Aristotle's Empiricism: experience and mechanics in the 4th century BC. By Jean De Groot. Las Vegas: Parmenides Publishing, 2014. Pp. xxv + 442. $127.00 (paper). ISBN: 978-1-9-30972-83-4.

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According to a generally held impression, which has coalesced out of centuries of misinterpretation occasioned mostly by misguided charitable commentary, but often by outright hostility to his followers (and occasionally deliberate misrepresentation of his ideas), Aristotle is a teleological (as opposed to 'mechanistic') philosopher, responsible for a qualitative (as opposed to quantitative) approach to physics that is thereby inadequately mathematical, whose metaphysical speculations, as absorbing as they continue to be even for contemporary and otherwise ahistorical analytical metaphysicians,[1] are essentially devoid of the virtues that determine the success of our modern sciences, which are in fact the result of overthrowing Aristotelian views. Jean De Groot's monograph *Aristotle's Empiricism: experience and mechanics in the 4th century BC* should completely wipe away that impression, as she offers an extremely attractive interpretation of Aristotle and his methods to replace it. This is a groundbreaking and exciting work, brimming with insights won from close and careful readings of both well-known and obscure passages of the Aristotle Corpus. It is an instant classic of Aristotle studies that should not only change the image of Aristotle's role in the history of science but also set the agenda for much of the future research in every area of his theoretical sciences, including metaphysics, mathematics, and natural science. Thus although my primary goal in this review is to summarize its contents and try to give an idea of the richness, depth, and breadth of de Groot's project, I will mention at the end what I think are the most important ways that the research should be developed and extended—the next areas of Aristotle studies that should incorporate these views and methods.

Before summarizing the contents however, a word about the title '*Aristotle's Empiricism*'. De Groot defines empiricism as 'the conviction that in one way or

[1] See, e.g., the essays in Tahko ed. 2012. The authors develop what they take up to be Aristotelian problems or positions in discussions of topics in contemporary analytic metaphysics without any direct discussion of Aristotle himself, and no pretense to doing history of philosophy whatsoever. Comparable to this, although generally operating with a very different set of historiographic assumptions, are the essays contained in Hüntelmann and Hattler edd. 2014.

another sense experience or being acted on by the world is the primary source of human knowledge' (1). Two conflicting families of complaints about Aristotle have arisen in connection with his empiricism. First is the charge that Aristotle is a naïve empiricist, 'taking things just as they appear and making those appearances into causes. Aristotle's empiricism is rather a critical empiricism in the sense of using seeing, sightings, or observations as they are significant in a context. This becomes clear through his use of mechanical principles' (xxi). Thus, 'despite dealing with mathematics in Aristotle, this book is called *Aristotle's Empiricism*, because its argument bears on what Aristotle means more generally by *phainomena*—phenomena, states of affairs, what occurs in nature' (xxi). The second, incompatible, charge, is the charge that our man is insufficiently empiricist—that he relies on 'dialectical', meaning conceptual or a priori, techniques of investigation, and that he ignores the kind of careful observation and experiment that are the hallmarks of our modern science. In part this charge has been fueled by an influential article by G.E.L. Owen (Owen 1961), who interprets the *phainomena* (phenomena) to be 'saved' as consisting mostly in *doxa* (common opinions). This view has been carefully taken apart in several articles by Robert Bolton, and De Groot's views, which partly build on Bolton's, now stand with these, as far as I am concerned, as ruinous criticism of that position (see De Groot's criticism at 7-8 and 74-81. See Bolton 1987, 1991, and 2009). De Groot, however, does not focus on directly critiquing the positions of Owen or his followers, but rather on building an alternative picture of what Aristotle is doing, for example by sharply distinguishing *phainomena* from *endoxa* in the context of discussions involving mathematical and mechanical principles.

Summarizing De Groot's work is difficult, and not only because it is a long book (nearly 400 pages), divided into 11 chapters (including over 60 figures, charts, and tables) that progressively build the case overthrowing myriad misconceptions about Aristotle's philosophy. Some of these misconceptions are due to an inadequate grasp of historians and scholars of Aristotle on the work of Aristotle's predecessors and contemporaries in mathematical fields, which is understandable since their works are lost and their views and achievements have to be reconstructed from meager fragments. But others are due to an inadequate grasp on the significance of some of the 'dubious' works in the Aristotle Corpus,[2] including the *Problems* and the *Mechanical Problems,* and this is less understandable, since these texts have been incorporated into editions of Aristotle since before the Renaissance, and modern editions and translations of them are readily available.[3] De Groot has to deal with some of these inadequacies in the

[2] By 'Aristotle Corpus' I mean all the works attributed to Aristotle included in the standard edition of Aristotle, edited by Immanuel Bekker. This Corpus includes works that are *dubious* (i.e., scholars do not agree whether the work was written by Aristotle, e.g., *Magna Moralia*) and others that are *spurious* (i.e., scholars are agreed that the work was not written by Aristotle, e.g., *Physiognomica*).

[3] For the text of the *Problems*, see Louis ed. 1991-1994; for translation, see Mayhew trans. 2011. For the text of the *Mechanical Problems*, see Bottecchia-Dehò ed. 2000. For translation of the

apprehension of the ancient evidence base in some detail in order to explain her position. Further adding to the complexity of her argument is the fact that De Groot is conversant with contemporary philosophy of science and philosophy of mathematics and often brings ideas of modern philosophers to bear on the problems she explores, a valuable complication that is becoming ever more rare in the extremely specialized scholarship on Aristotle's metaphysics. This last point led me to see De Groot's book as something more than a highly original interpretation of Aristotle (as great as that would be), but in fact as a highly original work of philosophy in its own right, one that craftily uses the Aristotle Corpus as an apparatus to make fascinating and instructive points about the history and nature of human cognition and mathematics. For these reasons, I will only be able to outline some of the most outstanding issues and will have to drop a number of interesting ones.

In chapter 1, De Groot explains the moving radius principle that was employed by Archytas of Tarentum (circa 435/10 to 360/50), a contemporary and associate of Plato.[4] In chapter 2, De Groot shows how the moving radius principle was also employed by Plato in *Laws* x and by Aristotle in well-known chapters such as *On the Heavens* ii 8 and *Movement of Animals* 1 and 7; and also in the less well-known but (according to De Groot) genuine *Physical Problems* xvi. Archytas may have provided the first mathematical treatment of the moving radius principle, but as De Groot explains in chapter 3, the moving radius principle is salient in our basic kinesthetic awareness of such actions as casting a fishing rod, or falling in the direction of a blow to the legs. Our ability to perceive conspicuous moving radius phenomena serves as a direct intuitive basis for the formulation of the moving radius principle as an empirical principle, which then puts us in a position to detect the moving radius in other artificial and natural phenomena, and so to extend the reach of the principle.

This is essentially the program of the *Mechanical Problems*, a text that 'has been the least studied of all works attributed to Aristotle' (169), and a work that De Groot takes to have been written by an Aristotelian living 'at least several decades after Aristotle's own time' (xxi); 'roughly fifty years after Aristotle's own *floruit*. Some scholars have placed the text in the circle of Aristotle's own research associates, however, or even made it the work of Aristotle himself' (21n46). De Groot does not attempt to resolve this chronological issue, referring us instead to the discussions of Krafft, Bottecchia-Dehò, and Schneider. Nevertheless, De Groot's explication of the moving radius principle and its significance requires the *Mechanical Problems*, and so the argument of that text is discussed in detail in chapters 2 and 8. The application of the moving radius principle is not as explicit, programmatic, and methodical in *Problems* xvi, and this may be an indication of the lateness or even different authorship of the *Mechanical Problems*. At the same time, there is no question that the scientific method of

Mechanical Problems, see Hett trans. 1980.

[4] For text, translation, and commentary on Archytas, see Huffmann 2005 and also my review of Huffman's work in Johnson 2008.

the *Mechanical Problems* is Aristotelian and in fact sheds much light on Aristotelian scientific method (more on this below). Thus the point about authorship is not very important to the philosophical issues, because De Groot has easily demonstrated that the principle was used by Archytas, Plato, and Aristotle, and it cannot be doubted that it was assumed by Aristotle to govern the circular motion of all bodies, and thus to have wide application not only in mechanics but also in other mathematical sciences, such as astronomy, and even in seemingly non-mathematical life sciences. Aristotle's application of the principle to new areas such as animal motion, embryology, and to various physical problems of the sort treated in *Problems* xvi are discussed in chapters 5, 6, and 7.

The moving radius principle as presented in the *Mechanical Problems* develops out of a conception of the balance beam as employed in scales and the lever, which can then be detected in machines, such as oars and rudders, and natural things, such as whirlpools or pebbles rounded on a beach. The principle is expressed verbally in either of the following formulae: 'points on a moving line all move at different speeds proportional to their distances from the center of a circle' or 'of concentric circles, a point on the circumference of the smaller circle moves in the same time a shorter distance than a point on the circumference of the larger circle' (2). Put in either of these ways, we have a kinematic formulation. Kinematic accounts are those given in terms of the geometrical features of motion, in contrast to dynamical ones, which involve causal accounts given in terms of forces, ideally expressed as laws of motion. De Groot points out that the author of the *Mechanical Problems* provides a viable kinematic account of the moving radius, but overlays 'weaker and under-conceptualized' (236) dynamical notions in terms of impulse or force (*ischus*) and constraint (*ekkrousis*) that do not entirely cohere with the kinematic account.

The kinematic version of the moving radius principle is a mathematical rule concerned with motion. Given De Groot's demonstration of its wide application in various works of Aristotle, one is immediately forced to revise the picture of the purely 'qualitative', non-mathematical and anti-mechanical Aristotle of legend. The *prima facie* reasonable position that would admit this but insist that the kinematic moving radius principle is just bad mathematics and mechanics (because, e.g., of its ignorance of pi and the notion of angular velocity) is a chief target of De Groot's argument throughout the book. She argues that 'the moving radius principle is good enough mathematics to the extent that it depends on a geometrically correct property of the circle. Furthermore, it has the advantage of being both mathematical and experiential in as fundamental a sense as a mathematical principle can be. Finally, Aristotle's application to nature of proportional thinking drawn from the mechanics of the moving radius introduces into philosophy the mathematical idea of an invariance present throughout deformation of a state of affairs. This idea still makes an important contribution to mechanics' (xxiii-xxiv).

In several cases in which he employs a kinematic conception of the moving radius principle, Aristotle also describes a diagram, and it is a real problem when these are not drawn in the modern texts in which the principle is invoked—even those texts in which it is the focus of description and discussion.[5] De Groot does not dwell on the importance of diagrammatic reasoning itself (although she does provide diagrams for the moving radius principle and many other extremely helpful diagrams throughout the work). Recent research including that of one of my students has convinced me that Aristotle's works are in general pervaded by diagrammatic reasoning, and that Aristotle's philosophy of science assigns a crucial role to diagrammatic reasoning as a complement to discursive reasoning.[6] The fact that diagrams were not usually transmitted in the medieval manuscripts of Aristotle's works, and are missing from many of the modern editions and translations is itself partly responsible for the failure to appreciate the important role of kinematics in Aristotle, and this has contributed to the mistaken impression that Aristotle is not a mathematical thinker. In fact, Aristotle's works contain the first descriptions of lettered geometrical diagrams in the history of mathematics, a remarkable fact for which more credit is deserved even where scorn has been heaped.[7] I think this is an extremely important aspect of Aristotle's mathematics, kinematics and empiricism—diagrams themselves are a crucial tool of empiricist and mechanical reasoning.

In later chapters, De Groot brings her interpretation of Aristotle's mechanics and empiricism to bear on some of the traditional problems of Aristotle's physics. In chapter 9, she discusses the relation between Aristotle's kinematics and what has been called his 'dynamics' in the discussions of movement, the continuum, place, void, and time in *Physics* iv-viii. In chapter 10, she discusses the various difficulties with Aristotle's notion of weight, which he treated as belonging to the category of quality as opposed to quantity. One might think that this precludes a mathematical treatment (resulting in a purely 'qualitative' one in the now pejorative sense). Be De Groot ably shows how Aristotle is able to devise proportional formulae that are genuinely mathematical by treating weight also in the category of relation. She also lends convincing support to Edward Hussey's sage suggestion that the reason Aristotle asserted that heavier weights 'move downwards faster' is that he was thinking of the starting speeds on the bal-

[5] Aristotle describes lettered geometrical diagrams throughout the Corpus, e.g., in his explanation of the halo in *Meteorology*: 'Let ACB and AFB and ADB be lines each of which goes from the point A to the point B and forms an angle' (373a6-8). On the basis of such instructions, it is possible to reproduce the diagrams, and usually fairly easy to do so. But no diagrams are drawn in the standard edition of the works of Aristotle edited by I. Bekker. Nor are there any diagrams in the most convenient and widely used English translation, Barnes ed. 1984.

[6] An excellent discussion of the importance of Aristotle's use of diagrams (focused on the context of meteorology) is contained in Taub 2003, 103-114. My student Ashley Attwood has conducted a general study of diagrams in the Aristotle Corpus in *Visualizing Universals: Diagrammatic Reasoning in Aristotle*, UCSD Philosophy Department Undergraduate Honors Thesis, submitted 2014.

[7] E.g., with reference to Aristotle's geometrical explanation of the halo, which includes description of a diagram still used in textbooks on meteorological optics, Netz 2003, 210 has stated that it is 'hardly worthy of being called mathematics'. For criticism of this view, see Taub 2003, 113-115 and Johnson 2009.

ance beam of a scale (De Groot, 267-268; see Hussey 1991). In these chapters De Groot patiently walks us through the longstanding debate about the role of Aristotle in the history of the sciences of dynamics and mechanics that includes Galileo and Newton, carefully sorting the insights and solid points from the anachronisms and shaky assumptions present in the accounts of Duhem, Carteron, Drabkin, Clagett, De Gandt, Owen, Hussey, and most recently Wardy and Berryman. There is much of interest in these chapters that I cannot possibly do justice to here, where I can do no better than to quote a summarizing remark from the conclusion of the book: 'It has not been recognized before that kinematics plays a large role in Aristotle's thinking about nature. The cognitively primitive kinematic thinking of a 'first mechanics' is the beginning of scientific empiricism. Aristotle's mechanical thinking is, at the least, one historical vector extending out from a core universal knowledge process. That knowledge process issued, in a different age, in classical mechanics. The process I have described culminated in a philosophy of nature that featured *dunamis* and *archē*' (365).

In the final chapter 11 and conclusion, De Groot discusses in broad terms the nature of Aristotle's empiricism, its grounding in mathematical-mechanical science, its diverse influences and applications throughout the Corpus, and its relation to the more traditional picture of Aristotle, including his metaphysics and teleology. The volume is filled out by a bibliography and indices of passages, names and subjects.

Now that I have given a skeletal outline of the contents of the book, I will discuss the only thing that I find questionable in what De Groot has been arguing, and this comes out most clearly at the very end of the book in a section entitled 'the other Aristotle'. Recognizing that her interpretation of Aristotle may seem 'jarring' and her perspective 'antagonistic to traditional interpretations of Aristotle's natural philosophy based on substance, essence, form, and teleology' (366), De Groot mentions a way in which her own view could serve as a useful complement to—not contradiction of—the metaphysical and teleological interpretations of Aristotle, but only briefly and hesitatingly before concluding that they are independent of one another: 'The interaction of teleology and the mechanical thinking that I have highlighted is a topic of considerable interest, but the lines of development of these two types of natural explanation seem at the present reading independent of one another in important ways' (368). De Groot states, without explanation, that keeping these 'independent' lines of interpretation separate will somehow clarify the interpretation of Aristotle: 'The separation that I have labored to maintain between natural philosophy and metaphysics in Aristotle's thought will finally, I believe, serve a better understanding of how these two philosophies are related for Aristotle' (370).

But at this point some questions need to be raised concerning the coherence of the interpretation with other important doctrines in the Corpus. One somewhat unpopular way of dealing with apparent divergences or discrepancies is to posit developmental interpretations according to which Aristotle changed his mind or his emphasis in different periods of his thought. De Groot sometimes offers developmental speculations, as when she discusses the relation of the teleological *Physics* ii to the kinematics (and dynamical notions) of the later books of the *Physics*: 'it is thus clear that the investigation of movement here is different from the one taken in *Physics* ii. There are many reasons to think the motion books of the *Physics* were written during Aristotle's second stay in Athens, and so also possibly *Physics* vii dates to that period. What is important is to notice just how much the direction of his research during his second stay in Athens comes from a different source or inspiration than either *Physics* ii or the biological works that were his preoccupation in the time he spent with research associates in Assos and Lesbos' (299). But nowhere does De Groot enter into the kind of detailed argumentation required to substantiate such speculations. Not that the speculations are objectionable in themselves (as some seem to hold; in my view developmental interpretations are as necessary as they are difficult to establish), only that they will eventually need to be demonstrated unless a means of doctrinal reconciliation can be found, or we are willing to admit that Aristotle's philosophy suffers from widespread incoherence and lack of systematicity. And in this particular case I have serious doubts that there was ever a development away from teleological thinking towards empirical, mathematical, or mechanical thinking. Aristotle's interest in both mechanics and teleology seems to me evident throughout his works. For example, in the second chapter of *Physics* ii Aristotle discusses the necessity of incorporating mathematical accounts into physics. De Groot discusses this chapter at some length because of its importance to her overall thesis about the mathematical Aristotle (e.g., 326-332), but there she does not remind us of her earlier assertion that *Physics* ii is devoted to an earlier or alternative (are we supposed to think superseded?) 'teleological' way of explaining physical phenomena.

That for Aristotle teleological and mechanical explanations are necessarily interdependent is a counterintuitive point that I have recently become convinced of (see Johnson forthcoming). Machines—the literal objects of the science of mechanics—are necessarily goal-oriented things. In every case of a machine, from the simple ones like scales, levers, oars, and rudders, to more complex ones like clocks and automata, there is always a goal or purpose of the machine at work; and it is these purposes that govern by hypothetical necessity the efficient and material causes we usually associate with 'mechanistic' explanations.[8] Art imitates nature or acts to fill in its deficiencies, and so machines (or devices) must be goal-oriented artifacts that imitate natural goal-oriented substances, or

[8] For present purposes I use the term 'mechanical explanation' to refer to explanations proper to the science of mechanics, which in the first place takes as its objects simple machines like the lever; and I use the term 'mechanistic explanation' to refer to explanations in other domains that are modeled on or use mechanical explanations, for example the biomechanical explanation of *Motu* 7. Berryman 2009, 15-20 has provided a useful taxonomy of the term 'mechanical'. Berryman doubts that there was 'a theoretical understanding of the discipline of mechanics in the fourth century' (104); she perceives no theoretical understanding of mechanics prior to the *Mechanical Problems*, which she (like De Groot) takes to be a product of Aristotle's successors.

fill in where they are deficient. This, I take it, is the main reason why automata were repeatedly used by Aristotle and so many others—especially the moderns—to model animal and human functional physiology and even behavior. Thus mechanical explanations necessarily involve and are even governed by teleological explanations. And because of Aristotle's insistence on complete causal explanations, it will turn out that teleological explanations will also usually involve mechanical explanations. The teleological part of the explanation answers the *Why* question, the mechanical explanation answers a *How* question. The challenge is to explain how these explanations can be integrated into a single explanation, and further, how that explanation can be expressed in the form of a scientific syllogism.[9]

This brings me to the next point about how the insights of De Groot need to be developed. An even more pressing question than how her account might square with Aristotle's teleology or metaphysics is whether and how it could be made to fit with the doctrine of the *Posterior Analytics*, according to which scientific knowledge is to be presented in the form of scientific syllogisms. De Groot says very little about this. In effect she assumes the same posture as with the issue of teleology, writing as if Aristotle's natural philosophy is better understood as somehow different from 'a propositional form of knowledge': 'This interpretation takes certain basic concepts of natural philosophy, in particular potency and form, as grounded in perception and less dependent on a propositional form of knowledge than has been thought in recent decades' (xxii).

But this seems to me unsatisfactory. According to the *Posterior Analytics*, scientific knowledge must be propositional—since it must be in the form of true propositions organized syllogistically. Either Aristotle's mechanics is propositional or can be made syllogistic in this way, or it cannot. If it cannot, than either the doctrine of the *Posterior Analytics* must be rejected, or Aristotle's mechanics must. But I see no reason to doubt that Aristotle conceived of mechanics as a proper syllogistic science. A strong *prima facie* reason to believe that he did is the fact that Aristotle discusses mechanics as a subordinate mathematical science in *Posterior Analytics* i 13 in a passage that De Groot discusses at length in her own elaboration of his views (330-336) without mentioning the wider context and syllogism-centric doctrine of the *Posterior Analytics*. A further indication is the fact that the author of the *Mechanical Problems* seems to have consciously followed the methodology of the *Posterior Analytics* (as I argue in Johnson forthcoming). In fact, it is somewhat ironic that the *Mechanical Problems* apparently follows the prescribed methodology of the *Posterior Analytics* more closely than any other work in the Corpus. Thus I disagree with De Groot's assertion that 'in its scientific role, *nous* concerns knowledge that can be propositionalized, but as *Mechanics* shows, propositional formulation is not always necessary to science if a mathematical formulation better expresses the cause' (72). As far as I can tell,

[9] For this reason I have developed in Johnson forthcoming a model of integrated teleological-mechanical explanations (e.g., of intentional human action) that can be expressed syllogistically.

'mathematical formulations', if they are to count as scientific explanations, themselves need to be at least in theory expressible propositionally and syllogistically, and it seems to me that the author of the *Mechanical Problems* is conscious of this and provides an account that is translatable into syllogisms. Thus it seems to me that Aristotle's mechanics should not be thought of as an alternative to a propositional form of knowledge—it is possible that it was by looking at chains of interconnected syllogisms that the author of the *Mechanical Problems* discovered a way to explain mechanical (including some natural) phenomena by reducing or relating them all to the moving radius principle, for example by tracing the cause of the power of the rudder to the lever, the lever to the asymmetric scale, and the scale to the moving radius principle.

Another area that it would be useful to expand De Groot's interpretation is to the interface between psychology and biomechanics. To explain what I mean, I need to call attention to some features of *De motu* 7 that De Groot does not mention in her otherwise insightful and useful analysis of that crucial chapter. The first is that the chapter begins with Aristotle introducing the notion of practical syllogisms in order to resolve an *aporia* about human action: 'But how is it that thought is sometimes followed by action, sometimes not; sometimes by movement, sometimes not? What happens seems parallel to the case of thinking and inferring about the immovable objects. There the end is the truth seen (for, when one thinks the two propositions, one thinks and puts together the conclusion). But here the two propositions result in a conclusion which is an action. For example, whenever one thinks that every man ought to walk, and that one is a man oneself, straightaway one walks' (*De motu* 701a7-14, Farquharson trans.). This should serve to underscore the above point, that Aristotle's mechanical thinking and methods cannot be very far separated from his commitment to the syllogism as a mode of scientific understanding. Notice, further, that, because of the presence of practical syllogisms in the chapter, it is clear that Aristotle assumes that intentional and rational human actions are to be explained in conjunction with the mechanical explanation, and so he cannot be straying very far from his interest in teleological explanation. Aristotle's proposal about how to unite these explanations involves showing how things like thoughts and desires (and, presumably, reasons) can, through psycho-somatic causes, produce mechanical effects.

> In the automata and the toy wagon there is no change of quality, since if the inner wheels became smaller and greater by turns there would be the same circular movement set up. In an animal the same part has the power of becoming now larger and now smaller, and changing its form, as the parts increase by warmth and again contract by cold and change their quality. This change of quality is caused by imaginations and sensations and by ideas. Sensations are obviously a form of change of quality, and imagination and thinking have the same power as the objects. For in a measure the form conceived be it of hot or cold or pleasant or fearful is like what the actual objects

> would be, and so we shudder and are frightened merely by thinking. Now all these affections are actually changes of quality, and with those changes some parts of the body enlarge, others grow smaller. *And it is not hard to see that a small change occurring at the center makes great and numerous changes at the circumference, just as by shifting the rudder a hair's breadth you get a wide deviation at the prow.* And further, when by reason of heat or cold or some kindred affection a change is set up in the region of the heart, even in an imperceptibly small part of the heart, it produces a vast difference in the body—blushing, let us say, or turning white, and trembling and shivers and their opposites. (*De motu* 701b10-32, Farquharson trans. adapted)

The passage, several parts of which De Groot illuminates greatly, makes clear Aristotle's intention to integrate a psychological, psychophysical, and biomechanical explanation into a single teleological explanation of intentional human action. The mention of the rudder and direct reference to the moving radius principle (which I placed in italics above) further suggests a way to integrate this kind of mechanistic explanation with a mechanical explanation of the rudder of the kind we find in the *Mechanical Problems*. Finally, once more, it is clear from the first part of *De motu* 7 that Aristotle has in mind a 'propositional', i.e., syllogistic formulation of all this.

These points that I have made, about how the account given by De Groot needs to be better integrated with the logical and methodological doctrines of the *Posterior Analytics*, and the teleological and action-theoretical doctrines of *Physics* ii and *De motu* 7, I honestly do not intend as criticisms of De Groot herself; they are suggestions for future work. De Groot has offered us an extremely valuable starting point for a reevaluation of the kind of philosopher Aristotle was. Everyone in Aristotle studies needs to understand these developments and help look for ways that they can be integrated or squared with other valuable parts of Aristotle's philosophy. Those working in the history of mechanics and mechanistic explanation also have important work cut out for them.[10]

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