection, some deeper shared essence. But if that is the case, how can such an essence be identified?

Categorization in nature no doubt goes back before the days of ancient Greece and Aristotle, but it is with Aristotle that orderly Western classification more or less begins. Members of a kind, according to Aristotle, share a common essence, or *eidos,* and it is the *eidos* that is responsible for making each member the sort of thing it is. In the Middle Ages this Aristotelian model continued to hold sway, mixed, however, with Christian theology until it became the Great Chain of Being. The Great Chain saw each creature in terms of a fixed essence that placed it on a hierarchy ranging from rocks to plants to animals to humans to angels to God. In the mid-1700s, Swedish taxonomist Linnaeus created the two-part genus-species classification still in use today, but as this was before the time of evolution, Linnaeus' categorization was based on a commitment to Aristotelian essentialism. Gone was the notion of the hierarchical single chain, but still there was the idea that genera and species had been supposedly endowed with