

Aristotle

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Aristotle (Ancient Greek: Ἀριστοτέλης [aristotélɛːs], *Aristotélēs*) (384 BC – 322 BC)^[1] was a Greek philosopher and polymath, a student of Plato and teacher of Alexander the Great. His writings cover many subjects, including physics, metaphysics, poetry, theater, music, logic, rhetoric, linguistics, politics, government, ethics, biology, and zoology. Together with Plato and Socrates (Plato's teacher), Aristotle is one of the most important founding figures in Western philosophy. Aristotle's writings were the first to create a comprehensive system of Western philosophy, encompassing ethics, aesthetics, logic, science, politics, and metaphysics.

Aristotle's views on the physical sciences profoundly shaped medieval scholarship, and their influence extended well into the Renaissance, although they were ultimately replaced by Newtonian physics. In the zoological sciences, some of his observations were confirmed to be accurate only in the 19th century. His works contain the earliest known formal study of logic, which was incorporated in the late 19th century into modern formal logic.

In metaphysics, Aristotelianism had a profound influence on philosophical and theological thinking in the Islamic and Jewish traditions in the Middle Ages, and it continues to influence Christian theology, especially the scholastic tradition of the Catholic Church. Aristotle was well known among medieval Muslim intellectuals and revered as 'المعلم الأول' – "The First Teacher".

His ethics, though always influential, gained renewed interest with the modern advent of virtue ethics. All aspects of Aristotle's philosophy continue to be the object of active academic study today. Though Aristotle wrote many elegant treatises and dialogues (Cicero described his literary style as "a river of gold"),^[2] it is thought that the majority of his writings are now lost and only about one-third of the original works have survived.^[3]

Aristotle



Marble bust of Aristotle. Roman copy after a Greek bronze original by Lysippus c. 330 BC. The alabaster mantle is modern.

Born	384 BC Stagira, Chalcidice
Died	322 BC (aged 61 or 62) Euboea
Nationality	Greek
Era	Ancient philosophy
Region	Western philosophy
School	Peripatetic school Aristotelianism
Main interests	Physics, Metaphysics, Poetry, Theatre, Music, Rhetoric, Politics, Government, Ethics, Biology, Zoology
Notable ideas	Golden mean, Aristotelian logic, syllogism, hexis, hylomorphism, Aristotle's theory of soul
Influenced by	
Influenced	

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Life

Aristotle, whose name means "the best purpose,"^[4] was born in Stagira, Chalcidice, in 384 BC, about 55 km (34 mi) east of modern-day Thessaloniki.^[5] His father Nicomachus was the personal physician to King Amyntas of Macedon. Although there is little information on Aristotle's childhood, he probably did spend some time then in the Macedonian palace, making his first connections with the Macedonian monarchy.^[6]

At about the age of eighteen, he went to Athens to continue his education at Plato's Academy. Aristotle remained at the academy for nearly twenty years before leaving Athens in 348/47 BC. The traditional story about his departure reports that he was disappointed with the direction the academy took after control passed to Plato's nephew Speusippus upon his death, although it is possible that he feared anti-Macedonian sentiments and left before Plato had died.^[7]

He then traveled with Xenocrates to the court of his friend Hermias of Atarneus in Asia Minor. While in Asia, Aristotle traveled with Theophrastus to the island of Lesbos, where together they researched the botany and zoology of the island. Aristotle married Hermias's adoptive daughter (or niece) Pythias. She bore him a daughter, whom they named Pythias. Soon after Hermias' death, Aristotle was invited by Philip II of

Macedon to become the tutor to his son Alexander in 343 BC.^[8]

Aristotle was appointed as the head of the royal academy of Macedon. During that time he gave lessons not only to Alexander, but also to two other future kings: Ptolemy and Cassander.^[9]

Aristotle encouraged Alexander toward eastern conquest, and his attitude towards Persia was unabashedly ethnocentric. In one famous example, he counsels Alexander to be "a leader to the Greeks and a despot to the barbarians, to look after the former as after friends and relatives, and to deal with the latter as with beasts or plants".^[9]

By 335 BC he had returned to Athens, establishing his own school there known as the Lyceum. Aristotle conducted courses at the school for the next twelve years. While in Athens, his wife Pythias died and Aristotle became involved with Herpyllis of Stagira, who bore him a son whom he named after his father, Nicomachus. According to the Suda, he also had an eromenos, Palaephatus of Abydus.^[10]

It is during this period in Athens from 335 to 323 BC when Aristotle is believed to have composed many of his works.^[8] Aristotle wrote many dialogues, only fragments of which survived. The works that have survived are in treatise form and were not, for the most part, intended for widespread publication, as they are generally thought to be lecture aids for his students. His most important treatises include *Physics*, *Metaphysics*, *Nicomachean Ethics*, *Politics*, *De Anima (On the Soul)* and *Poetics*.

Aristotle not only studied almost every subject possible at the time, but made significant contributions to most of them. In physical science, Aristotle studied anatomy, astronomy, embryology, geography, geology, meteorology, physics and zoology. In philosophy, he wrote on aesthetics, ethics, government, metaphysics, politics, economics, psychology, rhetoric and theology. He also studied education, foreign customs, literature and poetry. His combined works constitute a virtual encyclopedia of Greek knowledge. It has been suggested that Aristotle was probably the last person to know everything there was to be known in his own time.^[11]

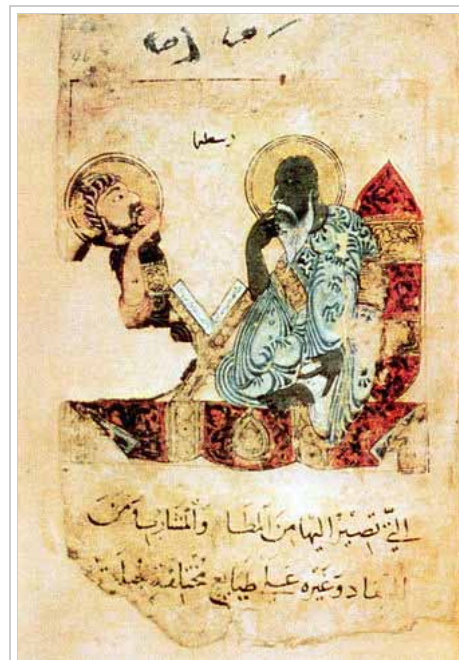
Near the end of Alexander's life, Alexander began to suspect plots against himself, and threatened Aristotle in letters. Aristotle had made no secret of his contempt for Alexander's pretense of divinity, and the king had executed Aristotle's grandnephew Callisthenes as a traitor. A widespread tradition in antiquity suspected Aristotle of playing a role in Alexander's death, but there is little evidence for this.^[12]

Upon Alexander's death, anti-Macedonian sentiment in Athens once again flared. Eurymedon the hierophant denounced Aristotle for not holding the gods in honor. Aristotle fled the city to his mother's family estate in Chalcis, explaining, "I will not allow the Athenians to sin twice against philosophy,"^{[13][14]} a reference to Athens's prior trial and execution of Socrates. He died in Euboea of natural causes within the same year: 322 BC. Aristotle named chief executor his student Antipater and left a will in which he asked to be buried next to his wife.^[15]

Thought

Logic

Main article: Term logic



An early Islamic portrayal of Aristotle (r) and Alexander the Great (l).

For more details on this topic, see Non-Aristotelian logic.

With the *Prior Analytics*, Aristotle is credited with the earliest study of formal logic, and his conception of it was the dominant form of Western logic until 19th century advances in mathematical logic. Kant stated in the *Critique of Pure Reason* that Aristotle's theory of logic completely accounted for the core of deductive inference.

History

Aristotle "says that 'on the subject of reasoning' he 'had nothing else on an earlier date to speak of'".^[16] However, Plato reports that syntax was devised before him, by Prodicus of Ceos, who was concerned by the correct use of words. Logic seems to have emerged from dialectics; the earlier philosophers made frequent use of concepts like *reductio ad absurdum* in their discussions, but never truly understood the logical implications. Even Plato had difficulties with logic; although he had a reasonable conception of a deductive system, he could never actually construct one, thus he relied instead on his dialectic.^[17]

Plato believed that deduction would simply follow from premises, hence he focused on maintaining solid premises so that the conclusion would logically follow. Consequently, Plato realized that a method for obtaining conclusions would be most beneficial. He never succeeded in devising such a method, but his best attempt was published in his book *Sophist*, where he introduced his division method.^[18]

Analytcs and the *Organon*

Main article: Organon

What we today call *Aristotelian logic*, Aristotle himself would have labeled "analytics". The term "logic" he reserved to mean *dialectics*. Most of Aristotle's work is probably not in its original form, since it was most likely edited by students and later lecturers. The logical works of Aristotle were compiled into six books in about the early 1st century AD:

1. *Categories*
2. *On Interpretation*
3. *Prior Analytics*
4. *Posterior Analytics*
5. *Topics*
6. *On Sophistical Refutations*

The order of the books (or the teachings from which they are composed) is not certain, but this list was derived from analysis of Aristotle's writings. It goes from the basics, the analysis of simple terms in the *Categories*, the analysis of propositions and their elementary relations in *On Interpretation*, to the study of more complex forms, namely, syllogisms (in the *Analytics*) and dialectics (in the *Topics* and *Sophistical Refutations*). The first three treatises form the core of the logical theory *stricto sensu*: the grammar of the language of logic and the correct rules of reasoning. There is one volume of Aristotle's concerning logic not found in the *Organon*, namely the fourth book of *Metaphysics*.^[17]

Aristotle's scientific method

For more details on this topic, see Aristotle's theory of universals.



Aristotle portrayed in the 1493 *Nuremberg Chronicle* as a scholar of the 15th century A.D.

Like his teacher Plato, Aristotle's philosophy aims at the universal. Aristotle, however, finds the universal in particular things, which he calls the essence of things, while Plato finds that the universal exists apart from particular things, and is related to them as their prototype or exemplar. For Aristotle, therefore, philosophic method implies the ascent from the study of particular phenomena to the knowledge of essences, while for Plato philosophic method means the descent from a knowledge of universal Forms (or ideas) to a contemplation of particular imitations of these. For Aristotle, "form" still refers to the unconditional basis of phenomena but is "instantiated" in a particular substance (see *Universals and particulars*, below). In a certain sense, Aristotle's method is both inductive and deductive, while Plato's is essentially deductive from *a priori* principles.^[19]

In Aristotle's terminology, "natural philosophy" is a branch of philosophy examining the phenomena of the natural world, and includes fields that would be regarded today as physics, biology and other natural sciences. In modern times, the scope of *philosophy* has become limited to more generic or abstract inquiries, such as ethics and metaphysics, in which logic plays a major role. Today's philosophy tends to exclude empirical study of the natural world by means of the scientific method. In contrast, Aristotle's philosophical endeavors encompassed virtually all facets of intellectual inquiry.

In the larger sense of the word, Aristotle makes philosophy coextensive with reasoning, which he also would describe as "science". Note, however, that his use of the term *science* carries a different meaning than that covered by the term "scientific method". For Aristotle, "all science (*dianoia*) is either practical, poetical or theoretical" (*Metaphysics* 1025b25). By practical science, he means ethics and politics; by poetical science, he means the study of poetry and the other fine arts; by theoretical science, he means physics, mathematics and metaphysics.

If logic (or "analytics") is regarded as a study preliminary to philosophy, the divisions of Aristotelian philosophy would consist of: (1) Logic; (2) Theoretical Philosophy, including Metaphysics, Physics and Mathematics; (3) Practical Philosophy and (4) Poetical Philosophy.

In the period between his two stays in Athens, between his times at the Academy and the Lyceum, Aristotle conducted most of the scientific thinking and research for which he is renowned today. In fact, most of Aristotle's life was devoted to the study of the objects of natural science. Aristotle's metaphysics contains observations on the nature of numbers but he made no original contributions to mathematics. He did, however, perform original research in the natural sciences, e.g., botany, zoology, physics, astronomy, chemistry, meteorology, and several other sciences.

Aristotle's writings on science are largely qualitative, as opposed to quantitative. Beginning in the 16th century, scientists began applying mathematics to the physical sciences, and Aristotle's work in this area was deemed hopelessly inadequate. His failings were largely due to the absence of concepts like mass, velocity, force and temperature. He had a conception of speed and temperature, but no quantitative understanding of



Plato (left) and Aristotle (right), a detail of *The School of Athens*, a fresco by Raphael. Aristotle gestures to the earth, representing his belief in knowledge through empirical observation and experience, while holding a copy of his *Nicomachean Ethics* in his hand, whilst Plato gestures to the heavens, representing his belief in The Forms.



"Aristotle" by Francesco Hayez (1791–1882)

them, which was partly due to the absence of basic experimental devices, like clocks and thermometers.

His writings provide an account of many scientific observations, a mixture of precocious accuracy and curious errors. For example, in his *History of Animals* he claimed that human males have more teeth than females.^[20] In a similar vein, John Philoponus, and later Galileo, showed by simple experiments that Aristotle's theory that a heavier object falls faster than a lighter object is incorrect.^[21] On the other hand, Aristotle refuted Democritus's claim that the Milky Way was made up of "those stars which are shaded by the earth from the sun's rays," pointing out (correctly, even if such reasoning was bound to be dismissed for a long time) that, given "current astronomical demonstrations" that "the size of the sun is greater than that of the earth and the distance of the stars from the earth many times greater than that of the sun, then ... the sun shines on all the stars and the earth screens none of them."^[22]

In places, Aristotle goes too far in deriving 'laws of the universe' from simple observation and over-stretched reason. Today's scientific method assumes that such thinking without sufficient facts is ineffective, and that discerning the validity of one's hypothesis requires far more rigorous experimentation than that which Aristotle used to support his laws.

Aristotle also had some scientific blind spots. He posited a geocentric cosmology that we may discern in selections of the *Metaphysics*, which was widely accepted up until the 16th century. From the 3rd century to the 16th century, the dominant view held that the Earth was the rotational center of the universe.

Since he was perhaps the philosopher most respected by European thinkers during and after the Renaissance, these thinkers often took Aristotle's erroneous positions as given, which held back science in this epoch.^[23] However, Aristotle's scientific shortcomings should not mislead one into forgetting his great advances in the many scientific fields. For instance, he founded logic as a formal science and created foundations to biology that were not superseded for two millennia. Moreover, he introduced the fundamental notion that nature is composed of things that change and that studying such changes can provide useful knowledge of underlying constants.

Geology

As quoted from Charles Lyell's *Principles of Geology*:

He [Aristotle] refers to many examples of changes now constantly going on, and insists emphatically on the great results which they must produce in the lapse of ages. He instances particular cases of lakes that had dried up, and deserts that had at length become watered by rivers and fertilized. He points to the growth of the Nilotic delta since the time of Homer, to the shallowing of the Palus Maeotis within sixty years from his own time ... He alludes ... to the upheaving of one of the Eolian islands, previous to a volcanic eruption. The changes of the earth, he says, are so slow in comparison to the duration of our lives, that they are overlooked; and the migrations of people after great catastrophes, and their removal to other regions, cause the event to be forgotten.

He says [12th chapter of his *Meteorics*] 'the distribution of land and sea in particular regions does not endure throughout all time, but it becomes sea in those parts where it was land, and again it becomes land where it was sea, and there is reason for thinking that these changes take place according to a certain system, and within a certain period.' The concluding observation is as follows: 'As time never fails, and the universe is eternal, neither the Tanais, nor the Nile, can have flowed for ever. The places where they rise were once dry, and there is a limit to their operations, but there is none to time. So also of all other rivers; they spring up and they perish; and the sea also continually deserts some lands and invades others The same tracts, therefore, of the earth are not some always sea, and others always continents, but every thing changes in the course of time.'^[24]

Physics

Main article: Physics (Aristotle)

Five elements

Main article: Classical element

Aristotle proposed a fifth element, aether, in addition to the four proposed earlier by Empedocles.

- Earth, which is cold and dry; this corresponds to the modern idea of a solid.
- Water, which is cold and wet; this corresponds to the modern idea of a liquid.
- Air, which is hot and wet; this corresponds to the modern idea of a gas.
- Fire, which is hot and dry; this corresponds to the modern ideas of plasma and heat.
- Aether, which is the divine substance that makes up the heavenly spheres and heavenly bodies (stars and planets).

Each of the four earthly elements has its natural place. All that is earthly tends toward the center of the universe, i.e., the center of the Earth. Water tends toward a sphere surrounding the center. Air tends toward a sphere surrounding the water sphere. Fire tends toward the lunar sphere (in which the Moon orbits). When elements are moved out of their natural place, they naturally move back towards it. This is "natural motion" —motion requiring no extrinsic cause. So, for example, in water, earthy bodies sink while air bubbles rise up; in air, rain falls and flame rises. Outside all the other spheres, the heavenly, fifth element, manifested in the stars and planets, moves in the perfection of circles.

Motion

Main article: potentiality and actuality

Aristotle defined motion as the actuality of a potentiality *as such*.^[25] Aquinas suggested that the passage be understood literally; that motion can indeed be understood as the active fulfillment of a potential, as a transition toward a potentially possible state. Because actuality and potentiality are normally opposites in Aristotle, other commentators either suggest that the wording which has come down to us is erroneous, or that the addition of the "as such" to the definition is critical to understanding it.^[26]

Causality, The Four Causes

Main article: Four causes

Aristotle suggested that the reason for anything coming about can be attributed to four different types of simultaneously active causal factors:

- Material cause describes the material out of which something is composed. Thus the material cause of a table is wood, and the material cause of a car is rubber and steel. It is not about action. It does not mean one domino knocks over another domino.
- The formal cause is its form, i.e., the arrangement of that matter. It tells us what a thing is, that any thing is determined by the definition, form, pattern, essence, whole, synthesis or archetype. It embraces the account of causes in terms of fundamental principles or general laws, as the whole (i.e., macrostructure) is the cause of its parts, a relationship known as the whole-part causation. Plainly put, the formal cause is the idea existing in the first place as exemplar in the mind of the sculptor, and in the second place as intrinsic, determining cause, embodied in the matter. Formal cause could only refer to the essential quality of causation. A simple example of the formal cause is the mental image or idea that allows an artist, architect, or engineer to create his drawings.

- The efficient cause is "the primary source", or that from which the change under consideration proceeds. It identifies 'what makes of what is made and what causes change of what is changed' and so suggests all sorts of agents, nonliving or living, acting as the sources of change or movement or rest. Representing the current understanding of causality as the relation of cause and effect, this covers the modern definitions of "cause" as either the agent or agency or particular events or states of affairs. So, take the two dominoes, this time of equal weighting, the first is knocked over causing the second also to fall over.
- The final cause is its purpose, or that for the sake of which a thing exists or is done, including both purposeful and instrumental actions and activities. The final cause or teleos is the purpose or function that something is supposed to serve. This covers modern ideas of motivating causes, such as volition, need, desire, ethics, or spiritual beliefs.

Additionally, things can be causes of one another, causing each other reciprocally, as hard work causes fitness and vice versa, although not in the same way or function, the one is as the beginning of change, the other as the goal. (Thus Aristotle first suggested a reciprocal or circular causality as a relation of mutual dependence or influence of cause upon effect). Moreover, Aristotle indicated that the same thing can be the cause of contrary effects; its presence and absence may result in different outcomes. Simply it is the goal or purpose that brings about an event. Our two dominoes require someone or something to intentionally knock over the first domino, since it cannot fall of its own accord.

Aristotle marked two modes of causation: proper (prior) causation and accidental (chance) causation. All causes, proper and incidental, can be spoken as potential or as actual, particular or generic. The same language refers to the effects of causes, so that generic effects assigned to generic causes, particular effects to particular causes, operating causes to actual effects. Essentially, causality does not suggest a temporal relation between the cause and the effect.

Optics

Aristotle held more accurate theories on some optical concepts than other philosophers of his day. The earliest known written evidence of a camera obscura can be found in Aristotle's documentation of such a device in 350 BC in *Problemata*. Aristotle's apparatus contained a dark chamber that had a single small hole, or aperture, to allow for sunlight to enter. Aristotle used the device to make observations of the sun and noted that no matter what shape the hole was, the sun would still be correctly displayed as a round object. In modern cameras, this is analogous to the diaphragm. Aristotle also made the observation that when the distance between the aperture and the surface with the image increased, the image was magnified.^[27]

Chance and spontaneity

According to Aristotle, spontaneity and chance are causes of some things, distinguishable from other types of cause. Chance as an incidental cause lies in the realm of accidental things. It is "from what is spontaneous" (but note that what is spontaneous does not come from chance). For a better understanding of Aristotle's conception of "chance" it might be better to think of "coincidence": Something takes place by chance if a person sets out with the intent of having one thing take place, but with the result of another thing (not intended) taking place.

For example: A person seeks donations. That person may find another person willing to donate a substantial sum. However, if the person seeking the donations met the person donating, not for the purpose of collecting donations, but for some other purpose, Aristotle would call the collecting of the donation by that particular donator a result of chance. It must be unusual that something happens by chance. In other words, if something happens all or most of the time, we cannot say that it is by chance.

There is also more specific kind of chance, which Aristotle names "luck", that can only apply to human beings, since it is in the sphere of moral actions. According to Aristotle, luck must involve choice (and thus

deliberation), and only humans are capable of deliberation and choice. "What is not capable of action cannot do anything by chance".^[28]

Metaphysics

Main article: Metaphysics (Aristotle)

Aristotle defines metaphysics as "the knowledge of immaterial being," or of "being in the highest degree of abstraction." He refers to metaphysics as "first philosophy", as well as "the theologic science."

Substance, potentiality and actuality

See also: Potentiality and actuality (Aristotle)

Aristotle examines the concepts of substance and essence (*ousia*) in his *Metaphysics* (Book VII), and he concludes that a particular substance is a combination of both matter and form. In book VIII, he distinguishes the matter of the substance as the substratum, or the stuff of which it is composed. For example, the matter of a house is the bricks, stones, timbers etc., or whatever constitutes the *potential* house, while the form of the substance is the *actual* house, namely 'covering for bodies and chattels' or any other differentia (see also predicables) that let us define something as a house. The formula that gives the components is the account of the matter, and the formula that gives the differentia is the account of the form.^[29]

With regard to the change (*kinesis*) and its causes now, as he defines in his *Physics* and *On Generation and Corruption* 319b–320a, he distinguishes the coming to be from:

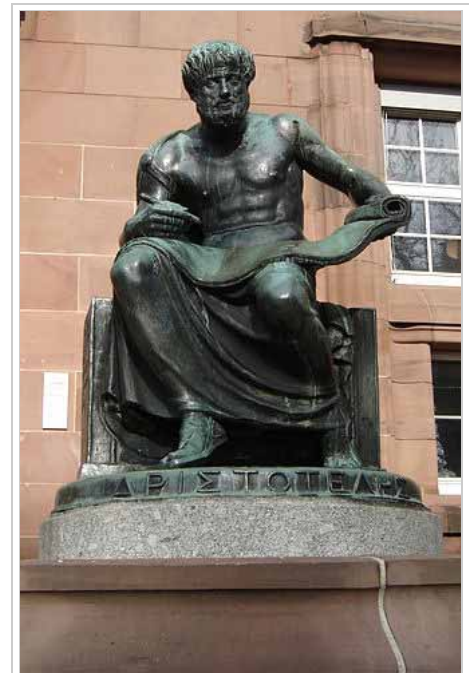
1. growth and diminution, which is change in quantity;
2. locomotion, which is change in space; and
3. alteration, which is change in quality.

The coming to be is a change where nothing persists of which the resultant is a property. In that particular change he introduces the concept of potentiality (*dynamis*) and actuality (*entelecheia*) in association with the matter and the form.

Referring to potentiality, this is what a thing is capable of doing, or being acted upon, if the conditions are right and it is not prevented by something else. For example, the seed of a plant in the soil is potentially (*dynamei*) plant, and if is not prevented by something, it will become a plant. Potentially beings can either 'act' (*poiein*) or 'be acted upon' (*paschein*), which can be either innate or learned. For example, the eyes possess the potentiality of sight (innate – being acted upon), while the capability of playing the flute can be possessed by learning (exercise – acting).

Actuality is the fulfillment of the end of the potentiality. Because the end (*telos*) is the principle of every change, and for the sake of the end exists potentiality, therefore actuality is the end. Referring then to our previous example, we could say that an actuality is when a plant does one of the activities that plants do.

"For that for the sake of which a thing is, is its principle, and the becoming is for the sake of the end; and the actuality is the end, and it is for the sake of this that the potentiality is acquired. For animals do not see in order that they may have sight, but they have sight that they may see."^[30]



Statue of Aristotle (1915) by Cipri Adolf Bermann at the University of Freiburg im Breisgau

In summary, the matter used to make a house has potentiality to be a house and both the activity of building and the form of the final house are actualities, which is also a final cause or end. Then Aristotle proceeds and concludes that the actuality is prior to potentiality in formula, in time and in substantiality.

With this definition of the particular substance (i.e., matter and form), Aristotle tries to solve the problem of the unity of the beings, for example, "what is it that makes a man one"? Since, according to Plato there are two Ideas: animal and biped, how then is man a unity? However, according to Aristotle, the potential being (matter) and the actual one (form) are one and the same thing.^[31]

Universals and particulars

Main article: Aristotle's theory of universals

Aristotle's predecessor, Plato, argued that all things have a universal form, which could be either a property, or a relation to other things. When we look at an apple, for example, we see an apple, and we can also analyze a form of an apple. In this distinction, there is a particular apple and a universal form of an apple. Moreover, we can place an apple next to a book, so that we can speak of both the book and apple as being next to each other.

Plato argued that there are some universal forms that are not a part of particular things. For example, it is possible that there is no particular good in existence, but "good" is still a proper universal form. Bertrand Russell is a contemporary philosopher who agreed with Plato on the existence of "uninstantiated universals".

Aristotle disagreed with Plato on this point, arguing that all universals are instantiated. Aristotle argued that there are no universals that are unattached to existing things. According to Aristotle, if a universal exists, either as a particular or a relation, then there must have been, must be currently, or must be in the future, something on which the universal can be predicated. Consequently, according to Aristotle, if it is not the case that some universal can be predicated to an object that exists at some period of time, then it does not exist.

In addition, Aristotle disagreed with Plato about the location of universals. As Plato spoke of the world of the forms, a location where all universal forms subsist, Aristotle maintained that universals exist within each thing on which each universal is predicated. So, according to Aristotle, the form of apple exists within each apple, rather than in the world of the forms.

Biology and medicine

In Aristotelian science, especially in biology, things he saw himself have stood the test of time better than his retelling of the reports of others, which contain error and superstition. He dissected animals but not humans; his ideas on how the human body works have been almost entirely superseded.

Empirical research program

Aristotle is the earliest natural historian whose work has survived in some detail. Aristotle certainly did research on the natural history of Lesbos, and the surrounding seas and neighbouring areas. The works that reflect this research, such as *History of Animals*, *Generation of Animals*, and *Parts of Animals*, contain some observations and interpretations, along with sundry myths and mistakes. The most striking passages are about the sea-life visible from observation on Lesbos and available from the catches of fishermen. His observations on catfish, electric fish (*Torpedo*) and angler-fish are detailed, as is his writing on cephalopods, namely, *Octopus*, *Sepia* (cuttlefish) and the paper nautilus (*Argonauta argo*). His description of the hectocotyl arm was about two thousand years ahead of its time, and widely disbelieved until its rediscovery in the 19th century. He separated the aquatic mammals from fish, and knew that sharks and rays were part of the group he called Selachē (selachians).^[32]

Another good example of his methods comes from the *Generation of Animals* in which Aristotle describes breaking open fertilized chicken eggs at intervals to observe when visible organs were generated.

He gave accurate descriptions of ruminants' four-chambered fore-stomachs, and of the ovoviviparous embryological development of the hound shark *Mustelus mustelus*.^[33]

Classification of living things

Aristotle's classification of living things contains some elements which still existed in the 19th century. What the modern zoologist would call vertebrates and invertebrates, Aristotle called 'animals with blood' and 'animals without blood' (he did not know that complex invertebrates do make use of hemoglobin, but of a different kind from vertebrates). Animals with blood were divided into live-bearing (humans and mammals), and egg-bearing (birds and fish). Invertebrates ('animals without blood') are insects, crustacea (divided into non-shelled – cephalopods – and shelled) and testacea (molluscs). In some respects, this incomplete classification is better than that of Linnaeus, who crowded the invertebrata together into two groups, Insecta and Vermes (worms).

For Charles Singer, "Nothing is more remarkable than [Aristotle's] efforts to [exhibit] the relationships of living things as a *scala naturae*"^[32] Aristotle's *History of Animals* classified organisms in relation to a hierarchical "Ladder of Life" (*scala naturae*), placing them according to complexity of structure and function so that higher organisms showed greater vitality and ability to move.^[34]

Aristotle believed that intellectual purposes, i.e., final causes, guided all natural processes. Such a teleological view gave Aristotle cause to justify his observed data as an expression of formal design. Noting that "no animal has, at the same time, both tusks and horns," and "a single-hooved animal with two horns I have never seen," Aristotle suggested that Nature, giving no animal both horns and tusks, was staving off vanity, and giving creatures faculties only to such a degree as they are necessary. Noting that ruminants had multiple stomachs and weak teeth, he supposed the first was to compensate for the latter, with Nature trying to preserve a type of balance.^[35]

In a similar fashion, Aristotle believed that creatures were arranged in a graded scale of perfection rising from plants on up to man, the *scala naturae* or Great Chain of Being.^[36] His system had eleven grades, arranged according "to the degree to which they are infected with potentiality", expressed in their form at birth. The highest animals laid warm and wet creatures alive, the lowest bore theirs cold, dry, and in thick eggs.

Aristotle also held that the level of a creature's perfection was reflected in its form, but not preordained by that form. Ideas like this, and his ideas about souls, are not regarded as science at all in modern times.

He placed emphasis on the type(s) of soul an organism possessed, asserting that plants possess a vegetative soul, responsible for reproduction and growth, animals a vegetative and a sensitive soul, responsible for mobility and sensation, and humans a vegetative, a sensitive, and a rational soul, capable of thought and reflection.^[37]

Aristotle, in contrast to earlier philosophers, but in accordance with the Egyptians, placed the rational soul in



Octopus swimming



Torpedo fuscumaculata



Leopard shark

the heart, rather than the brain.^[38] Notable is Aristotle's division of sensation and thought, which generally went against previous philosophers, with the exception of Alcmaeon.^[39]

Successor: Theophrastus

Main articles: Theophrastus and Historia Plantarum

Aristotle's successor at the Lyceum, Theophrastus, wrote a series of books on botany—the *History of Plants*—which survived as the most important contribution of antiquity to botany, even into the Middle Ages. Many of Theophrastus' names survive into modern times, such as *carpos* for fruit, and *pericarpion* for seed vessel.

Rather than focus on formal causes, as Aristotle did, Theophrastus suggested a mechanistic scheme, drawing analogies between natural and artificial processes, and relying on Aristotle's concept of the efficient cause. Theophrastus also recognized the role of sex in the reproduction of some higher plants, though this last discovery was lost in later ages.^[40]

Influence on Hellenistic medicine

For more details on this topic, see Medicine in ancient Greece.

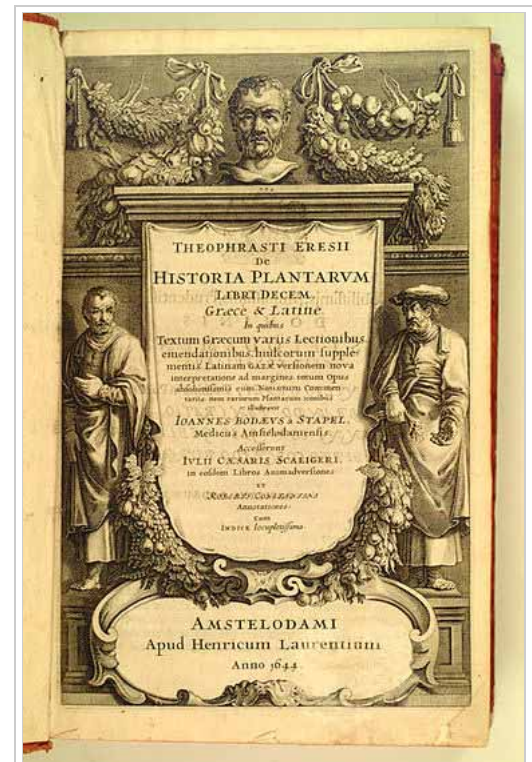
After Theophrastus, the Lyceum failed to produce any original work. Though interest in Aristotle's ideas survived, they were generally taken unquestioningly.^[41] It is not until the age of Alexandria under the Ptolemies that advances in biology can be again found.

The first medical teacher at Alexandria, Herophilus of Chalcedon, corrected Aristotle, placing intelligence in the brain, and connected the nervous system to motion and sensation. Herophilus also distinguished between veins and arteries, noting that the latter pulse while the former do not.^[42] Though a few ancient atomists such as Lucretius challenged the teleological viewpoint of Aristotelian ideas about life, teleology (and after the rise of Christianity, natural theology) would remain central to biological thought essentially until the 18th and 19th centuries. Ernst Mayr claimed that there was "nothing of any real consequence in biology after Lucretius and Galen until the Renaissance."^[43] Aristotle's ideas of natural history and medicine survived, but they were generally taken unquestioningly.^[44]

Psychology

Aristotle's psychology, given in his treatise *On the Soul* (*peri psyche*, often known by its Latin title *De Anima*), posits three kinds of soul ("psyches"): the vegetative soul, the sensitive soul, and the rational soul. Humans have a rational soul. This kind of soul is capable of the same powers as the other kinds: Like the vegetative soul it can grow and nourish itself; like the sensitive soul it can experience sensations and move locally. The unique part of the human, rational soul is its ability to receive forms of other things and compare them.

For Aristotle, the soul (*psyche*) was a simpler concept than it is for us today. By soul he simply meant the form of a living being. Since all beings are composites of form and matter, the form of living beings is that



The frontispiece to a 1644 version of the expanded and illustrated edition of *Historia Plantarum* (ca. 1200), which was originally written around 200 BC.

which endows them with what is specific to living beings, e.g. the ability to initiate movement (or in the case of plants, growth and chemical transformations, which Aristotle considers types of movement).^[45]

Practical philosophy

Ethics

Main article: Aristotelian ethics

Aristotle considered ethics to be a practical rather than theoretical study, i.e., one aimed at becoming good and doing good rather than knowing for its own sake. He wrote several treatises on ethics, including most notably, the *Nicomachean Ethics*.

Aristotle taught that virtue has to do with the proper function (*ergon*) of a thing. An eye is only a good eye in so much as it can see, because the proper function of an eye is sight. Aristotle reasoned that humans must have a function specific to humans, and that this function must be an activity of the *psuchē* (normally translated as *soul*) in accordance with reason (*logos*). Aristotle identified such an optimum activity of the soul as the aim of all human deliberate action, *eudaimonia*, generally translated as "happiness" or sometimes "well being". To have the potential of ever being happy in this way necessarily requires a good character (*ēthikē aretē*), often translated as moral (or ethical) virtue (or excellence).^[46]

Aristotle taught that to achieve a virtuous and potentially happy character requires a first stage of having the fortune to be habituated not deliberately, but by teachers, and experience, leading to a later stage in which one consciously chooses to do the best things. When the best people come to live life this way their practical wisdom (*phronesis*) and their intellect (*nous*) can develop with each other towards the highest possible human virtue, the wisdom of an accomplished theoretical or speculative thinker, or in other words, a philosopher.^[47]

Politics

Main article: Politics (Aristotle)

Like Aristotle, conservatives generally accept the world as it is; they distrust the politics of abstract reason – that is, reason divorced from experience.

Benjamin Wiker^[48]

In addition to his works on ethics, which address the individual, Aristotle addressed the city in his work titled *Politics*. Aristotle considered the city to be a natural community. Moreover, he considered the city to be prior in importance to the family which in turn is prior to the individual, "for the whole must of necessity be prior to the part".^[49] He also famously stated that "man is by nature a political animal". Aristotle conceived of politics as being like an organism rather than like a machine, and as a collection of parts none of which can exist without the others. Aristotle's conception of the city is organic, and he is considered one of the first to conceive of the city in this manner.^[50]

The common modern understanding of a political community as a modern state is quite different to Aristotle's understanding. Although he was aware of the existence and potential of larger empires, the natural community according to Aristotle was the city (*polis*) which functions as a political "community" or "partnership" (*koinōnia*). The aim of the city is not just to avoid injustice or for economic stability, but rather to allow at least some citizens the possibility to live a good life, and to perform beautiful acts: "The political partnership must be regarded, therefore, as being for the sake of noble actions, not for the sake of living together." This is distinguished from modern approaches, beginning with social contract theory, according to which individuals leave the state of nature because of "fear of violent death" or its "inconveniences."^[51]

Rhetoric and poetics

Main articles: Rhetoric (Aristotle) and Poetics (Aristotle)

Aristotle considered epic poetry, tragedy, comedy, dithyrambic poetry and music to be imitative, each varying in imitation by medium, object, and manner.^[52] For example, music imitates with the media of rhythm and harmony, whereas dance imitates with rhythm alone, and poetry with language. The forms also differ in their object of imitation. Comedy, for instance, is a dramatic imitation of men worse than average; whereas tragedy imitates men slightly better than average. Lastly, the forms differ in their manner of imitation – through narrative or character, through change or no change, and through drama or no drama.^[53] Aristotle believed that imitation is natural to mankind and constitutes one of mankind's advantages over animals.^[54]

While it is believed that Aristotle's *Poetics* comprised two books – one on comedy and one on tragedy – only the portion that focuses on tragedy has survived. Aristotle taught that tragedy is composed of six elements: plot-structure, character, style, thought, spectacle, and lyric poetry.^[55] The characters in a tragedy are merely a means of driving the story; and the plot, not the characters, is the chief focus of tragedy. Tragedy is the imitation of action arousing pity and fear, and is meant to effect the catharsis of those same emotions. Aristotle concludes *Poetics* with a discussion on which, if either, is superior: epic or tragic mimesis. He suggests that because tragedy possesses all the attributes of an epic, possibly possesses additional attributes such as spectacle and music, is more unified, and achieves the aim of its mimesis in shorter scope, it can be considered superior to epic.^[56]

Aristotle was a keen systematic collector of riddles, folklore, and proverbs; he and his school had a special interest in the riddles of the Delphic Oracle and studied the fables of Aesop.^[57]

Views on women

Main article: Aristotle's views on women

Aristotle's analysis of procreation describes an active, ensouling masculine element bringing life to an inert, passive female element. On this ground, feminists have accused Aristotle of misogyny^[58] and sexism.^[59] However, Aristotle gave equal weight to women's happiness as he did to men's, and commented in his *Rhetoric* that a society cannot be happy unless women are happy too.

Loss and preservation of his works

See also: Corpus Aristotelicum

Modern scholarship reveals that Aristotle's "lost" works stray considerably in characterization^[60] from the surviving Aristotelian corpus. Whereas the lost works appear to have been originally written with an intent for subsequent publication, the surviving works do not appear to have been so.^[60] Rather the surviving works mostly resemble lecture notes unintended for publication.^[60] The authenticity of a portion of the surviving works as originally Aristotelian is also today held suspect, with some books duplicating or summarizing each other, the authorship of one book questioned and another book considered to be unlikely Aristotle's at all.^[60]

Some of the individual works within the corpus, including the *Constitution of Athens*, are regarded by most scholars as products of Aristotle's "school," perhaps compiled under his direction or supervision. Others, such as *On Colors*, may have been produced by Aristotle's successors at the Lyceum, e.g., Theophrastus and Straton. Still others acquired Aristotle's name through similarities in doctrine or content, such as the *De*

Plantis, possibly by Nicolaus of Damascus. Other works in the corpus include medieval palmistries and astrological and magical texts whose connections to Aristotle are purely fanciful and self-promotional.^[61]

According to a distinction that originates with Aristotle himself, his writings are divisible into two groups: the "exoteric" and the "esoteric".^[62] Most scholars have understood this as a distinction between works Aristotle intended for the public (exoteric), and the more technical works intended for use within the school (esoteric). Modern scholars commonly assume these latter to be Aristotle's own (unpolished) lecture notes (or in some cases possible notes by his students).^[63] However, one classic scholar offers an alternative interpretation. The 5th century neoplatonist Ammonius Hermiae writes that Aristotle's writing style is deliberately obscurantist so that "good people may for that reason stretch their mind even more, whereas empty minds that are lost through carelessness will be put to flight by the obscurity when they encounter sentences like these."^[64]

Another common assumption is that none of the exoteric works is extant – that all of Aristotle's extant writings are of the esoteric kind. Current knowledge of what exactly the exoteric writings were like is scant and dubious, though many of them may have been in dialogue form. (*Fragments* of some of Aristotle's dialogues have survived.) Perhaps it is to these that Cicero refers when he characterized Aristotle's writing style as "a river of gold";^[65] it is hard for many modern readers to accept that one could seriously so admire the style of those works currently available to us.^[63] However, some modern scholars have warned that we cannot know for certain that Cicero's praise was reserved specifically for the exoteric works; a few modern scholars have actually admired the concise writing style found in Aristotle's extant works.^[66]

One major question in the history of Aristotle's works, then, is how were the exoteric writings all lost, and how did the ones we now possess come to us?^[67] The story of the original manuscripts of the esoteric treatises is described by Strabo in his *Geography* and Plutarch in his *Parallel Lives*.^[68] The manuscripts were left from Aristotle to his successor Theophrastus, who in turn willed them to Neleus of Scepsis. Neleus supposedly took the writings from Athens to Scepsis, where his heirs let them languish in a cellar until the 1st century BC, when Apellicon of Teos discovered and purchased the manuscripts, bringing them back to Athens. According to the story, Apellicon tried to repair some of the damage that was done during the manuscripts' stay in the basement, introducing a number of errors into the text. When Lucius Cornelius Sulla occupied Athens in 86 BC, he carried off the library of Apellicon to Rome, where they were first published in 60 BC by the grammarian Tyrannion of Amisus and then by the philosopher Andronicus of Rhodes.^{[69][70]}

Carnes Lord attributes the popular belief in this story to the fact that it provides "the most plausible explanation for the rapid eclipse of the Peripatetic school after the middle of the third century, and for the absence of widespread knowledge of the specialized treatises of Aristotle throughout the Hellenistic period, as well as for the sudden reappearance of a flourishing Aristotelianism during the first century B.C."^[71] Lord voices a number of reservations concerning this story, however. First, the condition of the texts is far too good for them to have suffered considerable damage followed by Apellicon's inexpert attempt at repair.

Second, there is "incontrovertible evidence," Lord says, that the treatises were in circulation during the time in which Strabo and Plutarch suggest they were confined within the cellar in Scepsis. Third, the definitive edition of Aristotle's texts seems to have been made in Athens some fifty years before Andronicus supposedly compiled his. And fourth, ancient library catalogues predating Andronicus' intervention list an Aristotelian corpus quite similar to the one we currently possess. Lord sees a number of post-Aristotelian interpolations in the *Politics*, for example, but is generally confident that the work has come down to us relatively intact.

On the one hand, the surviving texts of Aristotle do not derive from finished literary texts, but rather from working drafts used within Aristotle's school, as opposed, on the other hand, to the dialogues and other "exoteric" texts which Aristotle published more widely during his lifetime. The consensus is that Andronicus

of Rhodes collected the esoteric works of Aristotle's school which existed in the form of smaller, separate works, distinguished them from those of Theophrastus and other Peripatetics, edited them, and finally compiled them into the more cohesive, larger works as they are known today.^[72]

Legacy

More than 2300 years after his death, Aristotle remains one of the most influential people who ever lived. He contributed to almost every field of human knowledge then in existence, and he was the founder of many new fields. According to the philosopher Bryan Magee, "it is doubtful whether any human being has ever known as much as he did".^[73] Among countless other achievements,^[74] Aristotle was the founder of formal logic,^[74] pioneered the study of zoology, and left every future scientist and philosopher in his debt through his contributions to the scientific method.^{[75][76]}

Despite these achievements, the influence of Aristotle's errors is considered by some to have held back science considerably. Bertrand Russell notes that "almost every serious intellectual advance has had to begin with an attack on some Aristotelian doctrine". Russell also refers to Aristotle's ethics as "repulsive", and calls his logic "as definitely antiquated as Ptolemaic astronomy". Russell notes that these errors make it difficult to do historical justice to Aristotle, until one remembers how large of an advance he made upon all of his predecessors.^[8]



Aristotle with a Bust of Homer, by Rembrandt

Later Greek philosophers

The immediate influence of Aristotle's work was felt as the Lyceum grew into the Peripatetic school. Aristotle's notable students included Aristoxenus, Dicaearchus, Demetrius of Phalerum, Eudemos of Rhodes, Harpalus, Hephaestion, Meno, Mnason of Phocis, Nicomachus, and Theophrastus. Aristotle's influence over Alexander the Great is seen in the latter's bringing with him on his expedition a host of zoologists, botanists, and researchers. He had also learned a great deal about Persian customs and traditions from his teacher. Although his respect for Aristotle was diminished as his travels made it clear that much of Aristotle's geography was clearly wrong, when the old philosopher released his works to the public, Alexander complained "Thou hast not done well to publish thy acroamatic doctrines; for in what shall I surpass other men if those doctrines wherein I have been trained are to be all men's common property?"^[77]

Influence on Byzantine scholars

Greek Christian scribes played a crucial role in the preservation of Aristotle by copying all the extant Greek language manuscripts of the corpus. The first Greek Christians to comment extensively on Aristotle were John Philoponus, Elias, and David in the sixth century, and Stephen of Alexandria in the early seventh century.^[78] John Philoponus stands out for having attempted a fundamental critique of Aristotle's views on the eternity of the world, movement, and other elements of Aristotelian thought.^[79] After a hiatus of several centuries, formal commentary by Eustratius and Michael of Ephesus reappears in the late eleventh and early twelfth centuries, apparently sponsored by Anna Comnena.^[80]

Influence on Islamic theologians

Aristotle was one of the most revered Western thinkers in early Islamic theology. Most of the still extant works of Aristotle,^[81] as well as a number of the original Greek commentaries, were translated into Arabic

and studied by Muslim philosophers, scientists and scholars. Averroes, Avicenna and Alfarabi, who wrote on Aristotle in great depth, also influenced Thomas Aquinas and other Western Christian scholastic philosophers. Alkindus considered Aristotle as the outstanding and unique representative of philosophy^[82] and Averroes spoke of Aristotle as the "exemplar" for all future philosophers.^[83] Medieval Muslim scholars regularly described Aristotle as the "First Teacher".^[84] The title "teacher" was first given to Aristotle by Muslim scholars, and was later used by Western philosophers (as in the famous poem of Dante) who were influenced by the tradition of Islamic philosophy.^[85]

In accordance with the Greek theorists, the Muslims considered Aristotle to be a dogmatic philosopher, the author of a closed system, and believed that Aristotle shared with Plato essential tenets of thought. Some went so far as to credit Aristotle himself with neo-Platonic metaphysical ideas.^[81]

Influence on Western Christian theologians

With the loss of the study of ancient Greek in the early medieval Latin West, Aristotle was practically unknown there from c. AD 600 to c. 1100 except through the Latin translation of the *Organon* made by Boethius. In the twelfth and thirteenth centuries, interest in Aristotle revived and Latin Christians had translations made, both from Arabic translations, such as those by Gerard of Cremona,^[86] and from the original Greek, such as those by James of Venice and William of Moerbeke.

After Thomas Aquinas wrote his theology, working from Moerbeke's translations, the demand for Aristotle's writings grew and the Greek manuscripts returned to the West, stimulating a revival of Aristotelianism in Europe that continued into the Renaissance.^[87] Aristotle is referred to as "The Philosopher" by Scholastic thinkers such as Thomas Aquinas. See *Summa Theologica*, Part I, Question 3, etc. These thinkers blended Aristotelian philosophy with Christianity, bringing the thought of Ancient Greece into the Middle Ages. It required a repudiation of some Aristotelian principles for the sciences and the arts to free themselves for the discovery of modern scientific laws and empirical methods. The medieval English poet Chaucer describes his student as being happy by having

*at his beddes heed
Twenty bookes, clad in blak or reed,
Of aristotle and his philosophie,*^[88]

The Italian poet Dante says of Aristotle in the first circles of hell,

*I saw the Master there of those who know,
Amid the philosophic family,
By all admired, and by all revered;
There Plato too I saw, and Socrates,
Who stood beside him closer than the rest.*^[89]

Post-Enlightenment thinkers

The German philosopher Friedrich Nietzsche has been said to have taken nearly all of his political philosophy from Aristotle.^[90] However implausible this is, it is certainly the case that Aristotle's rigid separation of action from production, and his justification of the subservience of slaves and others to the virtue – or *arete* – of a few justified the ideal of aristocracy. It is Martin Heidegger, not Nietzsche, who elaborated a new interpretation of Aristotle, intended to warrant his deconstruction of scholastic and philosophical tradition. Ayn Rand accredited Aristotle as "the greatest philosopher in history" and cited him as a major influence on her thinking. More recently, Alasdair MacIntyre has attempted to reform what he calls the Aristotelian tradition in a way that is anti-elitist and capable of disputing the claims of both liberals and Nietzscheans.^[91]

List of works

Main article: Corpus Aristotelicum

The works of Aristotle that have survived from antiquity through medieval manuscript transmission are collected in the Corpus Aristotelicum. These texts, as opposed to Aristotle's lost works, are technical philosophical treatises from within Aristotle's school. Reference to them is made according to the organization of Immanuel Bekker's Royal Prussian Academy edition (*Aristotelis Opera edidit Academia Regia Borussica*, Berlin, 1831–1870), which in turn is based on ancient classifications of these works.

Honours

Aristotle Mountains on Oscar II Coast in Graham Land, Antarctica are named after Aristotle who was the first to conjecture the existence of a landmass in the southern high-latitude region, calling it *Antarctica*.^[92]

See also

- Aristotelian physics
- Aristotelian view of God
- Conimbricenses
- Corpus Aristotelicum
- Hylomorphism
- List of writers influenced by Aristotle
- Otium
- Philia

Notes and references

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62. ^ Jonathan Barnes, "Life and Work" in *The Cambridge Companion to Aristotle* (1995), p. 12; Aristotle himself: *Nicomachean Ethics* 1102a26–27. Aristotle himself never uses the term "esoteric" or "acroamatic". For other passages where Aristotle speaks of *exōterikoi logoi*, see W. D. Ross, *Aristotle's Metaphysics* (1953), vol. 2, pp. 408–410. Ross defends an interpretation according to which the phrase, at least in Aristotle's own works, usually refers generally to "discussions not peculiar to the Peripatetic school", rather than to specific works of Aristotle's own.
63. ^ ^a ^b Barnes, "Life and Work", p. 12.
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77. ^ Plutarch, *Life of Alexander*
78. ^ Richard Sorabji, ed. *Aristotle Transformed* London, 1990, 20, 28, 35–36.
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81. ^ ^a ^b *Encyclopedia of Islam, Aristutalis*
82. ^ *Rasa'il* I, 103, 17, Abu Rida
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88. ^ Geoffrey Chaucer, *The Canterbury Tales*, Prologue, lines 295–295
89. ^ *vidi 'l maestro di color che sanno seder tra filosofica famiglia. Tutti lo miran, tutti onor li fanno: quivi vid'io Socrate e Platone che 'nnanzi a li altri più presso li stanno; Dante, L'Inferno* (Hell), Canto IV. Lines 131–135
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- Massachusetts Institute of Technology (<http://classics.mit.edu/Browse/index-Aristotle.html>) – primarily in English
- Project Gutenberg (<http://www.gutenberg.org/browse/authors/a#a2747>) – English texts
- Tufts University (<http://www.perseus.tufts.edu/cgi-bin/perscoll?.submit=Change&collection=Any&type=text&lang=Any&lookup=Aristotle>) – at the Perseus Project, in both English and Greek
- University of Adelaide (<http://etext.library.adelaide.edu.au/a/aristotle/>) – primarily in English
- P. Remacle's collection (<http://remacle.org/bloodwolf/philosophes/Aristote/table.htm>) – Greek with French translation

- The 11-volume 1837 Bekker edition of *Aristotle's Works* in Greek (PDF (<http://isnature.org/Files/Aristotle/>)|DJVU (http://grid.ceth.rutgers.edu/ancient/greek/aristotle_greek/))
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- Timeline of Aristotle's life (http://www.concharto.org/search/eventsearch.htm?_tag=timeline%20of%20aristotle&_mapttype=0)
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