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Essay Review

Jesuit Science Between Texts and Contexts

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Ugo Baldini, *'Legem impone subactis': Studi su filosofia e scienza dei gesuiti in Italia, 1540–1632* (Rome: Bulzoni, 1992).
William A. Wallace, *Galileo, the Jesuits, and the Medieval Aristotle* (London: Variorum, 1991), 350 pp. ISBN 0-86078-297-2 Hardback £45.00.

Ugo Baldini and William Wallace have played a major role in the recent re-evaluation of the contribution of the Society of Jesus to the scientific revolution. Both authors have focused on the mathematical sciences and on the Jesuit mathematicians' and philosophers' contribution to the debate on the epistemological status of mixed mathematics—a crucial step toward the development of a philosophically legitimate method for mathematical physics. Both Baldini and Wallace share a concern with the relationship between the philosophers and the mathematicians within the Society of Jesus, and with the debates about the relative cognitive status of those disciplines—a topic that is central to contemporary debates about the scientific revolution. However, the two authors display markedly different views of the historical significance of Jesuit mathematics and natural philosophy, and of their relationship to the work of Galileo.

The somewhat asymmetrical structure of this review tries to take into account the different familiarity that English-reading scholars have with the work of these two authors. Wallace's work is well known to English-reading historians (and this volume is a reprint of essays published between 1974 and 1989) while Baldini's contributions (having been usually written in Italian) have not gained comparable visibility. Therefore, while my discussion takes a more descriptive approach to Baldini's work, it focuses on the more methodological aspects of Wallace's volume.

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While several of Wallace's essays focus on medieval debates on methodological issues within the Aristotelean tradition, eight of them deal with the relationship between the Jesuits' and Galileo's theories of demonstration. In them, Wallace argues that Galileo was more Aristotelian than usually believed. More precisely, what Galileo shared with the Aristotelians was not their cosmology or their views on the causes of motion, but rather selected elements of their philosophical system (such as their theory of demonstration) and that he borrowed these elements *not* from traditional commentators but from Jesuit natural philosophers and logicians who, in turn, had been influenced by other progressive commentators like the Spanish Dominican Domingo de Soto. Proving some continuity between Aristotelian tradition and Galilean innovation (via the progressive Jesuits commentators of Aristotle) is a major concern of Father Wallace's. This may reflect not only his views about the nature of scientific change, but also a concern with showing that, after all, the relationship between Galileo and the Church (or, at least, some of its philosophers) was not just one of conflict. Wallace's historiographical framework is characterized not only by a continuist view of scientific change, but also by a deep appreciation for the role which philosophy (especially Aristotelian philosophy) played in the scientific revolution. In fact, he seems to defend a version of the idealistic interpretation of the scientific revolution (à la Koyré and Burtt) according to which it was philosophy (in this case the Jesuit 'progressive' commentaries on Aristotle) which provided the grounds for the development of modern science. According to Wallace, not only was there no conflict at the methodological level between Galileo and progressive Aristotelians, but it was precisely the latter's work that made Galileo's scientific innovation possible. Moreover, Father Wallace is not just a historian of philosophy: he is a philosopher himself, and one who displays strong Thomistic leanings. As shown by his essay 'The Intelligibility of Nature: A Neo-Aristotelian View' reprinted in this volume, Wallace is concerned with what he perceives as today's global philosophical and moral crisis as exemplified in skeptical views about human nature and the intelligibility of nature that have emerged in the recent past. His response is a call for the revival (*cum* update) of Aristotelianism—a revival that should incorporate the methodological innovations of the Jesuits and Galileo. Therefore, by arguing for the Aristotelian roots of Galileo's science, Wallace is also suggesting that the commonly perceived break between Thomism and modern science and culture is a dangerous fallacy which may have contributed to the epistemological and moral crisis we allegedly experience today.

Of course, all historians have their (conscious or unconscious) cultural frameworks and agendas which often work as fruitful heuristic devices. In Wallace's case, we see that his strong commitment to a continuist view of science and to the productive role of Aristotelian philosophy within it has propelled him into a systematic search for the sources of Galileo's thought. As

shown by these essays (and his various books) such a search has produced very important findings that have deservedly received much attention by Galileo scholars. For instance, the evidence presented in 'Aristotelian Influences on Galileo's Thought' and 'Aristotle and Galileo: The Uses of *Suppositio* in Scientific Reasoning' (which he has amplified in later publications) shows that Galileo's early manuscripts on logic and physics (usually overlooked as his 'Juvenilia' but now thought to have been written around the beginning of Galileo's career as a university professor) were strongly derivative from Jesuit sources.

Having rejected what the Aristotelians saw as the physical causes of motion, Galileo's crucial methodological problem was to establish the physical principles on which to ground his demonstrations in mathematical physics. If, according to Galileo, these principles could not be borrowed from traditional natural philosophy, they had to be derived from the study of empirical evidence, that is, of effects. So, Galileo was left with having to infer causes from effects, and then show that the so-discovered causes were not *ad hoc* but real and necessary. In short, how could he argue that what he was trying to do was not entangling himself in a vicious circle? According to Wallace, the work of some Jesuit natural philosophers (especially Paolo Valla) took Galileo out of this demonstrative deadlock. For instance, Valla argued that the cognitive path from effects to causes and then back to effects (if properly executed) was not a vicious circle. One's knowledge changed as it traveled from *regressus* to *progressus*, and therefore such a trajectory constituted an 'epistemological loop' and not a sterile tautology. Galileo's early notebooks carefully studied by Wallace prove that he took Valla's suggestions very seriously—seriously enough to copy them down almost verbatim.

In this case, Wallace's strong philosophical and historiographical agenda has paid off by propelling him to discover new interesting evidence. However, the very agenda that may have made these discoveries possible seems to have pushed Wallace toward generalizations that are much less convincing—at least to this reviewer. First, Wallace's strongest evidence for a Jesuit influence on Galileo is limited to his early manuscripts and notebooks; the evidence becomes spotty and fragmentary once we consider Galileo's later published works. Wallace, however, wants to argue that the 'Jesuit connection' displayed in Galileo's early unpublished notebooks continues in all of Galileo's later work. Rather than focusing on the many discontinuities in Galileo's intellectual development and the many contextual moves he made in facing the shifting conditions of his remarkably complex career, Wallace follows his continuist sensibility and represents (in a very Aristotelian fashion) Galileo's early manuscripts as the 'seed' of his intellectual trajectory which is represented as a methodologically continuous curve. However, without wanting to embrace the old dismissive readings of most of these early manuscripts by early Galileo

scholars, it is still quite unclear (at least to this reviewer) what drove Galileo to compile these notebooks and how we could relate these earlier texts to later ones.

On more than one occasion, Wallace's historical and philosophical commitments seem to come into collision, and Wallace-the-philosopher seems to get the upper hand. In fact, his narrative tends to resemble less the genre of contextual history of science and more that of the philosophers' 'rational' reconstruction of the history of science. Wallace seems to endorse the Aristotelian philosophers' belief that their protocols of demonstration were the only acceptable form of certification of knowledge in general. In an Aristotelian fashion, Wallace seems to suggest that what the Jesuits did was to define the methodological 'essence' of modern science. Instead of seeing the Jesuits' (and Galileo's) methodological reflections as historical evidence about how some people thought that credibility could be achieved *in that specific context*, Wallace reads them as unproblematic texts, and sees the validity of their claims as going well beyond the context in which they were produced. Not unlike sacred texts, they are historical in the sense that they were written at some point in history, but their content transcends their historicity. The Jesuit philosophers are presented as having 'cracked the code' about how one should go about understanding nature. Consequently, the Jesuits and the other 'progressive' Aristotelians are treated not as historically situated authors but almost as some sort of 'methodological prophets'.

This may explain what I take to be the prescriptive subtext of his reading of Galileo's later texts as exemplified in his 'Galileo and Aristotle in the *Dialogo*', 'The Problem of Causality in Galileo's Science', and 'Aristotle and Galileo: The Uses of *Suppositio* in Scientific Reasoning'. If the essential core of science is its methodology (and one knows what *the* right methodology is), then one may tend not to be interested in the intricate processes and negotiations that framed the debates that led to those methodological positions. All that may be seen as falling into the category of 'context of discovery', that is, of historical accidents. It is to this deep-seated (and somewhat disguised) essentialism or 'methodological fundamentalism' that we can trace Wallace's disregard for context. In fact, not only does Wallace ignore the more social aspects of context, but he also downplays the intellectual context as well. For instance, he does not read Galileo's later texts with a holistic outlook, that is, to understand how his various concepts and linguistic categories held together within his intellectual framework. Instead, he looks at discrete elements of Galileo's later lexicon, and tries to match them with the terms found in Jesuit texts ('ex suppositione', 'cause', 'progressus', 'regressus', etc.). Of course, because of the decontextualizing nature of this piecemeal lexicographical approach, Wallace finds plenty of 'Aristotelian' terms in Galileo's work—occurrences which he then reads as signs of direct influence of the former on the latter.

Interestingly enough, Wallace seems to fall into a vicious circle not unlike those Valla had tried so carefully to avoid. While it is Wallace's 'essentialism' that allows him to adopt a decontextualizing reading of historical texts, it is such a decontextualized reading of the lexicographical analogies between the later Galileo and the Jesuits that makes him read them as signs of 'influence' which, in turn, confirms his belief in the 'essential' qualities of Jesuit methodology by 'showing' that it was that methodology that 'caused' Galileo's later science. Also, it is this same 'essentialism' that may explain the different scholarly standards Wallace adopts in dissecting Valla's texts or Galileo's early notebooks, and those (much looser) that he adopts when it comes to explain how the similarities between the Jesuits and Galileo or between the Jesuits and other philosophers and mathematicians came about.

In the first case, he introduces solid evidence and displays remarkable philological skills and knowledge of a wide range of obscure philosophical sources. In the second instance, however, he is quite satisfied with presenting hypotheses that are often supported by very slim circumstantial evidence. For instance, we are told that Galileo must have become acquainted with the Jesuits' reflections on methodology through Clavius who, concerned with the problems in the demonstrative apparatus of Galileo's early work on the center of gravity of solids he had read in 1588, sent him the lecture notes of the natural philosophers of the Collegio Romano so that he could, methodologically speaking, 'clean up his act'. However, as Wallace admits, we have not even the slightest bit of evidence that Clavius actually did that. Similarly, in 'Science and Philosophy at the Collegio Romano in the Time of Benedetti', Wallace argues that some of the demonstrative concerns displayed by the Venetian mathematician were interestingly similar to those of the Jesuits and, later on, of Galileo. However, as Wallace admits again, we have no evidence of any methodological transfer from the Jesuits to Benedetti (also because the Collegio Romano was only a fledgling institution during Benedetti's formative years). Well, Wallace hypothesizes, Benedetti's father was a Spaniard, so maybe Benedetti, through this 'Spanish connection', got wind of what the Spanish Dominican philosopher Domingo De Soto (whose work Wallace claims to have influenced the later 'progressive' Jesuit methodologists) was writing about the demonstrative status of *scientiae mediae*. As he puts it: 'All bits of coincidental evidence, I readily admit, but on their basis perhaps is not too much to think of Soto as the link that ultimately ties together Benedetti, Galileo, and the Collegio Romano' (VIII, p. 120). This type of narrative emerges also in his 'Randall *Redivivus*: Galileo and the Paduan Aristotelians'. There he argues that Randall and his followers were right for the wrong reasons. While their claim that Galileo's methodology was positively influenced by the work of the Paduan Aristotelian Zabarella has not survived later scholarly scrutiny, one could argue (as Wallace does) that the 'progressive' elements of Zabarella's work reached Galileo via the

Jesuit philosophers of the Collegio Romano who had incorporated them in their own commentaries. As in previous cases, the evidence Wallace is able to offer to corroborate this transfer is, in my view, inconclusive.

In a fashion that resembles a benign version of conspiracy theory, Wallace assumes that a progressive Aristotelian or a Jesuit *philosopher* must have been behind any good methodological innovation by a *mathematician*. Of course, it is of great historical interest to show how texts travelled and influenced the people who read them. As mentioned, Wallace has offered strong evidence that Valla's lecture notes were appropriated by Galileo in his early notebooks. However, this type of argument loses its force and becomes misleading when (in the absence of reliable historical evidence) it simply ends up reiterating Wallace's philosophical assumption that scientific methodology had to derive from philosophical discussions.

Let me stress that I am not faulting Wallace for presenting hypotheses as facts. Quite on the contrary, Wallace does usually present his claims about intellectual transfers as hypotheses. What I find peculiar is that he does not feel compelled to make those hypotheses stronger by working at filling the many gaps he himself perceives in them. The only way I can make sense of such a nonchalance about the need for a lot of contextual analysis is that Wallace does not think that the historical problem of how transfer happened (and how people read the texts they may have received) is that crucial. What seems to be most important to him is that, eventually, the Jesuits got methodology right and that, therefore, other leading authors (such as Galileo) had to recognize that and adopt the Jesuits' findings because that was the only rational choice they could make. In a sense, the prescriptive side of Wallace's arguments allow him not to be too upset by the lack (in most cases) of detailed evidence about how and why these transfers (to and from the Jesuits) happened. Wallace's subtext (as I read it) is that these transfers were bound to happen if modern science was to develop. Actually, the very fact that modern science developed 'proves' that these Aristotelian teachings must have reached and been appreciated by the scientists behind those developments. How could they have done it otherwise?

If Wallace is interested in the Jesuits as hinges between Aristotelean tradition and modern Galilean science, Baldini looks at the Italian Jesuit mathematicians (mostly those of the Collegio Romano) with a contextual perspective. This does not mean that Baldini's work does not reflect any commitment. For instance, his outlook might be also informed by a reaction to the frequent misrepresentation of the Jesuits as the 'bad guys' who created so much grief to Galileo—a view that used to characterize much of Galileo's studies. In fact, his focus is not so much on Galileo and the Jesuits, but on the Jesuits' 'scientific mentality' as this was constructed through education practices and institutional dynamics

like the tensions between them and the philosophers, their struggles with the censors of the Society (usually philosophers and theologians), and the constraints imposed on them by being members of a religious order which endorsed an Aristotelean worldview which they found often (if locally) inadequate. Of course, Galileo does enter Baldini's picture. However, he is neither a methodological follower nor an enemy, but rather a part-time fellow-traveller whose post-1615 claims (and the Inquisition's response to them) made the cosmological debate particularly slippery and dangerous, therefore limiting the range of institutionally acceptable positions available to the Jesuits. Significantly, Baldini's volume stops at 1632, that is, when the publication of Galileo's *Dialogue* (and the trial that followed it) closed the options for cosmological debate previously open to Catholic astronomers. Paradoxically, Galileo contributed (indirectly and unwittingly) to the Jesuit mathematicians' ultimate conservativeness in cosmological matters.

If Baldini and Wallace display different attitudes to the relationship between the work of the Jesuits and Galileo, they also differ as to the relative importance of philosophy in the development of the methodology of mixed mathematics. Unlike Wallace, Baldini's focus is on mathematicians like Clavius, not on philosophers like Valla. This is because Baldini's concern is with how mathematics became a legitimate field within Jesuit education, and how an interesting cluster of mathematicians (headed by Clavius) carved a niche of (ever-threatened) epistemological credibility within the Collegio Romano. Somebody like the Jesuit philosopher Vitelleschi (whose texts Wallace sees as expressing 'progressive' positions) is shown by Baldini to be the institutional man who, when placed in a position of doctrinal responsibility within the Society, acted as the conservative, canon-enforcing agent he was supposed to be. While of course Baldini discusses the extent of the dialogue between philosophers and mathematicians within the Society, the general picture he offers is that of ongoing (if formally polite) struggle between the two disciplines—a struggle that is better detected in internal documents rather than in published books.

In fact, these tensions become evident once one moves from an analysis of texts as transparent representation of the authors' thoughts (as Wallace does) to one that interprets them as artifacts whose production, censorship, and publication (or lack thereof) was the result of a long path through the cultural and institutional constraints and resources of the Society of Jesus. If Wallace sees the Jesuit philosophers' texts as 'causes' of later developments, Baldini looks primarily at the productions of Jesuit mathematicians as 'effects' of their contexts. As a result, Baldini's thesis about the historical relevance of Jesuit science is less pointed but more complex than Wallace's. Baldini's is a less thesis-based narrative, one that looks at the various aspects of the cultural and institutional world carved out and developed by the mathematicians headed by Clavius *vis à vis* the Society's religious agenda, its expectations about the role

of its mathematicians, and the positions of some of its philosophers and theologians such as Bellarmine.

Baldini's volume (which contains new essays as well as revised versions of previously published articles) opens with a section on the doctrinal and institutional framework in which the Jesuit mathematicians worked and were trained. This section includes a comprehensive analysis of the relationship between theology, philosophy, and mathematics in the Jesuit teaching curriculum, and continues with a chapter on the role of the Society's censors of book manuscripts in enforcing philosophical orthodoxy and disciplinary boundaries—a chapter that ends with an interesting documentary appendix about the censors' debate on Cabeo's *Philosophia magnetica* and Scheiner's *Rosa Ursina*. Besides documenting an element of the Society of Jesus that exerted a fundamental influence on what positions the Jesuit mathematicians and philosophers could hold, Baldini uses these documents as a tangible example of the cultural and institutional negotiations that framed the everyday scientific life of the Jesuit mathematicians.

The second section is about the work of Clavius and of the mathematicians he trained at the Collegio Romano, in the context of the crisis of astronomical theory that characterized the Italian scientific scene of the late sixteenth and early seventeenth century. Taking off with a discussion of Clavius's never completed *theorica planetarum* (but whose surviving manuscript section on the motion of the Sun is reproduced as an appendix to this volume), Baldini shows that while Clavius recognized the need to reintroduce coherence within planetary theory, his attempts to articulate his own position on the subject kept running against a stream of new evidence and alternative models that were emerging in those years (Tycho, Kepler, Galileo)—a range of developments to which he was open but had difficulties incorporating in his basically conservative outlook. In a sense, Clavius's 'paralysis' on planetary theory was emblematic both of the state of the debate on astronomy and of his institutional context and the way it had shaped his intellectual perspective.

These constraints and tensions between innovation and tradition (as well as between mathematics and natural philosophy) remain an ongoing theme of the next chapter in which Baldini discusses the Jesuit mathematicians' public lecture on the nova of 1604 (an event which seriously strained the Jesuit mathematicians' acceptance of Aristotelian natural philosophy). Similar tensions recur in his analysis of the correspondence of the Jesuit Griemberger on Galileo's work on buoyancy—a topic on which the Jesuit mathematician showed his openness to the new, non-Aristotelean natural philosophy of which Galileo's work was an example. The Jesuit mathematicians' cautious but innovative attitudes towards the discussions on new planetary models and alternative cosmologies is also at the center of the two final chapters of this section.

One is (mostly) on the debate about the Tychonic system between Biancani, Griemberger, and other censors of the Society over the publication of Biancani's *Sphaera Mundi* (a volume whose publication in 1620 can be seen as marking the Society's acceptance of Tycho's non-Aristotelian planetary system). The other is on the public debate about the comets of 1618 at the Collegio Romano (a debate which has been usually studied in the context of the dispute it later triggered between Galileo and Grassi). However, Baldini's attention is not primarily on Galileo's response, but rather on the tensions that emerged once more between the mathematicians and the philosophers of the Collegio Romano. As is shown by the previously unknown text on comets presented by a philosopher of the Collegio during this public debate, Grassi's position (one which Galileo found unacceptable and attacked) was actually quite radical *vis à vis* the philosophers' expectations of what the mathematicians should have said about comets.

The volume winds down with two (previously published) essays on Bellarmine's cosmological views and their relation to his philosophy and theology. It concludes with a section in which Baldini shifts his focus from Rome to the north-eastern area of Italy (Padua, Brescia, Parma, Mantova, Ferrara, and Bologna) where the Jesuit scientific activity was liveliest in the seventeenth century. In these concluding chapters, Baldini surveys the activities and teaching of mathematics and natural philosophy in those colleges and discusses their impact on the surrounding scientific culture (Galileo included). While this final section provides very interesting and previously unavailable information on the Jesuit mathematicians in north-eastern Italy, its survey-like character makes it less engaging than other parts of Baldini's volume.

While it may be apparent that I find Baldini's complex interpretation more rewarding than Wallace's 'essentialistic' reading, I think he may be leaving something important out of his contextualization of Jesuit science. For instance, Baldini begins his contextualizing analysis of the Jesuit mathematicians only after they had already become mathematicians of the Society of Jesus and were faced with a range of constraints and resources which framed their later decisions and claims. By doing so, the volume gets close to naturalizing the context of Jesuit science as if this was the only world in which these practitioners could operate—a methodological move which then tends to present their cosmological and methodological choices as the 'natural' result of such a context. For instance, we find no hint that a career within the Society of Jesus was not the only avenue open to early modern mathematicians. While we know that mathematics was a poorly patronized discipline in this period and that mathematical practitioners were faced with a grimly narrow range of professional options, somebody as knowledgeable as Baldini could have tried to produce a 'sociology' of those who joined the Society's ranks, that is, a discussion of the ingredients of their backgrounds which made them willing (or

maybe just able) to undergo the distinctive process of intellectual, social, and doctrinal socialization entailed by the membership in the Society of Jesus. Far from asking Baldini to pass judgments on the Jesuits' 'scientific ethics', I wished he had pushed his fine contextualization further back and showed us the beginning phases of the self-fashioning of a Jesuit mathematician. Without that, the volume may be read as an attempt to use contextualization to normalize their intellectual choices.

I think that by now (and thanks to scholars like Baldini) we know that the Jesuits were not the 'bad guys' Galilean apologetics had described them as being. Now we may need to go a step further and discuss the socio-cultural backgrounds and perceptions that disposed them to join an institution which then led them to produce the type of science they did.

Nevertheless, I believe that Baldini has provided us with the richest analysis of the culture of the Jesuit mathematicians operating in Italy between 1540 and 1632; and that, in addition, he should be thanked for the remarkable range of new documents that he has made available. This volume (and its English translation which is now in progress), as well as Clavius's correspondence which Baldini and Pierdaniele Napoletani have been able to edit (but which still awaits publication), will provide a crucial interpretive and documentary contribution to the ongoing discussion on Jesuit science and on the scientific revolution in general.