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*Modelli idrostatici del moto da Aristotele a Galileo* by Monica Ugaglia

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This book is comprised of two main parts, an appendix, a name index, and an *index locorum*. There is no bibliography. In the first part, Monica Ugaglia argues that Aristotle's physics has mostly been misinterpreted by generations of Aristotelian commentators who failed to understand the hydrostatic model of motion on which it was built. In particular, many commentators failed to realize the role played by the medium and the void. In the second part, the author argues that, while laboring under the delusion of overthrowing Aristotle's physics, both Giovanni Battista Benedetti (1530–1590) and Galileo Galilei (1564–1642) actually reinstated its original theoretical core. Thus, in Ugaglia's view, Benedetti's and Galileo's merit was not that of building a novel hydrostatic model of motion on the basis of Archimedes' theory of flotation, but that of freeing motion theory from Aristotle's hydrostatic model. The appendix is a brief essay on Benedetti's theory of motion.

So much for the thesis of this book. It is an ambitious project that raises expectations of fascinating insights. How does the author go about substantiating her thesis? Unfortunately, I must confess that I was disappointed by the superficiality of the arguments put forward by Ugaglia, and by the general paucity of historical and philosophical scholarship.

I will give a few examples in order to illustrate my negative conclusions. Ugaglia starts by grandly asserting that

*la necessità di stabilire cosa sia da intendersi per natura è ovviamente all base di qualsiasi ricerca fisica, essendo la fisica per definizione lo studio della natura* [15].

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the necessity of establishing what one should mean by ‘nature’ is obviously the basis of any physical inquiry, since physics is by definition the study of nature.

This is not exactly a crystal-clear statement by which to open a book. I do not know whether physics is by definition the study of nature. An abundance of literature in the philosophy of science has made me wary of such general assertions. Perhaps some qualifications are needed. Biologists interested in cancer research study the mechanisms of cell senescence, for instance, not physicists. Yet few would deny that cancers and cells belong to nature in some sense, and at the same time that biology is not physics. I also very much doubt that contemporary physicists and biologists base their inquiries on a preliminary agreement concerning the general meaning of ‘nature’. One would have hoped that such sloppiness was incidental. In fact it is rather common throughout the book. Worse, it appears to vitiate the author’s theses and conclusions, as the following considerations will make clear.

At one crucial point the author claims that in *Physics* 228b26–229a1, Aristotle ‘unequivocally’ asserts the necessity of distinguishing between weight and specific weight.<sup>1</sup> Now the passage quoted in support of this claim is rather obscure (at least to me). Here is the text in the Barnes/Oxford edition:

In some cases the motion is differentiated by quickness and slowness: thus if its velocity is uniform a motion is regular, if not it is irregular. So quickness and slowness are not species of motion nor do they constitute specific differences of motion, because this distinction occurs in connection with all the distinct species of motion. The same is true of heaviness and lightness when they refer to the same thing: e.g., they do not specifically distinguish earth from itself or fire from itself. [Barnes 1984, 1.386–387]

I see no way of reading this passage as stating the necessity of distinguishing between weight and specific weight, let alone *unequivocally*.

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<sup>1</sup> ‘Aristotele ribadisce in modo inequivocabile la necessità di distinguere tra peso e peso specifico’ [59].

Yet this is the sort of evidence that Ugaglia relies on in order to persuade the reader that Aristotle's motion theory was in its essence a hydrostatic theory. Dealing with specific weight, an essential ingredient of the hydrostatic theory of flotation, requires a mathematical treatment of magnitudes that is nowhere to be found in Aristotle. If you want to understand specific weight, you had better read Archimedes on floating bodies or Galileo's *De motu* (ca 1590). It seems to me that Ugaglia is here carried away by her unquestioned presuppositions. This is all the more surprising in view of the fact that in the introduction Ugaglia warns the reader not to take references to modern terminology in the book as attributing modern concepts to Aristotle, but as a way of clarifying discussion [see *Avvertimento importante*, p. 13]. She should have been more guarded against falling into this anachronistic pitfall herself!

As to the paucity of her historical scholarship, one is struck by the lack of evidence brought in support of the strong claim that Aristotle's physics has mostly been misinterpreted by generations of Aristotelian commentators who failed to understand the hydrostatic model of motion on which it was built. The reason why Ugaglia fails to bring such evidence to bear is painfully obvious. It would have been a mammoth task to substantiate such a claim, a task beyond the capacity of a single scholar.<sup>2</sup> Forget ancient and medieval commentators for a moment, and just think about Renaissance ones. In this case, we have a splendid bibliographic monument which makes clear once and for all why such an enterprise could not possibly be achieved by one scholar. I am referring to Charles Lohr's catalog of Renaissance commentaries on Aristotle [Lohr 1988–1995].<sup>3</sup> Cast a glance at Lohr's list and you will be convinced.

The second part of the book is even more perplexing. The whole analysis of Galileo's *De motu* is marred by the same sloppiness that

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<sup>2</sup> The only commentator discussed at length and referenced in the *index locorum* is John Philoponus [273]. Ugaglia relies mostly on secondary sources.

<sup>3</sup> The first volume of Lohr 1988–1995 is a 500-page collection of material previously published. It contains a list in alphabetical order by the author's name of commentaries on Aristotle from 1500 to 1650. The second volume is an index listing the opening (*incipit*) and closing (*desinit*) lines of each of the commentaries.

we have already noted in the part on Aristotle. For example, we read sentences of the following tenor:

*L' introduzione del vuoto come sistema di riferimento assoluto permette a Galileo di scomporre in modo univoco il peso apparente del corpo in peso reale . . . e spinta del mezzo. . .* [221]

The introduction of the void as an absolute frame of reference allows Galileo to decompose univocally the body's apparent weight into real weight. . . and the medium's thrust. . .

Does Galileo speak in *De motu* of absolute frames of references? No. Can the void be a frame of reference or an 'absolute' frame of reference? I really wonder.

Ugaglia concludes her analysis of Galileo's *De motu* as follows:

*Così, la profondità e la coerenza estreme dell' analisi con cui Aristotele nega l' esistenza del vuoto sono state penalizzate dall' averne l' esperienza posteriore invalidato il risultato, mentre in base a quella stessa esperienza . . . vengono accettate (e spesso indicate ad esempio) le ingenuità filosofiche che stanno alla base delle argomentazioni di Galileo* [235]

Thus, the utmost depth and consistency of the analysis by which Aristotle denies the existence of the void have been penalized by the fact that subsequent experiments have voided it; whereas, on the basis of those experiments, the philosophical naiveté which is at the root of Galileo's arguments is accepted and often brought forth as a model.

So, for Ugaglia, the fact that subsequent experiments (not mentioned in more detail) have finally done away with the utmost consistency with which Aristotle denies the existence of the void raises no questions about the utmost consistency of that analysis. Further, it raises no questions about the supposed philosophical naiveté of Galileo's arguments. Perhaps it is Ugaglia's naiveté that mischievously shows up here.

How about the thesis that Benedetti's and Galileo's merit was that of freeing motion theory from Aristotle's hydrostatic model? In what sense is 'merit' used here? No discussion of this portion of Ugaglia's thesis is to be found in the whole book. It looks as if it is an artifact hastily appended to the introduction *ex post facto*, since it neither guides her research nor receives supporting argument.

To conclude this brief review, I think that the project of the book is fascinating and ambitious but that the author fails to carry it out in too many ways.

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