Aristotle for nursing

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Abstract
This article aims: 1) to introduce the wider philosophy of Aristotle to nurses and health care practitioners; 2) to show that Aristotle's philosophical system is an interdependent whole; and 3) to defend its plausibility and usefulness despite its ancient and alien origins.

Aristotle's system can be set out as a hierarchy, with metaphysics at the top and methodology running throughout. Beneath metaphysics are the sciences, with theoretical, practical and productive (or craft) sciences in hierarchical order. This hierarchy does not imply that, say, metaphysics is superior to biology or nursing, but rather that metaphysics can be understood without reference to the other two but, as we shall see, not *vice versa*.

Two themes run through Aristotelian philosophy. The first is Aristotle's method of inquiry, central to which is that our starting point is not pure empirical data but rather current puzzles; complementing this method is a realist philosophy. The second theme is teleology, the understanding of action in the world in terms of ends, as when we say a plant grows roots in order to reach water and nutrients.

Implications for nursing. Good health is the good functioning of the material aspect of humans; flourishing is good functioning of humans *per se*. The goals of nursing, which are based in health, are subsumed by the overall human goal of flourishing, and this helps us to understand and set boundaries to health care. Two examples illustrate this. The first is that mental illness is strongly within the purview of nursing and health care whereas bad decisions, such as smoking, are only marginally so. The second is ethics, where it is argued that the attempt to describe ethical decision-making as in addition to and separate from the decisions made within nursing and health care itself cannot be sustained.

Key words
Aristotle, nursing, health, ethics

Aristotle and nursing

Introduction

This article has three aims: 1) to introduce the wider philosophy of Aristotle to nurses and health care practitioners; 2) to show that Aristotle's philosophical system is an interdependent whole; and 3) to defend its plausibility and usefulness despite its ancient and alien origins. This remit provides an opportunity not available in most discussions of health care issues, some of which might draw on elements of Aristotelian philosophy. In such discussions, the (reasonable) tendency will be to start with an issue or problem of immediate relevance relating to, say, i) science, ii) health or iii) ethics. As far as possible, esoteric and obscure issues in Aristotle such as the notion of formal cause or teleology will be avoided. The problem with such an approach is that oddities become apparent and hard to explain:

i) In science, Aristotle seems to have a vision of a world in which inanimate objects act purposefully, a vision side-lined since the reforms of the Enlightenment;

ii) Health is seen as an element in the good functioning of humans, but it is surely doubtful that humans have such a function; and,

iii) Ethics is seen as based in the notion of acting virtuously; but virtue is a concept that has a comical or absurd ring to modern ears. More importantly, virtue ethics seems to be viciously circular; ethically correct action is said to be that which would be chosen by the virtuous person but the virtuous person is one who would choose to do what is ethically correct.

Examination of Aristotle's wider system can, I will argue, overcome at least some of this problem of oddity; this is because the use of concepts from that system, such as virtue or practical wisdom, requires either an acceptance of the system as a whole, or an explicit explanation of how the concept can be used once detached from that system. An example of such a detachment is MacIntyre's use of virtue in his *After Virtue;* here he explicitly rejects the teleology on which Aristotle's concept of virtue is based and replaces it with his own, based in the idea of human practices (MacIntyre, 2007).

This article begins with brief comments on Aristotle's life and context and how this is reflected in his work. Next, Aristotle's system is set out using his major works as a guide. It is shown to be a hierarchical system with metaphysics at the top and methodology running throughout. Beneath metaphysics are the sciences, with theoretical, practical and productive (or craft) sciences in hierarchical order. This is not a hierarchy of worth but of understanding. In other words, the hierarchy does not imply that, say, metaphysics is superior to biology or nursing, but rather that metaphysics can be understood without reference to the other two but, as we shall see, not *vice versa.*

The main part of the article develops two themes that run through Aristotelian philosophy and which need to be understood by those wishing to draw on it. The first theme is Aristotle's method of inquiry, central to which is that our starting point is not pure empirical data but rather current puzzles; complementing this method is a realist ontology and epistemology. The second theme is his teleology, the understanding of action in the world in terms of ends that can be described approximately using phrases such as 'in order to', as when we say a plant grows roots in order to reach water and nutrients. The article links this teleological view of the world to the central Aristotelian idea of the four causes.

The final section of the article examines some implications for nursing. This begins with a teleological definition of nursing and its place in Aristotle's knowledge hierarchy as a productive science. Health features in this definition and so that is further examined teleologically and set against the well-known WHO definition of health. This examination links health to the Aristotelian idea of human function, end (*telos*) and form. Finally, the article suggests that understanding nursing (and health care generally) to be a productive science not only places it in the Aristotelian knowledge hierarchy but also that this can be

used as a guide to practice. The goals of nursing, which are based in health, are subsumed by the overall human goal of flourishing, and this helps us to understand and set boundaries to health care. Two examples are used to illustrate this. The first is that mental illness is strongly within the purview of nursing and health care whereas bad decisions, such as smoking, are only marginally so. The second is that of ethics, where it is argued that the attempt to describe ethical decision-making as in addition to and separate from the decisions made within nursing and health care itself cannot be sustained.

The Aristotelian works cited in this article are named in the text rather than in the reference list at the end. Where quoting directly I have used the Bekker numbering system that is standard. This takes the form of an initial number, indicating an original scroll, followed by a letter indicating a column (a or b) and then a number indicating line, for example *Metaphysics:* 1005b23. If larger amounts of text are referred to then a chapter of the book might be used or a line number followed by the term 'ff.' which indicates that line plus some of those that follow. Plato is similarly referenced using what is termed Stephanus pagination.

Life and context

Classical Greece
In some commentaries Aristotle is referred to as the Stagyrite or Stagirite, from his birthplace Stageira in the north-east corner of classical Greece, a province then known as Macedonia; Thessaloniki is the closest modern city. (This is not co-extensive with modern Macedonia, as modern Greeks sometimes forcefully attest.) Born in 384 BC he entered Plato's Academy in Athens at around the age of 18 and left when Plato died in 347. In his period away from Athens *inter alia* he worked on biology in Lesbos and tutored the future Alexander the Great. He returned to Athens and set up a school in the Lyceum in 335 where he worked closely with Theophrastus, who maintained the school and library till 287. In 323 he left Athens under threat of the death penalty for impiety. He died the following year exiled on the island of Chalcis.

When leaving Athens in 323 Aristotle is purported to have said he would not let the city sin twice against philosophy. This was in reference to the execution of Socrates who had also been charged with impiety. In Socrates' case, the impiety related to the controversial nature of his beliefs and to the behaviour of some of his followers; in Aristotle's case, the charge was probably entirely trumped up (O'Sullivan, 1997).

This tells us something of the context. The period to Aristotle's death marked exactly also the period to the end of Athens's 180 years of democracy. It ended finally in 322 having gone through many periods of strife, including 27 years of war with Sparta, and the loss of independence to Philip of Macedon following the battle of Chaeronea in 334. In 322 democracy was dissolved by the Macedon ambassador to and governor of Athens, Antipater. Aristotle was Macedon and his final exile followed long periods of festering anti-Macedonian sentiment in Athens; he was an outsider during a period that was often unstable. His ethical and political prescriptions of ways in which people and states might flourish were not therefore a product of a sheltered existence.

Prosperity
The term 'Classical' derives from Latin *Classis* which denominates the most prosperous of five property owning Roman classes. The Classical period follows the Bronze Age and was one in which surpluses of goods emerged by conquest, trade, farming and slavery. It was a period, unusual at the time, in which it was possible for some to pursue time-consuming activity that was not directly concerned with hand-to-mouth existence. In Greek terms, these people had scholê or leisure; from this Greek term derive 'school', 'scholar' and cognates. Philosophy was a product of this leisure. Aristotle's vision of the best society was one in which some could flourish through philosophy, but not all; women, 'natural slaves' and craftsmen were excluded but provided the wherewithal to give leisure for those that could. This (rightly) jars modern feelings but should be seen in this historical context. The more difficult question is whether Aristotle's prescriptions are so far removed from modernity as to be useless. Later philosophers, such as Rousseau, Mill and Marx would suggest possible a society in which many more, perhaps most, could flourish. Nussbaum and Sen provide an approach to human welfare, the Capability approach, which draws heavily on Aristotle but is a vision of society in which all with the potential to flourish (which is most people) might do so (Nussbaum & Sen, 1993; Nussbaum, 2006).

Footnotes to Plato
The philosophers of classical Greece can thus be thought of as scholars rather than philosophers in the modern sense. Aristotle's thought ranges well beyond areas covered in modern philosophy, such as astronomy, biology, physics and psychology. In those writings he engages not just with Socrates and Plato but with a large number of predecessors.

The intellectual activity of that period is captured in Raphael's fresco, *The School of Athens.* Many philosophers are pictured but at the centre are Aristotle and Plato. Plato is pointing skyward and carrying his dialogue *Timaeus.* Aristotle has his hand outstretched parallel with the ground and is carrying his *Ethics.* Plato's philosophy had become idealist, seeing truth as existing in the eternal forms, such as good, that were perfect and non-material

ideas existing in an unchanging non-physical realm. Our senses are barriers to understanding this realm:

> "And he attains to the purest knowledge of them [i.e. the forms] who goes to each with his mind alone, not introducing or intruding in the act of thought sight or any other sense" Plato *Phadeo* 65e

This rationalist idealism is unusual and sometimes described as a form of realism because it takes the forms to exist outside human perception or understanding of them; in this, he differs from the idealism of later thinkers such as Berkeley; indeed Burnyeat (2012) claims that there was no idealism of this modern form in Greek philosophy. Be that as it may, it is far removed from the realism of Aristotle. It reaches an extreme in Plato's comments on the soul put into the mouth of Socrates in recounting the latter's last hours; Socrates views death as liberation, the chance for the soul finally to be freed from the empirical realm in which it is trapped by the body and instead enters the true reality of the forms. When Crito asks Socrates in his final hours 'how shall we bury you?' he gets the gently mocking reply:

> Any way you like … that is, if you can catch me and I don't slip through your fingers. *Phaedo* 115c

Aristotle pictured with his hand (and head) at ground level views the soul and body as a unity. And he has greater faith in the senses. He is not, however, an empiricist; Aristotle prefers to talk of appearances (*phainomena*) (rather than sensory or empirical data) as our (albeit flawed or fallible) gateways to knowledge. Thus although Aristotle was responding to Plato in some of his work, and although philosophy was once light-heartedly described as 'footnotes to Plato', Aristotle might be thought of rather as developing an entire system and tradition in contrast to Plato's idealism, one of what would now be termed realism. In order to see how he gets to this point we turn now to some of his major themes as they pertain to the use of philosophy in nursing and other applied health sciences and practices.

Major works
The available works of Aristotle appear to be a fraction of his output; and much of what we have is written in concise, notational form rather than the clear prose of Plato. Aristotle is thought to have been a great writer, perhaps greater than Plato, but almost no evidence of this remains. His works are therefore difficult to read and ambiguous in interpretation to a greater extent than other philosophers. They cannot really be tackled without commentaries and interpretations; we shall mention a few towards the end of this article.

The development of Aristotle's thought is also disputed; there is no clear path from early to late works. To take one example, it is disputed whether the *Eudemian* or *Nicomachean Ethics* represents his mature thought; Kenny opts for the former against a majority preference for the latter (Kennedy, 1992). Having said that, this problem may not be overly troubling as there appears to be a great deal of continuity in his thought, unlike, say, Wittgenstein.

This leads to a central point about Aristotle's works, they form a whole; Aristotle is a supreme example of a system builder. His works can thus be represented as fitting into the relevant parts of his system, as in the diagram below.

Organisational works – methodology, logic, correct argumentation				
	First philosophy - metaphysics			
		Sciences		
	Theoretical	Practical	Productive	

Table 1: Aristotle's system

Organisational works: Overarching the whole system are lessons about methodology, deduction and argumentation set out in the works collectively known as the *Organon,* which include his *Categories,* and *Prior* and *Post Analytics.* These overarch the system because they are used in all the other parts of the system. For example, any inquiry in a theoretical or practical science will need to use deductive logic and correct argumentation.

First philosophy: First philosophy came to be termed *Metaphysics* because the work now termed by that name was anthologized after (*meta)* his *Physics.* Aristotle did not use the term. It fits above the sciences because its concerns with the nature of being in itself, such as the relationship between particulars and universals (one dog versus the category 'dogs') of causation and of knowledge underpins the work in the other areas. It is worth saying that the *Metaphysics* is often categorised as part of the theoretical sciences but seen as top of a hierarchy in these. The reason for its place at the top is that the other areas of inquiry will draw on metaphysics but not necessarily *vice versa.* For example, inquiry in natural science will draw on ideas of causation and universals which are themselves the object of study in metaphysics.

The Sciences
1. Theoretical science: Within knowledge of the world itself is a three way division. The theoretical sciences fairly well correlate with our natural sciences: physics, biology, astronomy and so on; they are represented in works such as *Physics, Parts of Animals, Generation of Animals* and *Metaphysics.* We noted that part of Aristotle's life was spent in observational work on biology and he wrote a great deal on that topic.

2. Practical science: There is no category that correlates easily with our social sciences. His psychology emerges from his metaphysical work on Form and Teleology, and then from his biology. It is further developed in the *Nicomachean Ethics.* The practical/theoretical division is, for Aristotle, based rather on a distinction between knowledge of what is the case versus what to do. Practical and productive sciences concern the latter. Practical science is focused on what human beings as such should do in order to flourish (more of which later) and covers ethics and politics; the associated works are the two *Ethics* plus the *Politics* and *Magna Moralia.*

3. Productive science: Productive science concerns itself with the knowledge required to produce external goods, such as artefacts but also medicine and art. Whilst Aristotle has something to say on this in general terms, particularly in the *Ethics*, his works primarily associated with it are limited to *Rhetoric* and *Poetics.*

Major themes

As noted, Aristotle is paradigmatic as a philosopher-scholar of the classical type rather than one focused on the narrower range of modern philosophy. He writes as a scientist as well as a philosopher of science, a poet, as well as philosopher of aesthetics and political scientist as well as political philosopher. And the notion of scholarly activity implies, as we have seen, the existence of leisure. With that comes the accusation of dilettantism, particularly in relation to science (Crossman, 1963). The Greek philosophers, including Aristotle, view natural science as a pure activity aimed at acquiring eternal truths about nature. Insofar as any of them value empirical activity, as Aristotle does, it is in terms of observation rather than experiment; any application of science is of secondary value only. The hierarchy seen in Aristotle's works is one based in part on this notion of distance from the mundane and ephemeral. In legend at least, Francis Bacon's great contribution to science was to throw off the shackles of Aristotle's scientific method and replace it with experiment and induction.

> [Aristotle] ventured to lay the severest shackles on the mind (Bacon, 1886) (p.94)

Why, then, should those working in areas of applied science and philosophy, such as nurses, consider re-donning those shackles? Let us consider two of them, both of which were attacked by Bacon and those who followed: methodology and teleology.

i) Aristotle's method

For Aristotle, all inquiry, aside from that concerned with the tools of inquiry itself, logic and mathematics, shares a structure which could be termed aporetic (or puzzle-based) and dialectic (Allmark, 2006). This method has three elements.

- The first element is that of appearances (or phainomena); this is how the world appears to us, for example, blue skies.

- The second element is puzzles or questions arising from or based in the appearances. These might take the form of wondering why something is as it is, such as why the sky appears blue. Or they might be puzzles, as when the appearance that the earth is stationary conflicts with careful observation of and reasoning about the movement of stars. Or they might be conflicts of theory and opinion over, for example, what causes storms. It is the questions and puzzles that stimulate inquiry and lead into the third element of Aristotle's method of inquiry.

- The third element is the development of a theoretical account that 'saves the appearances'. This is best illustrated with an example of puzzle-based inquiry. Faced with the conflict between geostationary and heliocentric accounts of astronomy, inquirers will find the latter is able better to explain and predict most relevant appearances. However, the heliocentric account is not satisfactory until it can explain the appearances that favour the geostationary account; why does the earth seem still and the heavens to move? We don't have a complete answer to an inquiry until we have explained (or 'saved') all the appearances, including those that favour the other views. This, then, is the core of Aristotle's dialectical method.

As an account of scientific inquiry it may seem unobjectionable but also uninformative, and compatible with a wide range of theories of the philosophy of science, including pragmatism, positivism and constructivism. Aristotle's views are not compatible with these, however; he is, as stated above, a realist. Realism in this context combines an ontological and epistemological claim. The ontological claim is that there exists a mind-independent world such that, for example, if all life on Earth were wiped out, there would still be an Earth.

The epistemological claim is that it is possible to gain knowledge of that world through inquiry.

The epistemological claim is central to realism. Some non-realists may tolerate the idea there is a mind-independent world but because we can know nothing about it view the notion as unimportant to science. Empiricists, for example, stick with the world of appearances; knowledge is both acquired from and is *about* appearances (Chakravartty, 2007). For example, the table that appears before us can be explained in terms of the chemicals of which it is made and, in turn, of the atoms of which they are made. All of these belong, however, to the world of appearances even though finding some of them empirically will require sophisticated aids. The other elements of scientific theories which are undetectable even in principle, such as universals ('tables' as a group rather than the one in front of us), laws of nature, and causation are aids to inquiry but not to be understood as real. All genuine knowledge is ultimately reducible to claims about the detectable-in-principle empirical realm.

By contrast, realists claim that we can have knowledge of a real but non-detectable realm and indeed that we must do so in order to have scientific knowledge. Take the example of 'good'. Plato claimed that the various ways in which the term could be applied as an adjective or adverb was the result of each of the objects or activities to which it is applied partaking in a universal form of the good; a good man and a good table each partook of the universal 'good'. An alternative, empiricist, view would be that good is simply an epithet of convenience; we call a man or table good if they suit our purposes at some point – but there is no non-empirical objective way of deciding something is good. Aristotle disagrees; he finds an objective, non-empirical basis for goodness in the (metaphysical) notion of 'end' or 'function'. We shall look at this in more detail shortly. The point to note for now is that Aristotle is a realist and that this is in contrast to the idealism of Plato and to modern views such as pragmatism and empiricism. Note also that as well as end/function, other 'real' but non-detectable entities in Aristotle's scheme are first principles, forms and causes.

If Aristotle is a realist, however, then his dialectic is insufficient as a method for discovering the non-detectable entities (Irwin, 1988; Nussbaum, 1986; Shields, 2014). It is, as we noted, compatible with a range of non-realist views. At best, it leads the inquirer to develop theories that are consistent and generally agreed. But what grounds do we have to believe them true? The problem of under-determination of theory by data shows that it is always possible for there to be more than one theory explaining a set of data (Chakravartty, 2007). Where two incompatible but equally explanatory theories co-exist only one, at best, can be true. Yet the dialectic seems to offer no way to choose between them. In other words, dialectic as described could result in our moving from appearances to two incompatible theories but then no way forward from that point. Two Aristotelian notions might work to strengthen the dialectic here: strong dialectic and first principles.

The term "strong dialectic" is due to Irwin (Irwin, 1988). A good example of how this works might be in the statement just made suggesting that two incompatible theories cannot both be true. This is an example of the principle of non-contradiction: one of Aristotle's descriptions of this is that opposite assertions cannot both be true at the same time (*Metaphysics:* 1005b23-26). Aristotle argues that it is impossible for someone to proceed dialectically and not hold to this principle; thus someone who tries to *argue* that the principle of non-contradiction is false can only do so by assuming it is true. Thus the conclusion of Aristotle's argument for the principle is not just that it is true but that it is unassailable. Insofar as this manoeuvre works, it helps not just in regard to non-contradiction but for the arguments of deduction too. Someone who attempts to argue against the rules of deduction has to use them to do so; as such, their argument becomes incoherent.

Irwin takes the notion of strong dialectic well beyond metaphysical principles and logic, however. He claims that the notions which begin with the strong dialectic of metaphysics go on to ground much else beside in Aristotle: for example, in his ethical theory

> Aristotle relies on his metaphysical theory of essence as form and function, and on his psychological theory of human function[.] (Irwin, 1988) [p. 388]

We shall shortly see how this is done – the point here, however, is that by building on foundations of strong dialectic rather than simple dialectic, Aristotle might be expected to reach conclusions which, if not unassailable, are at least stronger than simply "agreed". This is an improvement on the weaker dialectic which only seems capable of reaching points of possibly incompatible but agreed theories.

For the next step, we should note that Aristotle's 'appearances' are not straightforward empirical data. Even at their simplest, they are reports of how the world appears within the belief and conceptual system of the reporter. The simple statement, "The sky is blue" requires the reporter to have a conceptual scheme in which there is a sky (rather than, say, a sky-earth amalgam) and that colour can be attributed to it (rather than saying, for example, that blue is the noun and sky the adjective). It also requires some kind of acceptance that the words the reporter uses and that there is a link between the reporter's words, such as 'sky' and 'blue' and the world's own blue sky. This simplest of observational statements, a description, is thus metaphysically complex. The complexity increases when relational statements are added. "The snake ate the mouse" is metaphysically hugely complex. Why do we see the snake as persisting but the mouse not? Could not the animal have become a snake-mouse hybrid, or the mouse taken over the snake? We do, after all, sometimes claim that 'you are what you eat'.

Appearances are, then, how the world appears to us and are a product both of our empirical experience, our conceptual schemes and our reasoning about them; and the concepts and reasoning are at least in part a product of the intellectual world we inhabit. Appearances are theoretically loaded from the outset. And they have a history. When we engage in dialectical reasoning with appearances, therefore, we are engaged in theoretical development that belongs to the collective humanity. So appearances are not just how the world seems now but how it seems after a history of inquiry. This is problematic for any empiricism which requires the starting point of inquiry to be pure empirical data; by contrast it fits well with Aristotle's approach where the appearances, already theoretically loaded, are the starting point.

For this reason, Aristotle sets limits on the appearances to be permitted in inquiry; those he permits are a subset of appearances he terms the endoxa, meaning something like reputable appearances.

> Those things are endoxa which seem so to everyone, or to the majority, or to the wise – and either to all of them [the wise] or to the most notable and reputable among them. *Topics* 100b21-23

Outlying views held by eccentrics and fools are to be discarded. Precisely how this is done is moot and clearly it can go wrong, as, for example, when the bacterial theory of gastric ulceration was ignored for many years. But appearances without a history seem to be good candidates for rejection.

In summary, then, dialectic is not just the setting of one person's views against another with a view to reaching agreement; it is a stage in the development of our theories about the world. This continuity is shown in Aristotle's insistence on explaining the appearances, showing why, for example, the world appeared to some credible witnesses in a way that now appears to be false. For Aristotle, as for other scientific realists, appearances are like witnesses to the truth; they are all we have but must be treated with caution and examined critically.

> About all these matters, we must try to reach conviction *via* arguments, using appearances as witnesses and standards. *Eudemian Ethics* 1216b26

The endpoint of Aristotelian inquiry is first principles. From the way the world appears to us we move through inquiry towards the way it really is, the first principles.

> The naturally proper direction of our road is from things better known and clearer to us, to things that are clearer and better known by nature; for the things known to us are not the same as the things known unconditionally. Hence it is necessary for us to progress, following this procedure, from the things that are less clear by nature, but clearer to us, towards things that are clearer and better known by nature. *Physics 184a15-21*

Putnam makes a similar realist point well:

> Science does not … discover that there are no solid objects, no tables, no pink ice cubes; it discovers what solidity *is*, what tables and ice cubes *are,* and what colour *is.* (Putnam, 2015) [p. 3, emphasis in original.]

The first principles of each discipline differ, physics from biology from ethics and so on. Thus Aristotle is no reductionist; he does not believe that ultimately all inquiry terminates in physics, for example. In line with the principle of non-contradiction, however, the first principles must cohere. A full explanation within a discipline will start with the puzzle and the relevant appearances, move dialectically towards the first principles, then move deductively from those principles to an explanation which explains the appearances and resolves the puzzle. An example often used to illustrate this method is Aristotle's examination of weakness of will in the *Nicomachean Ethics* [Book VII]. Here he starts with the puzzle, that people both seem to decide to act in what they believe to be their best interest but then knowingly choose not to do so, for example, deciding to exercise then watching telly instead. He collects the various relevant appearances (mainly theories of psychology) and then moves to first principles of psychology, in this case, the division between appetitive and rational desire in humans. From there he deduces the possibility of conflict between these that explains the puzzle but also why it seemed to some, such as Socrates as described by Plato, that it could not really occur.

In summary, Aristotle's method of inquiry is dialectic and puzzle-based using appearances (or at least, credible appearances) as data. Using the method, the inquirer reaches towards truth, towards first principles, through strong dialectic, including the requirement for all first principles across disciplines to cohere and for appearances to be explained. Aristotle's method runs through the whole of his system and needs to be understood by anyone using it; the same is true of teleology, to which we turn next.

ii) Aristotle's teleology

The classical Greek word *telos* is something like an end, goal or purpose. Teleology is thus any form of explanation that draws on an end; for example, the chicken crossed the road *in order to* get to the other side. Teleology permeates almost all Aristotle's work to an extent that has sometimes invited mockery, as when he seems to say that objects fall with the goal of reaching their natural place. Even the sympathetic Macintyre rejects Aristotle's "metaphysical biology" in his *After Virtue*, although he seems to reinstate it in his later *Dependent Rational Animals* (MacIntyre, 1999, 2007). Nonetheless, the point remains that Aristotle's philosophy depends on teleology; it becomes mere fragments without it. So an examination is required.

To do this we can return briefly to first principles. Another way Aristotle describes explanation is as the grasping of the 'why' of a thing, in Greek, the *dioti*. This involves knowing its primary cause (*he prote aitia Physics* 194b20). Take the example of a statue: in answer to the question "what's that" we might say it is bronze, in the form of a goddess, made by the sculptor, for the purpose of honouring Athena. This gives us four *aitiai.* This

last term is variously translated, most commonly as 'causes' but also as 'aspects' and 'becauses' (Lear, 1988; Nussbaum, 1987); we shall stick with 'causes' but be wary of confusing it with modern notions of cause, particularly those associated with Hume. The four causes are:

- Material: the bronze of which the statue is made;
- Formal: in the form of the goddess;
- Efficient: by the sculptor
- Final: for the *telos*, honouring Athena.

As an explanation of artefacts this works well enough although we have yet to know why Aristotle regards the Final cause as the primary cause and, therefore, the "why". It does not seem to work well for most natural objects, plants, animals and humans. It is possible to assign purpose to natural objects via human plans: hence plants and animals may be farmed to a purpose; and humans can have purposes within roles. But it does not seem possible to assign a *telos* to natural objects *per se* without imagining a creator with a purpose for them. This argument can be rebutted, however.

In the first place, it is unproblematic to assign purposes to parts of natural objects. Eyes are to see; legs are for transport; and so on. We know also that some parts of nature do proceed on the basis of plans – humans, for example. In most cases it is not possible to explain someone's activity without including their goal (Anscombe, 2000). This seems to be true of other animals where the goal may barely be conscious, and certainly not rationally formulated. The running lion could be playing, chasing prey, running from a rival: the point is that its activity has an end and that without knowing it, we do not understand it. Even the growth of a plant is explicable teleologically: the canopy that develops at the highest point in rainforests is the product of the trees reaching for the sunlight in order to photosynthesise without impedance. So the purposes of the parts of plants and animals are meaningful only against the purposes of the natural being itself: for a lion, eyes and legs are to hunt, play, run away and all the activities associated with being a lion. Note that none of this requires a creator or external planner. Whilst god and the gods feature in parts of Aristotelian thought,

> There is no place for ideas of creation, a personal god, or the latter's providential relationship with humans. Nor is Aristotle's god the recipient of prayers or the object of meditation. (Hoffe, 2003)(p.108)

But Aristotle believes that without reference to *telos*, albeit an end without an external planner, we cannot understand the natural world. Let us now apply the four-cause explanation to the natural world, using the lion example.

- Material cause: the blood, bones, sinews, brain and so forth that make up the lion. As noted, these have the purpose of aiding the lion in its characteristic activities of hunting, breeding and so on. Note also that each of these parts can also be defined in terms of four causes but that they are subsumed by animal's causes, particularly its final cause or *telos*. As Aristotle puts it, "No part of an animal is purely material or immaterial" (Parts of Animals 643a24-6). One reason for this is that matter always has some form; there is no such thing as pure, unformed matter.

- Formal cause: we noted earlier that when a snake eats a mouse the snake remains. This is despite its material change (it is now full of former mouse molecules) and indeed other changes, such as a feeling of satiation and perhaps some learning. Similarly, parts of an animal can be removed whilst it remains: the cat that formerly had four legs would be the same cat even if it lost one of those legs, for example. One way of understanding the formal cause of something then is as that which

persists through change. We shall shortly see that Aristotle identifies this with the final cause in natural beings.

- Efficient cause: that which caused the lion to come into being but also to maintain itself; thus not just the activity of its parents but also its own activities such as eating and breathing.

- Final cause: that for which the lion exists, which is, to flourish as a lion. This will consist in successful activity characteristic of a lion – the various things that lions do with their eyes, legs and so on. Aristotle also calls this the lion's function (or *ergon*) although, as with the idea of the animal's purpose, it does not require an external being with a purpose or function for the lion. It is this purpose or function which persists through change such that the lion continues and the gazelle does not when the former eats the latter. When the lion's form, its characteristic activity ends permanently, it has died and, although the material cause may remain for a short period, the lion has gone. Hence Aristotle identifies the animal's *telos* with its form.

Almost no account of Aristotle is uncontroversial; and this one of the four causes would be disputed. However, there is enough here to show how Aristotelian teleology does not require an external holder of purposes or ends, a creator (although presumably it is compatible with one also, just as is, on some accounts, Darwin.)

There is also the germ of an argument here to show that teleology is not necessarily incompatible with evolutionary theory. Roughly, species and the parts of species result from natural selection not from any goal aimed at by the process; natural selection is the efficient cause, chaotic and random as evolutionary theory describes. But the forms of the species, the animal, and its parts, have the character they do because of their contribution to the life and flourishing of the animal, to the animal's *telos*. A bacterium which mutates is still only fully described in terms of the four causes. Whether it goes on successfully to realise its *telos* by reproducing will depend on how suited it is to the environment. But nonetheless, the *telos* is there. Even within evolution, teleology is the final cause of natural beings. Clearly there is more to say here but hopefully this is enough to allay two immediate attempted refutations of Aristotelian teleology (Gotthelf, 2012).

In summary: Aristotle's work constitutes a hierarchical system with metaphysics atop, then, in order, theoretical, practical and productive sciences. Aristotle himself was an empirical scientist, as illustrated most clearly in his biological work. Thus his hierarchy is not based on any notion of the value of each but rather on the fact that, say, practical science draws on theoretical and metaphysical levels but not *vice versa*. Running through that system are methodology and teleology, including the four-cause account. The systematic nature of Aristotle's thought is such that it is not possible to draw from one area of it without reference to the others. For example, one cannot adopt Aristotle's ethical theory whilst ignoring the teleology. This does not mean it is a take-it-or-leave-it system. Macintyre's *After Virtue* replaced the teleology of human function with a teleology based in the notion of human practice, for example. But it does mean that the system needs to be acknowledged in any adoption of a part of it. With that in mind we can now turn to the implications for nursing.

Implications for nursing
To talk of a philosophical system having implications for nursing is to take a philosophical position in itself, namely, that philosophy can have implications for a practical discipline such as nursing. This would be disputed by philosophers, for example those of positivist disposition, who would argue that philosophy can describe how the world is and how concepts relate to it, but it cannot say anything about how it should be. Whilst this discussion will not be engaged with here, it is clear that Aristotle's system itself belongs in the camp of those who believe philosophy can have practical implications. Aristotle himself uses his philosophical system to develop ethical and political recommendations, for example. We should thus expect this system to have implications across nursing theory, practice, education and research. Here we shall pick out a few, based around three questions: 1) What is nursing? 2) What is health and illness? And 3) What should the nurse do?

1) What is nursing?
The significance of this question is that there has long been an attempt by some nurses to define the essence or the uniqueness of nursing and in doing so, for example, to describe which practices should and should not be described as nursing. In the hierarchy of Aristotle's system, nursing belongs to the productive sciences. The distinction in the type of knowledge required for three different sciences is set out in Table 2.

Science	Theoretical	Practical	Productive
Knowledge	Theoretical wisdom (sophia)	Practical wisdom (phronesis)	Craft knowledge (techne)
Object	Universals	Universals and particulars	Universals and particulars
Criteria for success	Truth	Good action	Good production

Table 2: Comparison of the three 'sciences'

If nursing is one of the productive sciences, or crafts, then what does it aim to produce? The paradigmatic crafts are things like pottery and poetry where the knowledge required seems primarily to be a know-how rather than knowledge of truth. But these paradigmatic examples are deceptive; few crafts are purely matters of verbal and manual dexterity picked up solely by practice. Aristotle's examples of crafts include building, navigation and medicine (*Nicomachean Ethics* 1140a6ff. 1104a7-10). Practitioners of these crafts cannot excel without theoretical knowledge; and development of these crafts includes education in such theory as well as apprenticeship in the dextrous, know-how parts; in the case of some, such as medicine, this theoretical education will be substantial. As a craft, nursing more resembles medicine than pottery. How, then, is it distinct from medicine and the other health care professions?

Within each craft there will be many different particular ends: the house-builder will build different types of houses in different areas; the cook will produce different meals. And within each case of production there will be sub-goals; the builder will aim to produce good foundations, walls, roofs and plumbing. Each sub-goal will need different know-how and

different theory; this can occur to such an extent that specialisation may be necessary amongst builders. This division is largely one of convenience - all crafters involved in the act of building a house have the same final goal, the house to be built, but that goal is better achieved with this sub-division of crafts.

We know that nursing too is an activity broken down into sub-goals, and that it takes place in different areas with different patients and clients. What is its overall *telos* or goal? Arguably, nurses are more like the specialists in a sub-craft, like roofers rather than (entire) house-builders. Their end is shared with all others working in health care; approximately, this is to secure as best as possible, the health of a group of people where that is threatened by illness. As with roofers, the boundary is one of convenience rather than necessity. Health care has come at least in part by custom to be divided into the various professions such as medicine, nursing and physiotherapy but the boundaries between these are fuzzy and could, like the map of Africa, have been divided up entirely differently. As such, nursing could disappear in a redrawing of boundaries but the activity of health care could continue. If this is correct then attempts to find a defining essence of nursing will always fail, as will attempts to define a unique body of nursing knowledge. Whether it is the activity of a nurse, doctor or generic health carer, the same skill is required to draw blood, and the same knowledge to prescribe drugs safely.

2) What is health?
If nursing is one of the activities with the aim of producing health then it would seem pertinent to know what we mean by health. What distinguishes a health profession from, say, the production of food, which also seems to promote health? And how is it that some behaviour is considered a manifestation of mental ill-health in some but of, say, criminality in others?

The term 'healthy' can be attributed on the basis of possession, contribution and indication. Hence we have a healthy animal (possession), diet (contribution) and complexion (indication) (*Categories* 1a20ff.). Of these, possession seems to be the primary type to which contribution and indication apply. In this primary form it is applied only to living organisms: plants, animals and people. Where terms such as a healthy profit are used it is either of the contribution or indication type or is analogical.

What, though, is the difference between a flourishing and a healthy organism? In the appearances there does seem to be a possible disjunct in some cases. This is probably not so with plants: a healthy plant is a flourishing plant. With animals it is less clear. We might say of a well looked after animal in a zoo that it is healthy but not flourishing; as an example, think of a wolf that does not hunt for its food. And the disjunct seems almost obvious with people: someone may be healthy but living a wretched life.

The explanation for the disjunct can be found in Aristotle's tripartite account of the soul. Here caution is in order. Plato, as we've seen, conceived of the soul as separate from the body, just as Descartes later would. And to modern ears, the term often has the supernatural connotation. Aristotle's theory of the soul is not of this type. Aristotle's views the soul as hylomorphic, that is, an amalgam of form and matter, in the manner set out earlier in our discussion of the four causes. There is no hint in Aristotle of the separability of form and matter; indeed, form cannot exist without matter and *vice versa.* We also saw in our account of the four causes that in organisms the formal and final cause are the same; the function or end of an organism is its characteristic activity and this is also what formally defines it and which explain its other features (such as its eyes and legs). Three categories of organism, plant, animal and human, are formally separated by three types of soul which in the higher organisms (animals and humans) form a nested hierarchy.

Plants have a vegetative soul: they grow, take nutrition and reproduce. If they do this successfully they are flourishing. Different plants will do this in different ways: for example, some disperse seeds by air, others by insect. And even the same plants might flourish in different ways where the environment differs, as some trees might have all branches facing in one direction when growing in windy areas, for example.

Animals also have a vegetative element to their soul; they too grow, feed and reproduce. However, they also have an appetitive soul. They have appetites and sensations, and they move and act to satisfy these appetites. Again, and obviously, they do this in many different ways both across and within species. But this perhaps gives a clue to why the wolf in the zoo might not be thought to flourish; it is no longer able to flourish because it cannot engage in its characteristic activity as a wolf, such as to hunt for food. In some ways it has become plant-like.

Humans have both the vegetative and appetitive elements. In addition, they have rationality, the rational soul. Paradigmatically, humans act for reasons such that where animals can only act on the basis of satisfying appetites, humans can act on the basis of believing the act to be good or, even if not good in itself, overall to contribute to what is good (for them). Aristotle also argues that humans cannot exercise their rationality alone; they are by nature social (or political) animals (*Politics* 1253a). One indication of this is that rationality requires language which in turn is a social form. An isolated human being cannot flourish.[1] And one who fails to reason well does not flourish.

We can now turn to health. The WHO definition of health is famous, perhaps infamous.

> Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity. WHO [online].

On an Aristotelian account, perhaps the problem here is that it is closer to flourishing than to health alone. It seems to run counter to the appearance with which we began this section, that healthy humans can live wretched lives. Aristotle's definition of flourishing (not health) is famously set out in his *Nicomachean Ethics;*

> [Activity] of the soul in accordance with virtue [*Nicomachean Ethics* 1098a15]

Clearly good reasoning is central to this. But note the vegetative and appetitive element to our soul; this too needs to be satisfied in a flourishing human life. Hence in order for humans to flourish they need elements (goods) beyond that of good reasoning. Aristotle describes three categories of goods. The first are external goods, which lie outside a person's mind, feelings, character and body (*Nicomachean Ethics* 1098b12-16). Critical here will be sufficient wealth to maintain nutrition and satisfy basic appetites, but also friends and (in Classical Greek style) noble birth and honour (*Nicomachean Ethics* 1009a31-b8). The second category is goods of the body consisting mainly of health, strength and appearance but also bodily pleasure itself. The third category is goods of the soul where Aristotle is referring to the rational part of the soul only - hence these are the qualities (or virtues) of good reasoning in theoretical and practical matters.

Aristotle's definition of flourishing highlights the third category but elsewhere and often he acknowledges the requirement for other goods, external and bodily. This is not to say that good reasoning plays no part in their attainment; prudence protects both, for example. But a good deal may be down to luck or fate; serious illness can strike anyone. This was a source of vigorous debate in the Classical period. The Stoics in particular disagreed, believing that virtue was the whole of flourishing such that no misfortune could undermine it (Annas, 1993). Aristotle's theory is far better aligned to the appearances of the world, however.

Health, then, is good functioning of the material body, of the material part of our hylomorphic soul, the bones, blood, muscles, nerves, and so on. These can affect our

[1] Aristotle would be unimpressed by spiritual hermits as would the Greeks in general; their word for private, *idios*, grounded the notion of idiocy, which for them was the natural state into which we are born and which we develop away from as we become citizens.

reasoning, as when a headache stops our work, or when mental illness strikes. But the point is that on an Aristotelian account the illness resides in the material level.

Illness is, if you like, a flaw in the material part of the soul. They are as opposed to flaws in the reasoning part of the soul, which are in the main a reflection of character, described in terms of vice or other states that are less than virtue, such as weakness of will. Take the example of someone whose behaviour is generally fearful or cruel and as a result he fails to flourish. If the problem resides in the rational part of the soul it is a problem of character, the behaviour reflects vice or a similar failing. If the problem resides in the material part of the soul, say through bipolar disease, he is ill.

Someone might object here that character itself is material. If human beings are hylomorphic souls then at some level character will reside in the material level just as bipolar disease does. There are two responses to this concern. The first is that the location of the treatment of the problem will vary. Treatment of illness is aimed at the bodily level; treatment of character defect is aimed at the level of reasoning. This suggests that there is reasonable ground within practice to locate the problems at different levels of the soul; we can, at least in principle, treat bipolar disease through health care; we cannot treat character deficiency in the same way. The second response relates to the notion of morality and ethics. As we shall shortly see, there is some doubt that there is an Aristotelian notion of morality similar to the notions developed in the medieval period and into the Enlightenment. If this is so, then we should be less concerned with developing an account that helps us separate the morally blameless ill person from the, say, wicked bad person. Both are barriers to flourishing that are to be avoided or treated. Health care is simply the science that deals with the former; politics and ethics, the latter.

3) What should the nurse do?
As we've seen, there are two treatises on productive science in the surviving body of Aristotle's work, *Rhetoric* and *Poetics*. One feature of both is that each of these crafts are viewed as having a goal or *telos*; for *Rhetoric* it is persuasion, for *Poetics*, roughly, the discovery of how to live through mechanisms such as catharsis and imitation. A second feature is that these goals are at the service of the overall human goal, flourishing itself. Nursing's goal is the health of those within its purview, a goal shared with the other health care professions. And as with the crafts Aristotle has written about, the health care goal is ultimately subsumed by that of human flourishing.

This subsuming sets boundaries to the activity of health care. In Aristotelian terms, actions which apparently service health but not flourishing are not really in accordance with health care. Let us examine two areas in relation to this: mental illness and ethics.

Mental illness: A core problem in mental health care is the difficulty of distinguishing eccentricity from illness. Why is some mental illness justifiably to be treated as a health care problem where this is not so for similar behaviour not linked to mental illness? For example, suicidal behaviour is seen as something to be prevented by health carers when it is a manifestation of mental illness but if not then the suicidal behaviour is seen either as outside of the health care remit or, in extreme cases, as something to be facilitated by health carers. This type of problem is at the core of Szasz's argument that mental illness is a myth (Szasz, 1998). The implication for practitioners of mental health is that behaviour deemed to be mental illness is actually that which is deemed socially unacceptable; mental health practice then makes pathology of a social judgement and is more like behaviour policing than health care.

Aristotelianism may have the resources to ground a realist account of mental illness that can a) counter the idea it is a myth b) offer tools to distinguish between mental illness and eccentricity or vice. In line with the definition of health given earlier, mental illness is malfunctioning located at the material level of the soul and which results in harmful and bad decisions and behaviour. This is as opposed to malfunctioning which is located at the reasoning level of the soul, which is a character flaw rather than an illness. The business of health care as treatment is in dealing with the former rather than the latter. Having said

that, it is within the potential remit of health care to ensure that people making decisions about, say, smoking, are aware of the risks; this would be similar to the firefighters role in risk assessment of people's homes. This argument is developed elsewhere for example by Megone in a dialogue with Szasz (Megone, 2000).

Ethics: In nursing and health care, ethics is usually discussed on a stand-alone basis. Using the terminology already introduced, nursing is a craft that draws on a great deal of theoretical as well as productive or craft knowledge. A good nurse will know how to do things practically, such as take blood, but also have the theoretical knowledge to, for example, prescribe or dispense drugs safely. Ethical considerations are taken to be separate and are often undertaken in the face of ethical dilemmas or problems, such as truth-telling, the fair distribution of resources, whistleblowing and euthanasia. As might be guessed from the foregoing discussions, this does not match Aristotle's nested picture of the sciences; in this hierarchy craft knowledge is beneath productive (ethical and political) knowledge. We should expect the decisions made at the craft level to be based upon knowledge at the higher levels. This is clear with theoretical knowledge, as with the prescribing and dispensing of drugs. Is it also true of ethical knowledge; in other words, in making the decisions of the nursing craft, is the nurse already working within an ethical framework rather than needing to call upon something separate from the craft? Let us see why the answer to this from an Aristotelian viewpoint is affirmative.

The modern renaissance of Aristotelian ethics is usually marked as the publication of an article, 'Modern moral philosophy', from Elizabeth Anscombe (Anscombe, 1958). She begins from the apparently interminable nature of modern moral discussions. For example [not Anscombe's], the debate about the ethics of abortion seems to be characterised by the immovable object of the right to life meeting the irresistible force of the right of women to make decisions concerning their own health and body. Or take the well-known four principles approach, where dilemmas are characterised as clashes between one or more of the '*prima-facie*' principles but where the approach gives no clue as to how to decide which should take precedence in any given situation.

Anscombe's diagnosis is that the terms used in moral debates, such as good and bad, human rights, and justice, derive their original force and meaning from a teleological and theological framework. Thus, for example, an act is good because it is decreed by God's word as revealed in scripture or through His worldly agents in the Church. The Enlightenment cut humanity loose from this framework both in terms of science and of ethics. Hence, just as the natural world could be described in terms of forces and laws that were not the produce of God's decree, so too could ethics. Whilst this was a successful strategy in science, it turned out to be unsuccessful in ethics; thus MacIntyre talks of the failure of the Enlightenment project (MacIntyre, 2007); a similar argument is put also by Bernard Williams, although he also suggests Aristotle falls foul of a similar failure (Williams, 1985). (A plausible response is that Aristotle was not trying to establish an account of ethics or morality of the standalone type Williams is concerned with.) The result of this failure is that what we had in ethical discussion was a set of concepts that had visceral and rhetorical force but no stable and agreed origin. It was like two blind people arguing over colour.

The way out of this problem for Anscombe and those who followed her lead was to return to the nature of human beings, to facts about psychology, for example. Rather than ask whether an action is good *per se* we should ask whether it is good for people, with a clear and agreed idea of what that is. And of course, this is precisely what Aristotle offers: ethical terms grounded in the idea of human flourishing.

Because Aristotle's specific works of ethics make great use of the concept of virtue, this return to an Aristotelian framework is sometimes described as virtue ethics. There are problems here. In the first place there is the archaic absurdity of the term, satirised by Muriel Spark in here character Miss Jean Brodie when she cites *Proverbs* 31:10, "Oh where shall I find a virtuous woman, for her price is above rubies?" (Spark, 1961). More importantly, the important metaphysical concepts, of function and form, for example, and

psychological concepts, such as reason and appetite, can be lost. We may end up with a virtue ethics that simply replaces the conceptually adrift ethics that Anscombe criticised, with similarly adrift notions of virtue (Coope, 2006). This is one of the many problems with the current focus on the so-called 6Cs in UK nurse education. These quasi-virtues, compassion, care, courage and so forth, are conceptually adrift, often defined using other similarly adrift terms: compassion is said to be based on empathy, respect and dignity, for example. But, as I've argued elsewhere, you cannot be simply caring *per se*, there has to be a goal that defines caring about what and in what manner (Allmark, 1995, 1998). A similar point can be made with regard to the other "Cs". The apparent vicious circularity in Aristotelian ethics referred to earlier is overcome by the teleology that associates virtue with flourishing; but detached from that *telos* it becomes circular in the ways apparent in some modern virtue ethics and in the 6Cs.

Hence the question the Aristotelian health-carer asks in relation to decisions about practice, education or research is not "And what does ethics or ethical theory suggest here?" Rather, her thinking is within a framework of human flourishing such that her final all-things-considered decisions will be for flourishing and therefore ethical.

Conclusion

Insofar as Aristotle's philosophy is to be of use to practitioners, it needs to be seen as a system, not simply cherry-picked. For that reason, this article has primarily been about the system rather than what some readers might have expected, such as a focus on virtue ethics, or realism in research, or the notion of practical wisdom in education. As that resume of topics shows, however, there is much more of potential use in Aristotle's philosophy. What I hope this article has shown is that the system itself is sturdy and worth engagement with for the practitioner.

Further reading

The references to this article will offer some guide to readers. It is worth restating that the extant Aristotelian *corpus* is difficult because it was not intended to be read in the form presented. While it is customary in philosophy to recommend reading the original texts, it's hard to see this as the right route here; no-one cuddles up with an Aristotle. Even the apparently readable works, mainly the *Poetics* and *Nicomachean Ethics* hide mysteries a casual reader will fail to notice; and for such a reader, the argument will thus usually be unpersuasive. Some works are so difficult as to be unreadable without guidance. I have not read anything other than sections of the *Metaphysics* or *Topics*, for example, and then only with a guidebook or when checking it against an academic article or similar. Aristotle's texts are readily available, often free on the internet. I would not particularly pick out any translations aside from the *Nicomachean Ethics* where the translation by Roger Crisp is good for clarity, perhaps even for cuddling up with, and by Terence Irwin for its helpful notes; I note also a recent translation by Reeve which looks promising (Aristotle, 1999, 2000, 2014).

Fortunately, there are plenty of good texts out there. I can only report on one or two that I have found useful; an internet search would turn up others which the reader may prefer. A good overview is the fairly recent *Aristotle* by Christopher Shields (Shields, 2014); I have drawn on it for this article and would recommend it as a first stop. More difficult, but well established, is *Aristotle: the desire to understand* by Jonathan Lear (Lear, 1988). Important in my development was Terence Irwin's *Aristotle's First Principles* (Irwin, 1988) but this is a difficult text which I could read only because I was doing a PhD at the time. I have not read but there are good reports of a popular introduction to Aristotle's biology, *Aristotle's Lagoon* by Amand Leroi (Leroi, 2015). The other biology text already referred to is perhaps more difficult but I found it useful (Gotthelf, 2012). The set of articles edited by Rorty is also widely used and helpful (Rorty, 1992).

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