



Aristotle's Zoology

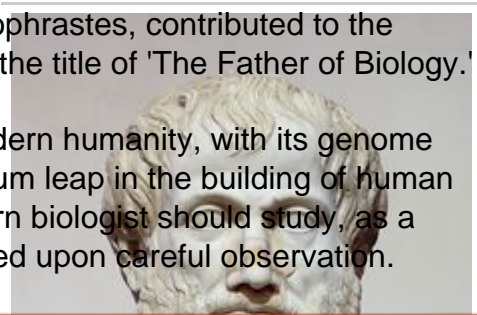
The History of Biology

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Any history of biology must start with Aristotle's zoology, one of the earliest studies of the natural world and a true defining moment in scientific history.

Whilst other Ancient Greeks, such as Anaximander and Theophrastes, contributed to the history of biology, Aristotle's zoology earns this brilliant mind the title of 'The Father of Biology.'

Aristotle's methods and theories seem a little primitive to modern humanity, with its genome codes, microbiology and medicine, but his work was a quantum leap in the building of human knowledge. Aristotle's zoology is something that every modern biologist should study, as a perfect example of how to build up a store of knowledge based upon careful observation.



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History of Biology - Anaximander and Theophrastus

Although Aristotle's zoology cemented his place as the father of biology, as the first person to apply empirical techniques [1] and a rudimentary scientific method [2] to his research, the earlier Greek philosophers, Anaximander and Theophrastus, deserve mentioning.

Aristotle's zoology was largely built upon their work and observations [3], so they earned a place in the annals of the long history of biology. As with much of the work of the Greek philosophers, much of the work of Anaximander and Theophrastus is lost in the mists of time

and their thoughts must be gleaned from secondary sources, revealing a tantalizing glimpse of their talent.

Anaximander the Milesian (c. 610 BC-c. 546 BC), the pupil of Thales, is often referred to as the first proponent of evolution. Whilst his theories seem very strange when compared to the later work of [Charles Darwin](#) [4], he was the first philosopher to postulate relationships between the various animals and humanity. Many of his exact points concerning the evolution of species and the origins of humanity sound almost comical, but the basic principle and philosophy behind his idea was extremely insightful.

There is much disagreement between historians over the various fragmentary sources and translations, but his thought certainly follows a chain of reasoning. Greek Philosophers did not like 'uncaused causes,' so Anaximander attempted to explain the origin of humanity by pointing out that the first humans must have come from somewhere, the first real inclusion of humans in the history of biology.

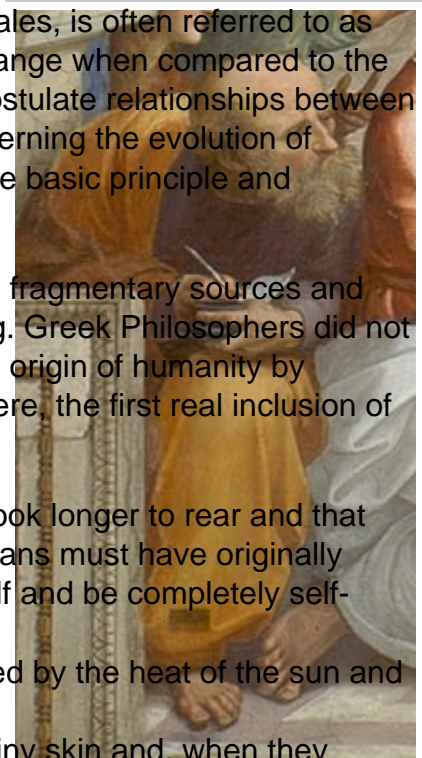
- Anaximander noticed that, compared to animals, humans took longer to rear and that children could not find food for themselves. Therefore, humans must have originally originated from another species that could find food for itself and be completely self-sufficient from a young age.
- Primitive animals were derived from the moisture evaporated by the heat of the sun and early humans resembled a fish
- The animals swimming in the water were protected by a spiny skin and, when they emerged onto the land, this skin split and their behaviors changed to suit the new environment.
- Therefore, fish and men were not created at the same time, but fish were first and gave rise to humanity through this process of change. This explains his first point, namely how could humans have arisen if the young cannot fend for themselves.

One other addition, found in a Latin text, was that fish emerged from the water and their skins burst, revealing humans who had grown to puberty inside the fish. However, this is so different from the other sources that it is possibly a very bad translation from the Greek, supported by the fact that this translation contains no direct quotes, unlike the others.

If this latter source is discredited, you can see the basis of a proto-evolutionary theory, that certainly lies at the foundation of both Lamarck's and Darwin's theories. Anaximander made other additions to the store of knowledge lying at the beginnings of the history of biology, but this contribution was one of the most important

Aristotle's Zoology - The Parts of Animals and the History of Animals

Aristotle (384 BC - 322 BC), the pupil of Plato, took great interest in the natural world, including many aspects of meteorology and geography, but his greatest contribution to science was in the fields of natural history and biology. Whilst earlier scholars made observations about flora and fauna, Aristotle was the first to use [empirical](#) [1] methods and techniques in a proto-scientific method. His meticulous methods and record keeping laid out the template for future researchers in the field, namely the later Islamic scholars, who would guard the wisdom of the Greeks and pass it to the Western world.



Detail de L'École d'Athènes de Raphaël, 1510-1511, Vatican, Rome (Public Domain)

Aristotle wrote a number of treatises based around his study of Zoology:

- The Parts of Animals
- The History of Animals
- The Movement of Animals
- The Progression of Animals
- On Sense and Sensible Objects
- On Memory and Recollection
- On Sleep and Waking
- On Dreams
- Of Prophecy in Sleep
- On Length and Shortness of Life
- On Youth and Old Age
- On Life and Death
- On Respiration
- On Breath
- On Plants

Aristotle's Zoology - Epigenesis and Bird Eggs

In a fine early example of an early observational biology experiment, Aristotle dissected bird's eggs at various stages of development, trying to understand the order in which the organs of the growing embryo developed. He noticed that the heart was the first thing to develop, with the other organs following in order. This fuelled his theory of Epigenesis, where the organs developed in a specific order, contrary to the prevalent belief that all of the organs were present from conception and simply grew in size.

Without the aid of a microscope, Aristotle was actually incorrect about the heart, as it was the spinal cord that he saw developing. He believed that the most important organs would develop first and, as he believed that the heart was the seat of thought, logically this would be the first organ to develop. However, his idea of a strict order to development was correct, a fact not fully established for many centuries.

Taxonomy

The First Systematic Classification in the History of Biology

Whilst earlier philosophers had tried to place animals into groups, the classifications were broad and sweeping, revealing little about the animals other than whether they flew, walked or swam. [Aristotle's zoology](#) ^[5] included systematically observing and studying a wide range of animals, noting the similarities and trying to connect like with like. He studied animals from all around Greece, and it is likely that he received exotic specimens from his sponsor and ex-pupil, Alexander the Great.

Aristotle's' zoology and the classification of species was his greatest contribution to the history of biology, the first known attempt to classify animals into groups according to their behavior and, most importantly, by the similarities and differences between their physiologies. Using observation and dissection, he categorized species. Although his broad classifications seem strange to modern zoologists, considering the limited equipment and store of knowledge he

had access to, Aristotle's zoology stands as a tribute to his systematic methods and empirical approach to acquiring knowledge.

In the 'History of Animals,' he looked at the physiology of animals, comparing and contrasting the organs and their specific functions. He noted how the same organs varied in different animals and documented how the same organs possessed completely different functions. He related this to the lifestyle and the habitat of the species, pointing out how organs differ according to whether the animal lives on land, flies or is aquatic, and whether the animal breathes air or not.

These distinctions had been made by other Ancient Greek scholars earlier in the history of biology, but Aristotle's zoology went further and pointed out that, for example, aquatic animals occupied completely different habitats, some living in the sea, others in rivers, lakes or marshes. These sub-divisions further compounded the differences between the organs. Even animals that lived in the sea could be differentiated by habitat and, therefore, form and function, with some animals being pelagic, some living on rocks, and others adopting a littoral lifestyle.

Amongst land animals there were divisions, with some animals having lungs and breathing air in the same way as humans and also collecting food in much the same way. Aristotle's zoology proposed that bees and insects did not breathe air, based upon their lack of lungs; he was incorrect in this but, considering that he had no access to microscopy, Aristotle can be forgiven this inaccuracy.

Aristotle's zoology also made distinctions between the habits of animals, pointing out that some ate flesh, some fruit and others both. His work continued in this way, meticulously dividing and subdividing animals into groups and pointing out exceptions to the rule. Aristotle noticed that, whilst most sharks produce eggs, some produced live young, a feature that he could only have noticed through careful observation and dissections.

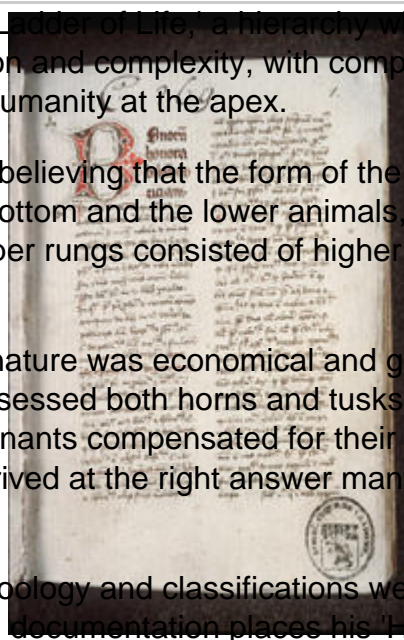
Aristotle's Zoology and the Ladder of Life

Ultimately, he proposed the 'Ladder of Life,' a hierarchy where animals were ultimately classified according to function and complexity, with complex organisms occupying positions further upon the ladder and humanity at the apex.

Aristotle proposed 11 levels, believing that the form of the creature at birth dictated their position. Plants were at the bottom and the lower animals, laying cold, hard eggs, occupying the middle echelons. The upper rungs consisted of higher animals giving birth to warm, live young.

In addition, he believed that nature was economical and gave no animal too many gifts, observing that no animal possessed both horns and tusks and pointing out that the chambered stomachs of ruminants compensated for their weak teeth. This was a surprisingly subtle observation and he arrived at the right answer many centuries before Darwin, albeit with incorrect reasoning.

Ultimately, whilst Aristotle's zoology and classifications were broad and often inaccurate, the sheer scale and the thorough documentation places his 'History of Animals' as one of the landmark scientific texts in the history of biology. Aristotle's work was the beginning of the



Expositio et quaestiones in Aristotelis De anima (Public Domain)

science of zoology, with many of his observations pre-empting the studies of great naturalists such as Darwin, Linnaeus and Wallace. Sadly, whilst the observations were spread across nine books relating Aristotle's history of animals, much of this work was lost

Aristotle's Zoology and Philosophy

Aristotle's zoology, due to the dominant philosophical view in Greece, had a very holistic view of nature and believed that all life had souls. Plants possessed a 'vegetative soul,' which conferred the gift of reproduction and growth, and animals added a 'sensitive soul,' granting movement and senses. Only humans possessed a 'rational soul,' gifting humanity with the ability to reason and reflect.

In this philosophy, Aristotle did not attempt to separate the empirical research [1] from philosophy and spirituality, a unity that would continue until the coming of the rationalists and the enlightenment.

Theophrastes

The Father of Botany

If Aristotle goes down in the history of biology as the Father of Biology and Zoology, Theophrastes (371 - 287 BC) certainly earns the title of 'Father of Botany.' As the pupil and companion of Aristotle, and the man Aristotle chose as his successor, Theophrastes applied Aristotelian empiricism and meticulous methodology to the study of plants.

In two works, 'Enquiry into Plants' and 'On the Causes of Plants,' he made the first systemized study of the plant world, in exactly the same way that his mentor categorized animals. His ten book 'Enquiries into Plants,' series, of which nine survive, studied the distribution, germination methods, size and common uses as ways of dividing and subdividing into groups.

The first book dealt with the parts of plants and their function, and he also recognized the importance of germination. He attempted to classify over 500 plants into trees, shrubs, undershrubs and herbs and, whilst he was not entirely successful in this, he certainly understood which features of plants were necessary for making distinctions. Like Aristotle, he was completely unaware of the sheer complexity of the fine distinctions between plants, as shown by modern classification systems.

Theophrastes (Public

The History of Biology - Other Ancient Greek and Roman Contributions

Other Ancient Greeks contributed to the burgeoning history of biology, although their contributions are not as well known as Aristotle's zoology. In the 3rd Century BC, Diocles of Carystus wrote a treatise on herbal plants, and he was emulated by Crateuas, in the 1st century CE, but their work did not survive. Pedanios Dioscorides wrote De Materia Medica, in 65 CE, a lengthy treatise on known medical herbs.

The work of Pliny the Elder, *Naturalis Historia*, covered botany and zoology in detail, documenting many animal and plant species. This, alongside Cato the Elder's (234 - 149

Ancient greek philosopher and botanist. (Creative Commons [6])

BCE) work on medicine and farming, known as De Agricultura, marked the Roman contribution to the history of biology. The history of biology was interrupted by the fall of the Roman Empire and would only be resurrected with the coming of the Islamic age.

The History of Biology - The Ancient Greeks

Considering the limited equipment and knowledge of the Ancient Greeks, their contribution to the history of Biology was truly remarkable, bringing a systematic approach to study and the first signs of empiricism and a proto-scientific method. Anaximander was the first known mind to contemplate the origins of humanity and largely separate it from divine creation stories.

Aristotle's zoology earns him the title of the father of biology, because of his systematic approach to classification and his use of physiology to uncover relationships between animals. He influenced Theophrastes and, whilst other Greeks and later Roman philosophers contributed, these three can lay claim to being at the starting point of the history of biology.

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