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Review of Allan Gotthelf's *Teleology, First Principles, and Scientific Method in Aristotle's Biology* and James G. Lennox and Robert Bolton's (ed.) *Being, Nature, and Life in Aristotle*

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Review Essays

Review Essay: Allan Gotthelf's *Teleology, First Principles, and Scientific Method in Aristotle's Biology* and James G. Lennox and Robert Bolton's (ed.) *Being, Nature, and Life in Aristotle*

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Although readers of *Reason Papers* are no doubt familiar with Allan Gotthelf's extensive efforts aimed at a more widespread appreciation of Ayn Rand's philosophical thought, he is best known among historians of philosophy and science for his contributions to the understanding of Aristotle's biological works, which have shed much light on Aristotle's scientific methodology, epistemology, and metaphysics. Two new books allow us to take account of Gotthelf's contributions to Aristotelian studies. The first is a collection of Gotthelf's most important papers on Aristotle.¹ Although the papers were written independently, there is little superfluous repetition, and taken together they constitute a comprehensive and coherent account of Aristotle's biology and its philosophical significance. The second, which has its origin in a 2004 conference in Gotthelf's honor, is a collection of papers on Aristotle, most of which focus on themes that Gotthelf himself has discussed.² Some of the papers further his thought, taking it in new directions; others depart from Gotthelf in philosophically interesting ways.

Gotthelf believes that one of his most important contributions to Aristotelian studies lies in his account of teleology in the biological writings. For this he gives credit to Rand (p. viii) (who personally led Gotthelf to the study of Aristotle), for she had argued that scientific explanation must identify potentials inherent in natures. This was in contrast to the predominant empiricist strategy of taking explanation to be a matter of subsuming an

¹ Allan Gotthelf, *Teleology, First Principles, and Scientific Method in Aristotle's Biology* (Oxford: Oxford University Press, 2012).

² James G. Lennox and Robert Bolton, eds., *Being, Nature, and Life in Aristotle: Essays in Honor of Allan Gotthelf* (Cambridge: Cambridge University Press, 2010).

observed phenomenon to observed regularities. The second major contribution that Gotthelf understands himself to have made in the area of Aristotelian science is having worked with James Lennox to show how, appearances to the contrary, the explanations to which the biological treatises are intended to lead, and that Aristotle offers in a partial form, conform to the general structure of demonstration as laid out in Aristotle's *Posterior Analytics*. A crucial impetus behind all of Gotthelf's work in Aristotle's biology can be found in the pioneering work of David Balme, who set the example of closely reading the biological works with an eye to what Aristotle is actually up to within them, as opposed to reading them with an eye to seeing how they conform to common presumptions of what Aristotle is doing. Fittingly, Gotthelf's collection is dedicated to the memories of both Rand and Balme.

In the first essay of *Teleology*, "Aristotle's Conception of Final Causality," Gotthelf works through the interpretation of Aristotelian teleology with which he is most commonly associated: Aristotle's view is that in order to explain a feature of a natural substance, one must appeal to an "irreducible potency for form." On this account, the functioning or development of a biological organ, for example, cannot be explained on the basis of underlying material or chemical processes alone. Rather, one must appeal to the nature of the organic whole of which it is a part. This is not, as other scholars have suggested, a concession to the pragmatic aspects of explanation, or to the nature of the human mind and its dealings with the world; the potential being actualized is a feature of reality over and above the material constituents that underlie it. Gotthelf supports his reading with a close analysis of the relevant texts. This essay is essential reading, as it is the best defense of the traditional reading of Aristotle as positing irreducible biological natures.

The traditional interpretation of Aristotelian teleology is, however, more robust than that of Gotthelf, for it takes the actuality correlative to an irreducible potentiality to be something of value, a *good*. This might seem to be an unwarranted importing of normative notions into natural science, but, as Rand puts it, "every 'is' implies an 'ought.'"³ The ought dimension of things is found in the actuality; to say that a being or state is a natural actuality is to say that there ought to be that being or state toward which a nature is oriented. (For Rand, the relevant actuality for a human being is life itself; for Aristotle, it is living well, a full actualization of the relevant potentialities.) But when we call such a state or being good, are we saying anything more? Gotthelf says no. In effect, his Aristotle is an ethical reductionist, defining ethical terms on the basis of non-normative notions. Such a view, which has obvious repercussions for Aristotelian metaethics, has come under sustained (and, I think, justified) criticism from those who take Aristotle to hold that the attributes of the divine intellects in some sense manifest goodness over and above their being actual, and to take other actualities to be good insofar as

³ Ayn Rand, "The Objectivist Ethics," in Ayn Rand, *The Virtue of Selfishness* (New York: Signet, 1961), p. 19.

they approach the attributes of divinity. The second essay, “The Place of the Good in Aristotle’s Teleology,” presents Gotthelf’s forceful rejection of the traditional reading, in defense of his more minimalistic account of the interface between Aristotle’s metaethics and his biology.

There follows a series of essays that take aim at those interpretative strategies that bring Aristotelian biology in line with contemporary biology, by taking material interactions and movement to be sufficient for necessitating the actualization of biological form (even if, for pragmatic or psychological reasons, explanatory accounts must refer to natural potentials and forms). Gotthelf’s general response to these lines of interpretation is found in the volume’s third essay, “Understanding Aristotle’s Teleology.” Two more, “Teleology and Embryogenesis in Aristotle’s *Generation of Animals* II.6” and “What’s Teleology Got to Do With It? A Reinterpretation of Aristotle’s *Generation of Animals* V” (co-authored with Mariska Leunissen), present close readings of passages from *Generation of Animals*, which offers an account of conception and gestation that has sometimes been thought to support interpretations incompatible with the “strong irreducibility” that Gotthelf advocates. Gotthelf’s essays here do not constitute the last word, as Aristotle’s meaning is underdetermined by the text, but they are essential works for those seeking clarity in regard to Aristotle’s position concerning the irreducibility of biological form.

Another challenge to the interpretation of life in Aristotle as an actualization of an irreducible potential derives from Aristotle’s recognition of the phenomenon of spontaneous generation, a phenomenon thought to occur when a living being arises out of material constituents that happen to be disposed in an appropriate manner, even though no parent imparting form is present. Gotthelf subjects *Generation of Animals* 3.11 to a close reading and argues (*contra* Lennox) that even in the case of spontaneous generation there is an actualization of an irreducible potentiality, that which is found in “vital” heat. In the case of spontaneous generation, vital heat is not species-specific. Unlike other varieties of biological generation, the nature of being that results from that irreducible potential results from contextual factors.

The following chapters concern the underlying logical structure of scientific explanation in Aristotle. “First Principles in Aristotle’s *Parts of Animals*” argues that the *apodeixeis* (demonstrations) to which Aristotle refers in *Parts of Animals* 1 are, indeed, demonstrations that conform to the requirements of the *Posterior Analytics*. *Parts of Animals* has as its ultimate goal biological demonstrations that proceed from first principles concerning morphological parts, not the species to which those parts belong. Aristotle begins that work with a discussion of the general characteristics of each part, and then distinguishes their differences, with an eye to explaining those features, general and specific, that result from the essential features of those parts. Gotthelf convincingly shows how the sorts of explanations that are offered, such as the account given of why ruminants have multiple stomachs, conform to the formal requirements of canonical demonstration. This project is furthered in the next essay, “The Elephant’s Nose: Further Reflections on

the Axiomatic Structure of Biological Explanations in Aristotle,” in which Gotthelf shows how a particular explanation appeals to first principles that concern generic and analogical unities at various levels, a scheme more complicated than but not fundamentally different from that envisaged in the *Posterior Analytics*. (This result is confirmed by the evidence collected in Chapter 8, “Notes towards a Study of Substance and Essence in Aristotle’s *Parts of Animals* 2-4.”) Gotthelf’s attempt to reconcile the *Posterior Analytics* with Aristotle’s own biological practice has been the occasion for some words of caution,⁴ but his account is now generally accepted.

Another major methodological issue raised by *Parts of Animals* 1 concerns the role to be played by the successive division of generic kinds by their differentiae. Lennox has shown how it has a crucial role to play in a pre-explanatory stage of science, clarifying which features and facts require explaining.⁵ Gotthelf complements this by showing how division is at work within the very process of working through explanations. The differences within a genus are appealed to in accounting for the differences among those attributes that are to be explained. References to the generic differences ensure explanatory completeness.

“A Biological Provenance: Reflections on Montgomery Furth’s *Substance, Form, and Psyche: An Aristotelian Metaphysics*” is an appreciation of and retrospective essay on Furth’s groundbreaking work,⁶ among the first to emphasize the importance of biology for Aristotle’s metaphysics. Gotthelf cautions that the account of substance that Furth presents presupposes only rudimentary background knowledge in biology. The biological works offer a much more complex and sophisticated account of certain issues (such as that of the unity of definition) than that offered within the *Metaphysics*. Gotthelf suggests that Furth had missed opportunities to integrate the philosophical insights of Aristotle’s biological and metaphysical works. For example, Gotthelf suggests that his own irreducibility thesis is the key to understanding the metaphysical thesis of the unity of substantial form.

In showing how Aristotle aims at *explanation* of the features of *parts*, Gotthelf has done much to help jettison the once common consensus that Aristotle’s biological works have the *classification* of biological *kinds* as an ultimate or intermediate goal. One passage in *History of Animals* 1.6, in which Aristotle refers to *the megista genē* (very large—or highest—kinds)

⁴ See especially G. E. R. Lloyd, “The Theories and Practices of Demonstration,” in G. E. R. Lloyd, *Aristotelian Explorations* (Cambridge: Cambridge University Press, 1999), pp. 8-37.

⁵ James G. Lennox, “Divide and Explain: The *Posterior Analytics* in Practice,” in *Philosophical Issues in Aristotle’s Biology*, ed. Allan Gotthelf and James G. Lennox (Cambridge: Cambridge University Press, 1987), pp. 90-119.

⁶ Montgomery Furth, *Substance, Form, and Psyche: An Aristotelian Metaphysics* (Cambridge: Cambridge University Press, 1987).

seems, however, to support the attribution to Aristotle of a classificatory project. That passage is subjected to scrutiny in two chapters: “Data-Organization, Classification, and Kinds: The Place of the *History of Animals* in Aristotle’s Biological Enterprise” and “*History of Animals* I.6 490b7-491a6: Aristotle’s *megista genē*.” Gotthelf concedes that here Aristotle does seem to be grouping together kinds of organisms, as opposed to parts of organisms, but his appeal is to commonly recognized pretheoretical groupings. The establishment of such groups is not the aim of the treatise, and any such pretheoretical classification will need to be revised in light of a theoretical account of the varieties of faculties of soul.

Prior to a “coda,” “Aristotle as Scientist: A Proper Verdict,” which offers a nontechnical overview of Aristotle’s achievement in biology, the volume concludes with discussions of the impact Aristotle had on two other biologists. “*Historiae 1: Plantarum et Animalium*” asks whether the results Gotthelf and others have arrived at in their study of Aristotle’s biological writings can be applied to the botanical writings of Aristotle’s student and colleague Theophrastus. The verdict is that it can. In *Historia Plantarum*, Theophrastus lays out the differences among the kinds of plants. Like Aristotle, he does so with an eye to discovering and organizing a body of explanations of those differences. Both scientists left their project far from complete, but Aristotle made more progress than Theophrastus. “Darwin on Aristotle” considers Darwin’s letter to William Ogle, in which appears the famous line “Linnaeus and Cuvier have been my two gods, though in very different ways, but they were mere school-boys to old Aristotle” (p. 345). Recent scholars have suggested that because Darwin knew little of Aristotle, the letter offers polite words but no evidence of a real intellectual encounter with Aristotle’s biological writings. Gotthelf explores the implications of evidence within that letter to the effect that, in the few pages of Ogle’s translation of Aristotle that Darwin read prior to his death, Darwin recognized that Aristotle was on his way to a workable scheme of biological classification, and that Darwin approved of Aristotle’s attempts to explain the nature of biological parts on the basis of their function.

A full appreciation of Gotthelf’s achievement can be gained not only through close study of his own works, but also through those of other specialists in Aristotelian studies, who are both in debt to his work and take his lines of inquiry in new directions. *Being, Nature, and Life in Aristotle: Essays in Honor of Allan Gotthelf* collects the work of such Aristotle scholars. Although not all of the essays bear directly on the themes Gotthelf has explored, all of them are well worth study by those with an interest in Aristotle.

David Sedley’s “Teleology: Aristotelian and Platonic” follows Gotthelf in understanding final causation in Aristotle as a matter of the actualization of irreducible potentialities. He shows how this has an antecedent in the cosmological thought of Plato. For Plato, the purposiveness that gives direction to the actualization of these potentialities is found in the providential order within a divine intellect. Aristotle rejects this and,

accordingly, dispenses with the belief in cosmic creation. As noted above, Gotthelf downplays the importance of those passages in which Aristotle suggests that the actualization of living potentials are “good” insofar as they approach the characteristics of the divine. Sedley takes such language more seriously. Teleologically organized beings of different kinds strive for different actualizations; all are good, but the better ones more fully share in the characteristics of God. Sedley also differs from Gotthelf in regard to the scope of teleological structures in Aristotle. As Gotthelf interprets Aristotle, the self-perpetuating structures and order found in the world have their root in the individual potentialities for individual substances. Higher-level order, whether at the cosmic or the social levels, results from individuals’ pursuit of goals proper to them, alone. Sedley here defends the view he has argued for elsewhere,⁷ namely, that Aristotle takes teleological causation also to be at work globally, on a scale larger than that of the individual structure. Here too, Sedley suggests, Aristotle is following the lead of Plato.

In *Metaphysics* Z.17, Aristotle identifies substantial form as the cause of the fact that some matter constitutes a particular substance. The standard take is to identify biological form (as a biological principle) with substantial form (as a metaphysical principle). On this account, the biological explanation of why there is this particular biological substance is a more determinate form of the question “Why is there this substance?” Gotthelf’s approval of the main lines of Furth’s account of the central books of the *Metaphysics* suggests that he would be in agreement with this account. However, in “Biology and Metaphysics in Aristotle,” Robert Bolton suggests that such an account would violate Aristotle’s explicit strictures on the autonomy of the sciences. Each science explains different facts, and does so by means of different principles. Biology explains biological facts by means of appealing to biological form, and metaphysics explains ontological facts by means of appealing to substantial form. For this reason, Bolton takes substantial form to be a metaphysical principle, not a biological principle. The principle of biological coming-to-be is rather to be found in the formal motions of the progenitor’s seed, which serve as efficient cause. Does such an account of biological principles require revision of Gotthelf’s irreducible potential thesis? I suspect that it would, since Gotthelf takes teleological explanation to account for more than how certain biological features come to be; he also sees it as at work in explaining why a living thing *is* as it is, and why it does what it does. We have a choice between attributing to the *Metaphysics* a less strict application of the principle of the autonomy of the sciences than what is argued for in the *Posterior Analytics*, on the one hand,

⁷ David Sedley, “Is Aristotle’s Teleology Anthropocentric?” *Phronesis* 36 (1991), pp. 179-96; and David Sedley, “Metaphysics Λ 10,” in *Aristotle’s Metaphysics Lambda: Symposium Aristotelicum*, ed. Michael Frede and David Charles (Oxford: Oxford University Press, 2000), pp. 327-50.

and limiting the scope of biological teleological explanation (as Gotthelf has accounted for it), on the other.

Although there are points of disagreement, Gotthelf's thoughts on Aristotelian teleology, method, and explanation developed largely in tandem with those of James Lennox. To a certain extent, their work can be seen as collaborative. Lennox's "The Unity and Purpose of *On the Parts of Animals 1*" furthers Gotthelf's work in showing that *Parts of Animals 1* is far from a hodgepodge of unrelated remarks; it is rather "a tightly integrated discussion" (p. 60). Lennox shows how Aristotle has his eye on showing how both his account of the varieties of causal explanation and his account of the necessity of nondichotomous division are to be put in the service of his account of biological methodology.

The strategy of looking to the biological works for ways to resolve metaphysical puzzles concerning substance is implicitly challenged by Alan Code's "An Aristotelian Puzzle about Definition: *Metaphysics Z.12*." Within that chapter Aristotle argues that if a definition is a principle of both the unity and the substantiality of a living substance, such a principle is to be found in the differentia expressed in a definition, taking the form genus + differentia. Code argues, though, that this is inconsistent with the conclusion of *Metaphysics Z.17* that it is *form* that is the substance of a living thing. He suggests that *Metaphysics Z.12* is a kind of *reductio* argument: If definition per genus and differentia expresses the substance of a living thing, then the substance will be differentia, which is a quality. However, substance cannot be quality. Hence, the conjunction of genus and differentia does not constitute the substance of a thing. The form of a living thing (i.e., its soul) is to be understood with reference to the genus; the differentia helps us to *classify* a living thing, but not to account metaphysically for its substantiality. Code's suggestion leaves untouched one of Gotthelf's major theses: that identification of basic differentiae has an explanatory as well as a classificatory function. On Gotthelf's view, the primary purpose of the identification of differentiae is to enable the biologist to explain derivative attributes of a thing. Whether the differentiae explain that thing's substantiality is another question altogether.

In "Unity of Definition in *Metaphysics H.6* and *Z.12*," Mary Louise Gill too looks to the discussions within the central books of the *Metaphysics* concerning the unity of definition in order to clarify the interface between Aristotle's biology and metaphysics. However, she puts the pieces together in a very different way. *Metaphysics H.6* reveals that Aristotle's central concern in considering the unity of definition is the question of the unity of matter and form. The differentiae, which, as Gotthelf has shown, are collected and collated in preparation for the explanatory project, are logically independent. Following Gotthelf, Gill argues that the goal of biological research is to show how their unity can be explained on the basis of a teleological account of the kind to which they belong, with reference to the way of life of organisms belonging to that kind. This cannot be done with reference to the genus alone, since the genus does not determine or exhaust the possible ways of life of the kinds subsumed under it. The analogy that Aristotle is drawing in *H.6* is that

the formal characteristics of a living thing are likewise to be understood as resulting from the teleological organization of the matter that is unified by form; these characteristics too are neither already contained in nor entailed by the matter. Gill places great weight on Aristotle's insistence that hylomorphic substances are somehow (*pōs*) one (1045b21). The relation between genus and differentia is fundamentally different from that between matter and form. The genus as determined by the differentia constitutes a determinate essence, but matter retains certain properties that are not contained in its formal determination. This accounts for the instability and consequent mortality of living substances.

Gotthelf's essays concentrate on the ways in which the Aristotelian biologist will work toward the attainment of genus/differentia definitions, and the ways in which these are to ground the explanations of other features. Within the second book of the *Posterior Analytics*, however, Aristotle suggests that explanations themselves can ground definitions, or be understood as a form of explanation. Much ink has been spilled on reconciling these two accounts. Are definitions principles or explanations—or, as Pierre Pellegrin argues in "Definition in Aristotle's *Posterior Analytics*," both? Pellegrin shows how the *Posterior Analytics* is working with two somewhat independent notions of understanding, and very sensibly resists the temptation to account for this by asserting that different notions of demonstration stem from different phases of the development of Aristotle's thought. He does not, however, take the lead of W. D. Ross and others (including myself) in taking Aristotle to be distinguishing between two different kinds of defined things; rather, on Pellegrin's view, we are dealing with two different kinds of linguistic accounts by which essences are expressed.⁸

Aryeh Kosman's "Male and Female in Aristotle's *Generation of Animals*" follows Gotthelf's lead in subjecting the biological works to a close reading in order to reveal what Aristotle actually says, moving beyond traditional presuppositions concerning what Aristotle says. Aristotle's account of sexual reproduction is not that the mother provides the matter and the father provides the form of the organism. Rather, the form that the father

⁸ Perhaps I may be forgiven for using this review to point out that the account of 2.8 93a5-8 that Pellegrin ascribes to me, and severely criticizes, is not one that I have ever expressed or subscribed to. He quotes my translation of 93a5-6: "The account of this is that there is some cause, and it is either the same or different." This is a literal translation of the text that within my book I interpret as elliptical for "it is either the same as the thing caused or it is different from it"; see my *Explaining an Eclipse: Aristotle's Posterior Analytics 2.1-10* (Ann Arbor, MI: University of Michigan Press, 1996), p. 102, which is Pellegrin's understanding of the passage as well. We differ insofar as I follow Ross in taking Aristotle to be discussing *things*, so that the cause in question lies in the subject of the feature to be explained, while Pellegrin takes Aristotle to be discussing *propositions* about things, so that the causes are propositional principles and what is caused are derivative propositions.

provides is a *dunamis* (what Gotthelf would call an irreducible potential) for initiating those motions within the mother, by which she grows and bears their offspring. This brings Aristotle's account more in line with contemporary biology than does the traditional understanding of Aristotle.

In "Metaphysics Θ 7 and 8: Some Issues Concerning Actuality and Potentiality," David Charles wonders how Aristotle's notion of *dunamis* ("potentiality" or "capacity") can be correlative to both form and to the composite of form and matter. Is there a single notion of *dunamis* at work here? Charles argues that there are two notions. Within *Metaphysics* Θ it is the latter understanding (i.e., that the actualization of a *dunamis* is the form/matter composite) that is primary. Matter persists through the existence of the composite substance insofar as no change occurs that undermines the relevant potentiality for the composite. The actuality of the composite substance is to be understood teleologically. (Charles brackets the issue of how teleology is to be understood, a point on which he and Gotthelf have significant disagreement.) Other varieties of potentiality and actuality are to be understood as "abstractions" from this scheme.

In "Where Is the Activity? (An Aristotelian Worry about the Telic Status of *Energeia*)," Sarah Broadie offers a heterodox but philosophically fascinating account of what Aristotle means when he says that in the case of a transitive activity (such as fire heating a stone or a teacher teaching a student) the activity is located in the patient. Aristotle wishes to distance himself from the Platonic view that the teleology of an action is a matter of a thing's reaching for an end beyond that thing (such as a separate Form). The end of the action, and accordingly its ontological locus, is in the goal attained. Broadie's ideas here could profitably be integrated with Kosman's account of the father's activity in biological generation.

As noted above, Gotthelf's account of Aristotelian teleology restricts final causes to aspects of a thing within an organism itself. The order manifested by any whole of which the substances are parts is a kind of epiphenomenon that does not itself constitute a kind of final cause; it arises from the independent actions of substances. (Perhaps a parallel can be drawn to how, on Rand's view, civic order results from the "selfish" actions of individual citizens.) In "Political Community and the Highest Good," John Cooper argues that Aristotle's social and political philosophy is not to be interpreted along such lines. The citizens are parts of a social whole in a strong sense. It is not only the case that the *polis* ("city-state") provides the necessary preconditions for the virtuous activity of its members. Rather, their activity is necessarily communal activity, just as the action of an organ is to be properly understood as an action of a whole living organism.

One of these volumes offers a convenient way of accessing Gotthelf's key work. The other allows us to see how that work is being built upon in new and exciting directions. The community of Aristotle scholars owes its gratitude to Gotthelf and looks forward to the paths he has yet to take in the exploration of Aristotle's biological writings.