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**Review of *Theory and Practice in Aristotle's Natural Science***

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How are Aristotle’s scientific treatises related to his thoughts on metaphysics and the methodology of the sciences? Generations of scholars have taken these to be largely independent. The *Posterior Analytics* formalizes scientific reasoning as a series of syllogisms with premises derived from definitions; the biological writings contain few definitions and are free of explicit syllogisms. Further, Aristotle rarely works through how any of his more abstruse metaphysical speculations are employed in biological and other scientific works. In recent decades, however, it has become clearer how Aristotle’s thought as a theoretical philosopher is integrated with his scientific research. There is no clean separation between Aristotle’s empirical research and more general investigations into knowledge and nature, which fall more squarely into what we recognize as philosophy. The two are implicated in each other and are to some extent inseparable. As its title indicates, the present volume contains new scholarship along these lines. A common theme is that longstanding misinterpretations of Aristotelian theory are due to a failure to appreciate the mutual implications that hold between Aristotle’s own practice as a natural scientist and what we would consider his more philosophical work. The volume as a whole aims to correct such purported misinterpretations. Not all readers will find all the proposed corrections here equally convincing, but not a single paper is less than intriguing, and the volume advances the project of understanding how Aristotle’s work hangs together as a whole.

I discuss four of the papers collected in the volume.

At *Metaph.* H.4, 1044a33-b20 Aristotle says that explanation of what is natural but not a substance is structurally parallel to explanations of substances. The explananda always include the form of the explanandum and, in the case of substances, its matter. As there is no matter for such things, the explanation of natural entities outside of the category of substance appeals to something analogous to matter. Aristotle’s example is sleep, but it is unclear what exactly Aristotle takes its matter/analogue to be. Alan Code’s “The ‘matter’ of sleep” turns for an answer to the account of sleep that Aristotle presents in *De Somno*. The first question to resolve is why a natural nonsubstance like sleep does not have matter in which it inheres. Matter is the persisting substrate of what comes to be and passes away. Sleep does not come to be or pass away. Strictly speaking, sleep does not come from wakefulness nor vice versa; it is the wakeful substance who comes to be asleep, and so forth. The substrate that persists through the cycle of sleep and wakefulness will not be matter but a matter-analogue. Code argues that the matter-analogue will not be homoiomerous kinds found within the human physiology (for it is not a specific hot stuff, for example, that comes to sleep), but is that organ that in turn takes on and loses a kind of form, the affection in question. Aristotle says that this affection is “an immobility of some sort”
(akinēsia toiadi) that results in an inability to perceive (1044b19). Code appeals to De Somno to argue that the subject of this affection is the heart, understood teleologically as the primary organ of perception. The partially digested stuff that surrounds the heart and renders it unable to perceive is not, contra Ross, the material cause of sleep; it is rather its efficient cause (41-3).

Understood in this way, Aristotle’s account of sleep appeals to all four causes, in accordance with the general lines of Aristotelian teleology.

Code has a strong argument but there are problems. If sleep is a kind of incapacity for perception, its subject should be the same as that of the ability to perceive. But Aristotle is explicit that the subject of perception is not the sense organ, but the whole perceptive animal. Although at DA 1.4, 408b8-9 Aristotle suggests that anger and fear are certain movements of the heart (not the soul), at b14-15 he speaks more precisely in saying that it is the (whole) human being who undergoes these passions (by virtue of the soul). Whether it is the heart or the whole person who undergoes such passions is clarified at 1.1, 403a18-19: in such cases the body undergoes something at the same time as the soul. Psychological changes such as coming to perceive, or coming to be imperceptive, are to be analyzed in the same way. Something happens to the heart when the whole ensouled human being comes to be in a condition in which she cannot see. That is not, however, to say that it is the heart that either perceives or sleeps. So it would seem that in the case of sleep the matter-analogue, as Code understands it, is the whole human being. But that is not to speak against Code’s interpretation. For there is an ambiguity latent within De Somno. Insofar as perception is a proper characteristic (idion) of neither the body nor the soul, sleep too is a pathos of neither (454a7-10), but of the whole ensouled body, which undergoes sleep by virtue of the heart. (Cf. DA 2.1, 412b18-25, in which Aristotle says that if the ensouled eye were an independent living being one could say that the matter of sight is the eye; but as it stands, the whole perceptive faculty inheres in the whole living body—not, we note, the heart.) On the other hand, sleep is explicitly said to be a pathos of the perceptual organ (454b10), which suggests that one could legitimately say that it is the heart that sleeps.

David Ebrey’s “Blood, Matter, and Necessity” returns to the role of matter in natural science. Ebrey takes issue with scholars like Lennox, Gill, Henry, and Leunissen according to whom “in the Parts of Animals Aristotle frequently provides explanations in terms of material necessity” (61). Within PA Aristotle will take it to be necessary that, when they are in appropriate contact, an agent act on a certain patient (for example, fire by necessity heats); but Ebrey argues that it is a distortion of Aristotle’s thought to call this a case of material necessity. Within the PA, matter plays a functional role; it is what comes to be something else, and for that reason has the function of nourishing. This is an important terminological point, about which writers on PA and other works should be more careful. But surely sometimes the agent that is identified in regard to a process in which an agent necessitates a certain result in a patient is, from another point of view, matter. For example, in the case of sleep, discussed by Code, the blood (matter insofar as it nourishes) heats or cools the heart (it is controversial which), resulting in the characteristic inability to perceive that is sleep. Insofar as we would consider such accounts wholly physicalist, we would call such incidences of causation “material.”

Thomas K. Johansen’s “The two kinds of end in Aristotle: the view from De Anima” discusses Aristotle’s distinction between a telos as an end (to hou heneka) and the telos as beneficiary (to tini). The former (“the end-genitive”) is appealed to in definitions that make appeal to the soul’s capacities. The exercise of that capacity is the telos. The latter (“the end-dative”) identifies the thing that is benefited by that exercise. Johansen argues against Gaiser, who takes the end-dative to be applicable only in the case in which humans are the beneficiary, and against Sedley, who takes it to be a way of “smuggling in” a hierarchy of telē culminating in the good of the cosmos as a whole (124). Light is shed on the end-dative by DA 2.4, 415b8-22 where, Johansen argues, the soul is identified as such an end. As the soul does not have interests in itself, it is an end-dative insofar as the whole living being is the beneficiary, in respect to being ensouled. The
A living thing is defined by a number of functionally organized organs, each defined by appeal to the exercise of its distinctive capacity; yet a definition needs to be unified if it is to be the definition of a unitary thing. Johansen’s paper helps to show how Aristotle’s general account of teleology allows the capacities themselves to be understood as unified by virtue of the contribution that they make to a whole substance.

One of the puzzles faced by recent interpreters of the *Posterior Analytics* concerns the classification of the varieties of definition. Is an account of the meaning of a word a variety of definition, or must a definition indicate something real? In David Sedley’s “Varieties of definition,” real progress is made on this issue. Appealing to Aristotle’s natural philosophy, Sedley shows how the issue is not simply terminological, concerning the way in which the term *horismos* is to be used. Sedley argues that *APo.* shows that Aristotle always conceives of a definition as indicating not only something real, but something causal. A demonstration’s middle term expresses the cause of the major term’s inherence in the subject; the conjunction of the minor and major term is a kind of incomplete definition, which may well correspond to what the term for the major term means. But such a definition is simply the expression of the same thing as the adequate definition which, insofar as it includes the (causal) middle term, will be a scientifically adequate definition. The conclusion of the demonstration is an incomplete expression of that. Sedley argues that even the expression of the meaning of a word that does not refer is still a true causal definition. The example that shows how this is so is the definition of the void in *Phys.* 4.7, 213b31: “the place in which there is nothing.” This definition allows one to infer that the void is that in which there is nothing heavy or light. The matter for both heavy and light, qua matter, is such a thing. So, Sedley argues, according to Aristotle the void, properly understood, does in fact exist. The definition that guides inquiry into the void, then, though it has the status of what the word “void” means, is a very different kind of account from the meaning of a term like “goatstag,” which does not refer at all, and accordingly is not a definition of any kind. Sedley’s account is persuasive, and allows us to have a deeper understanding of both *APo.* and the *Physics.* It has the advantage of shedding light on the closely related discussion of the phases of scientific inquiry in *APo.* 2 1-2. For in those chapters Aristotle says that when inquiring into something we first determine whether something is before determining what it is. One may well ask how one can determine whether there is an x unless one already has the provisional definition of x, that is, the meaning of the term “x”. Sedley would suggest that somehow there is a grasp of some feature of the world (such as “the moon’s suffering light,” or “a place neither light nor heavy”) that allows for the inquiry into its cause. It is this initial grasp that constitutes the knowledge of the “if it is” or “the fact” that makes possible the inquiry into its cause, allowing for the establishment of a real definition. No such inquiry could even get started in the case of the goatstag.

The volume’s other eight papers are likewise of high value. Ebrey and his contributors deserve thanks for showing new ways to appeal to Aristotle’s practice to shed light on his theory, and vice versa.

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