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SCIENCE AND THEOLOGY IN THE FOURTEENTH  
CENTURY: THE SUBALTERNATE SCIENCES IN  
OXFORD COMMENTARIES ON THE *SENTENCES*\*

ABSTRACT. Both Pierre Duhem and his successors emphasized that medieval scholastics created a science of mechanics by bringing both observation and mathematical techniques to bear on natural effects. Recent research into medieval and early modern science has suggested that Aristotle's subalternate sciences also were used in this program, although the degree to which the theory of subalternation had been modified is still not entirely clear. This paper focuses on the English tradition of subalternation between 1310 and 1350, and concludes with a discussion of the theory advanced by Thomas Claxton early in the fifteenth century.

In the second of the focal essays for this conference, Pierre Duhem provides a distillation of his celebrated punctuated continuity thesis: "When we see", he says, "the science of a Galileo triumph over the stubborn Peripateticism of a Cremonini, we think, uninformed as we are of the history of human thought, that we witness the victory of the young, modern Science over medieval philosophy . . . whereas in fact, we are contemplating the long-prepared triumph of the science born in fourteenth-century Paris over the doctrines of Aristotle and Averroes, restored to honour by the Italian Renaissance".<sup>1</sup> From his early work in the history of statics to the magnum opus of the *Système du monde*, it was Duhem's contention that the seeds of seventeenth-century science could be found in the scholastic writers of the fourteenth century. And while the thesis sustained much criticism and has undergone considerable revision, Duhem's contemporary rivals were forced to concede limited recognition of the principle; as I have noted elsewhere, even George Sarton observed that in the history of science, "there are no unbegotten fathers except Our Father in Heaven".<sup>2</sup>

The particular aspect of Duhem's work that I should like to focus upon here involves the application of mathematics – and particularly geometry – to the effects of nature. Duhem's historical researches and those of his successors have emphasized that medieval scholastics created a science of mechanics by bringing both observation and mathematical techniques to bear on natural effects. But while the successes of this program were evident, the foundations were certainly not: in particular,

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precisely what justified the extensive application of mathematics to natural philosophy? Medieval readers of Aristotle's *Posterior Analytics*, *Ethics*, *Metaphysics*, and *Physics* were well aware that the Philosopher had cast a dim view on the unrestrained application of techniques of one science in the domain of another. Whether this position was part of an emerging theory of scientific method that Aristotle never brought to full fruition,<sup>3</sup> or reflects fundamental contradictions in the historical development of his thought is still unclear.<sup>4</sup> But the fact remains that Aristotle's discussion presented medievals with an enormous methodological problem.

Aristotle's discussions of disciplinary autonomy carried with them a significant exception, the so-called subalternate sciences. Autonomous in their own right yet dependent upon other sciences for their first principles, the subalternate sciences comprised a relatively small class of disciplines, particularly between mathematics and natural philosophy. For a number of reasons, the medieval development of subalternation theory holds special significance in a reassessment of Duhem's historical work. First, the initial object of Duhem's work – statics – was included among these sciences, both by Aristotle and his medieval readers.<sup>5</sup> A far more problematic step had been taken by the end of the fourteenth century, for it seems clear that at least in some circles the new techniques of dynamics and kinematics developed during the course of that century were being associated with subalternation: in the 1380s, for example, Henry of Langenstein at Paris included the *latitudines formarum* among such sciences, adjacent in his *arbor scientiarum* to the more traditional disciplines of astronomy and music.<sup>6</sup> Recent research into Galileo's early thought also suggests that the subalternate sciences were a source for his ideas about scientific method and the correct reading of the book of nature, although it is still not entirely clear whether the conception of the subalternate sciences upon which Galileo was drawing was in fact the same as that which Aristotle had prescribed,<sup>7</sup> and as Professor McMullin has suggested, the subalternate sciences in the sixteenth century were 'an ambiguous heritage'.<sup>8</sup> Finally, in the intervening period, during which according to Duhem a 'superstitious archaism' was responsible for the rejection or at least neglect of earlier theories of the *moderni*,<sup>9</sup> we find both Pietro Pomponazzi and Galileo's teacher Francesco Buonamici lamenting the excessive injection of mathematics into natural philosophy<sup>10</sup> – that is, precisely

the objection that Aristotle had made in the *Posterior Analytics* and which the subalternate sciences had sought to overcome.

It is rather well known that Duhem concentrated much of his historical research on the University of Paris, ignoring or at least deemphasizing the parallel achievements across the Channel. In spite of – or perhaps because of – this, I should like to focus my attention on the English and especially Oxford tradition of the subalternate sciences, particularly during the crucial years between 1310 and 1350. The source upon which I shall draw will not be commentaries on the *Posterior Analytics*, the work in which Aristotle discussed his theory of subalternation most directly, but rather medieval commentaries on Peter Lombard's *Sentences*, in which subalternation was frequently discussed in prologues. I have done so for several reasons. As a pragmatic consideration, while the *Posterior Analytics* remained a popular text in Europe during the fourteenth century, it seems to have been less popular at Oxford, where some of the most interesting scientific work was taking place. In fact, during the period 1250–1400, Oxford scholars seem to have produced fewer than half the number of commentaries on the *Analytics* that one finds at Paris during the same period.<sup>11</sup> Second, commentators on the *Sentences* were generally older and perhaps more mature than those in the Arts Faculty who commented on the *Analytics*. And finally, in general, discussions of subalternation found in commentaries on the *Sentences* were divorced from Aristotle's text, and thus open to considerably more interpretive latitude.<sup>12</sup>

At the outset, a concession is in order. Despite the considerable number of commentaries on the *Sentences* produced at Oxford during the fourteenth century, and while many contain discussions of *scientia*, not all commentators chose to discuss the subalternation of the sciences. About 1334, Robert Holcot, for example, produced a quodlibetal question 'Utrum theologia sit scientia', frequently a *topos* for discussion of subalternation, but Holcot's treatment omits any such material.<sup>13</sup> At Cambridge, Robert of Halifax (Franciscan, fifty-sixth lector at the Cambridge Convent, ca. 1336) included in his prologue the question, 'Utrum scientia quam potest theologus habere . . . sit practica vel speculativa'. Such questions frequently were sources for discussions of subalternation, in part because of Aristotle's reference in *Posterior Analytics* in part because of Aristotle's reference in *Posterior Analytics* though the latter is not formally subalternated to the former. Yet

Halifax's question likewise omits such material.<sup>14</sup> And finally, the copy of Richard Fitzralph's commentary on the *Sentences* preserved in Oxford, Oriel College MS 15 contains a prologue with a similar discussion,<sup>15</sup> but which once again omits reference to subalternation.<sup>16</sup>

When combined with the relative neglect of Aristotle's *Posterior Analytics*, one might be inclined to suggest that it is slightly at variance with the idea that periods of intense scientific change are both preceded and accompanied by appeals to philosophical analyses of scientific method.<sup>17</sup> In fact, however, I believe other factors are at work. First, discussions of subalternation were frequently reserved for prologues to commentaries, and as the fourteenth century progressed, such prologues often came to be reduced in length and eventually omitted entirely.<sup>18</sup> Doubts about the scientific status of theology and the resulting reduction in the size of prologues seem to be responsible in part for omissions of discussions of subalternation. As a result, when commentators chose to discuss the topic, they sometimes found room for it in related questions in Book I, as Adam Wodeham did, for example, in distinction I, question 3, in a reservation entitled, 'whether the same conclusion can be demonstrated in different sciences' (*Utrum eadem conclusio possit demonstrari in diversis scientiis*).<sup>19</sup> Second, in the thirty or forty years prior to 1330, the problem of subalternation had been debated thoroughly in commentaries on the *Sentences*, and a variety of positions were now available. As newer, more topically significant questions arose, subalternation passed from primary importance because it was already a topic on which a core consensus, if not unanimity rested.

If we turn now to the elements of that consensus, we find several rather interesting developments in the theory itself. The first, and clearly most pronounced, is the tremendous influence exercised by Robert Grosseteste; indeed, the extent to which fourteenth-century scholars achieved a general consensus at all is attributable to Grosseteste's authority. In almost every commentary that discusses subalternation, he is cited repeatedly, sometimes more frequently than Aristotle himself. Thus the Benedictine scholar Robert Graystones cites Grosseteste's commentary on the *Analytics* nine times in a rather short question on subalternation, frequently quoting substantial sections of the text, while citing Aristotle's text only three times.<sup>20</sup> He apparently considered the commentary so important that he procured a copy for the Durham College library.<sup>21</sup> Graystones's contemporary, John of

Reading, cites Grosseteste's commentary twenty-eight times, Aristotle's text only twelve times.<sup>22</sup> And even when commentators fail to cite Grosseteste explicitly, as is the case for Robert Cowton and William of Nottingham, it seems clear that Grosseteste's positions stood behind their texts.<sup>23</sup>

The reasons for this infatuation with Grosseteste's commentary are not too difficult to determine. For Franciscans like John of Reading and William of Ockham, Grosseteste's previous ties to the Order provided a fraternal link and, as I have argued elsewhere, perhaps even an authoritative text in the convent library. But for the Benedictine Graystones and the Augustinian author of an anonymous commentary found in Balliol College MS 63, and indeed for the Franciscans as well, the motive was one of clarity and elucidation: where Aristotle's explanation of subalternation was elliptical or incomplete, Grosseteste provided a more complete mechanism. As subsequent readers saw it, Grosseteste's contributions could be summed up under four ideas. The subalternating and subalternate subjects were nonidentical, for otherwise there would be no need to transcend the original science in demonstration, and indeed one would fall victim to Aristotle's injunction against importing the elements of other disciplines. Second, these two subjects were distinguished by the so-called superadded condition that made the middle term of the syllogism the nexus of subalternation. Third, subalternate sciences were subalternated simultaneously to two superior sciences, each providing a critical element in the demonstration.<sup>24</sup> And finally, because of the superadded condition imposed in subalternation, the subalternate subject possessed an accidental rather than essential unity.<sup>25</sup>

All of these positions can be found to some degree in Aristotle's text itself. What impressed fourteenth-century readers of Grosseteste's commentary was the degree to which the latter could extend the former. Thus, in an argument dependent on the superadded condition, Robert Graystones first quotes Aristotle, then follows with Grosseteste's elucidation:

This is confirmed by the Philosopher, in *Posterior Analytics* I: the subalternate science always concerns being *per accidens*; whence in the same place, chapter 12, the Lincolniens [says], 'It must be known that the inferior science superadds a condition through which it appropriates to itself the subject and properties of the superior science. And there are in the conclusion of the subalternate science, as it were two natures, viz. a nature which it takes from the superior, and a proper nature which it superadds'. So far [Grosseteste].<sup>26</sup>

For Graystones, as for many of his contemporaries, Grosseteste did not replace Aristotle as much as extend the Philosopher's original meaning.

Aside from Grosseteste, there was one other crucial context for discussions of subalternation. Fourteenth-century commentators frequently affiliated their discussions of subalternation with discussions of the unity of science. For example, John of Reading made subalternation the subject of two questions in his prologue and balanced them against a still more substantial question on the unity of science, referring back to his discussions of subalternation no fewer than seven times. And as I have already noted, Adam Wodeham likewise introduced an argument from subalternation into a question on the appropriateness of the same conclusions to diverse sciences. The reasons for this affiliation are not difficult to ascertain. First, Aristotle himself had associated the two topics, for it appears at least three times in *Posterior Analytics* I, particularly because it is clear that when he discusses the relationship between the subalternate and subalternating sciences, the underlying assumption is that there are well-defined criteria that distinguish the sciences.<sup>27</sup> Second, one should not underestimate the influence of Peter Aureol's commentary on the *Sentences* for this aspect of the discussion. Aureol had linked the two topics very closely, and his work became a target for several subsequent readers, including both Ockham from one side and Reading from another.<sup>28</sup> Finally, there seems to be a particular link between this discussion and the original theological text of the Lombard's *Sentences*. Fourteenth-century discussions of the unity and subalternation of the sciences in particular were frequently cast in the psychological language of the *habitus* of science. Briefly, medievals argued that corresponding to each act of the intellect, there was a habit residing in the soul that reproduced this act and thus allowed for such things as recall and cogitation. As a result, discussion of the unity of science and by extension subalternation was married to epistemological discussions of the unity of *habitus*, topics that Aristotle had treated separately in the *Posterior Analytics* and the *Categories*, respectively.<sup>29</sup> The broker for this marriage seems to have been, in part, Lombard's text, for the opening chapter of distinction 1 draws upon Augustine in maintaining that "every doctrine is of things or of signs" (*Omnis doctrina de rebus vel de signis*).<sup>30</sup> Clearly, the original intent of the passage was exegetical, but the door was also open to discussions of the

relationships between names and things, and with them came discussions of science.

Aside from this association with discussions of unity of science, there is some evidence to suggest that early fourteenth-century commentators developed their positions on subalternation by drawing upon logical techniques developed in the middle ages. This is perhaps best exemplified by drawing once again upon John of Reading. Reading begins his discussion of subalternation by reviewing the now-familiar criteria for subalternation that he has gleaned from Robert Grosseteste, and in particular, the notion that the subalternate science must be subsumed under two subalternating sciences. The requirement of the superadded condition imposed on the subalternate subject precluded an inferior science that was merely a contraction of the superior. This leads John to an extended discussion of predication, in the course of which he lists seven ways by which logical ascent and descent can occur in superior and inferior sciences. It would take us too far afield to discuss each of these, but the significant fact is that John concludes that only one of them – descent under a quidditative concept that is *per se* one to a concept that is one *per accidens* and that joins the higher subject with an accidental property – produces subalternation.<sup>31</sup> It should, in fact, come as no surprise that John concludes that these are Grosseteste's criteria dressed up in more recent garb. But in fact, the purpose of John's discussion and the reason for his reference to logical ascent and descent was to distinguish between the descent and ascent of supposition theory and the doctrine of subalternation, for at least in John's account, there seems to have been some conflation of these issues in the years immediately preceding John's tenure at Oxford.<sup>32</sup>

It is rather well known that Duhem was often not kindly disposed to medieval uses of logic, particularly at Oxford. On occasion, he was inclined to see the use of logic as going beyond legitimate purpose and becoming an artificial exercise, a 'logical acrobatics'.<sup>33</sup> But at least in the case just cited, Duhem probably would have agreed that Reading's extensive logical discussion served the purpose of setting the theory of subalternation on firm ground and avoiding unwarranted and illegitimate claims on the theory.

John's purpose, at least in this context, was to guard against unlimited appeals to subalternation as a technique justifying cross-disciplinary work. But at about the same time – that is, about 1320 – the association

of subalternation with discussions of the unity of science and with the notion of scientific habits, seems to have produced some inclination to expand the criteria for subalternation of one science to another. William of Ockham, for example, called attention to a strict and broad sense of subalternation, and in the first question of his prologue noted that while Aristotle mentioned explicitly only a few pairs of subalternating/subalternate sciences, he intended to permit cross-disciplinary work in other sciences subordinated in other ways.<sup>34</sup> Likewise, despite John of Reading's determination to hold a conservative line on the expansion of subalternation, even he notes in his discussion of generic descent under a subject that while the inferior is "not properly and completely subalternated to the [superior science], . . . in a certain way perhaps it can be said [to do so]".<sup>35</sup> The anonymous author of a commentary in Balliol 63, while discussing the relationship between two sciences, one of which depends on the other for the certitude of its truths, notes that this is "not properly subalternation, but nevertheless . . . has a similarity with subalternation".<sup>36</sup>

Although to my knowledge, no one in the early fourteenth century explicitly tied the expansion of subalternation to the new attempts to quantify qualities, statements such as these may well have convinced proponents that those attempts were legitimate. It is hardly surprising that such ideas might be held implicitly rather than explicitly, for if indeed there was consensus on the theory of subalternation, it was on this issue of cross-disciplinary transmission that consensus was tested most severely. I have already alluded to John of Reading's otherwise conservative tendencies. His contemporary, Robert Graystones, was even more direct: speaking of the resolution of principles within the subalternate and subalternating sciences, Graystones notes that strictly speaking, such resolution cannot occur except within the proper genus. "For", as he points out, "the geometer cannot resolve beyond what his faculty permits; rather, it is proper that resolution should remain primarily within its own limits . . .".<sup>37</sup> Writing at approximately the same time, but in London, Walter Chatton expressed much the same sentiments in a direct response to Ockham's more liberal discussion.<sup>38</sup> If fourteenth-century scholars found that subalternation provided room for legitimate growth in new techniques, they retained a healthy caution about extending it too far.

On several occasions in this paper, I have referred to a consensus about



subalternation. In doing so, I do not wish to imply that there was agreement in every detail of the theory, for as we have seen, certain aspects were open to continued discussion; the consensus rather extended to a core of material that I have tried to identify. In view of that, I should like to conclude by discussing the ideas of a Dominican scholar at Oxford from the early fifteenth century, Thomas Claxton.<sup>39</sup> Claxton's work has often been taken as the culmination of a revival of Thomism at Oxford early in the fifteenth century,<sup>40</sup> but while this may be true in general, it would seem that his ideas about subalternation and the unity of science depend as much on his reading of subsequent fourteenth-century sources as a review of Aquinas. The second question to Claxton's prologue investigates the well-worn issue of whether the theology that we possess in this life is in fact *scientia*, and in his own autographed copy preserved in Cambridge, Gonville and Caius College MS 370(592), he devotes some twenty-seven closely written folios to the issue. He begins by proposing six principal arguments against the view: it is not demonstrative, nor is it evident, intuitive, and abstract; it is neither practical nor speculative; it is not numerically one; and finally, it has no determinate subject.<sup>41</sup> He proposes to treat each of the issues plainly, openly, and truthfully, so that his students should understand, for, as he tells us, the theologians of old very often were deficient in logic. And despite his long narration of these six arguments, he maintains that he will not dwell on prior opinions excessively, since only those which by merit of fame or nearness to truth must be treated. Others, he trusts, will be refuted by apparent truths, since if a little error in the beginning leads to a great one at the end, so also truth always easily declares itself.<sup>42</sup>

In his preliminary definitions, Claxton says that there are three genuine senses of science and one that is spurious. Science is first, the evident assent of the mind to what is, was, or will be. Second, in the strictest sense, it may also be evident assent that is caused syllogistically, and this, he says, is what Aristotle had in mind when he referred to science as the cognition of a conclusion in a demonstration. Third, it may refer to a habit of the mind created from many assents collected together, each having a certain coordination to the other by comparing the first subject and predicate. This, he says, is the way Aristotle speaks of natural science in the *Physics*, the *Metaphysics*, *De caelo et mundo*, and many other places. All three are equally valid ways of referring to science. As for the spurious sense, Claxton says that some doctors of

theology suggest that science is merely true assent without vacillation, whether evident or inevident. This allows them to call faith science, but Claxton notes that this is false, because it does not make sufficient distinction between opinion and science. And although Augustine speaks in this way, he does so *modo vulgaris loquendo*, and this sort of expression ought to be avoided by those in the schools.<sup>43</sup>

It is in his responses to the fifth and sixth principal arguments – on the unity and subject of science – that Claxton discusses subalternation. A science, or for that matter, anything can be one in several senses: one numerically *per se*, one specifically, one generically, one *per conclavationem* (literally, being locked up together), or one by attribution and coordination.<sup>44</sup> The latter he singles out for special consideration, because he says this sense of unity is a bit more restricted and is in fact the way sciences – he lists natural philosophy, ethics, arithmetic, and music – are said to be one by attribution or coordination to one first principle, that is, the first proposition in which the primary predicate equally (although not really) is predicated. And in a reference to a popular fourteenth-century analogy that derives ultimately from the *Metaphysics*, he says this sort of unity is like that of the people of England, since they have one king, one law, one polity.<sup>45</sup>

Claxton then gives a more concrete example, the case of natural philosophy and medicine. Both have the same first principle in which the primary predicate (the so-called *tertium adiacens*) is predicated, namely “Some body is mobile” (‘*Aliquod corpus est mobile*’). But they are not the same science, because the first predicate is applied to natural philosophy and medicine through separate first principles: in natural philosophy according to place, quantity, etc., in medicine according to health and infirmity or the excesses of the humors and other such things. Thus, in spite of their attribution to one first principle, the coordination is held under different species, and they are not one science. One science, says Claxton – echoing Aristotle – is of one genus, that is, of one subject and the things joined to it by proper first principles.<sup>46</sup>

This discussion of the unity of science leads Claxton to subalternation. In subalternation, one needs not only the same subject in each science, but also equally significant first proper principles whose subjects and predicates are *per se* superior and inferior. For example, medicine, he says, is subalternated to natural philosophy because under the latter’s

first principle 'corpus est mobile', medicine has its own first principle, 'corpus animale est mobile ad infirmitatem vel sanitatem vel neutralitatem', in which both subject and predicate are related as superior and inferior. The same thing is true of geometry and perspective, through the respective first principles 'figura est terminata' and 'linea visiva terminatur ad oculum faciens visionem'. But, Claxton adds, another part of perspective is subalternated to natural philosophy under a different first principle, viz., 'animal est mobile ad visionem a corpore lucido sibi obiecto'.<sup>47</sup> It is clear that what allows Claxton to speak in this way about partial subalternation is once again the propositional notion of science and a unity based on attribution and coordination, although elsewhere it is clear that he takes issue with previously formulated versions of such ideas, particularly those of Ockham and Holcot.<sup>48</sup>

Still later, Claxton elaborates on this subordination of principles. In his response to the sixth principal argument of the question, concerning the relationship between the theology of the wayfarer and the blessed, he notes that no science is subalternated to another unless the principles of the subalternating and subalternate sciences compare by means of an addition (*habet se ex additione*) as plainly in the subject as in the predicate. But clearly in the two theologies concerned, there are not two such differentiated subjects, but an identical one.<sup>49</sup> Although he does not cite Robert Grosseteste anywhere in this question – perhaps an indication of the distance between discussions in the opening years of the fifteenth century and those of a century earlier – his ideas about subalternation are consistent with the received tradition that derived ultimately from the bishop of Lincoln. In this sense, Claxton's commentary represents still a further distillation of the late medieval tradition of subalternation.

It should be clear that this tradition was vitally dependent upon the theological context in which it developed, an issue that returns us once again to Duhem. As Stanley Jaki has reminded us in his recent biography,<sup>50</sup> Duhem's ideas about medieval science were inseparable from his understanding of medieval theology. The fuller treatment of this theological tradition of subalternation would require equal consideration of positions developed at Paris and elsewhere during the fourteenth century, for indeed in addition to native positions, Claxton cites the imported ideas of Gregory of Rimini and other Parisians.<sup>51</sup> But this must remain for another occasion.

## NOTES

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<sup>1</sup> Duhem (1987), p. 341.

<sup>2</sup> Livesey (1987), p. 365; Sarton (1959), p. 38.

<sup>3</sup> McKirahan (1978).

<sup>4</sup> Graham (1987). The structure of his thesis is set out at pp. 14–17.

<sup>5</sup> *Posterior Analytics* I. 13 78<sup>b</sup>38. Version P of the so-called *Liber Jordani de ponderibus*, which Duhem was particularly keen to attribute to Jordanus or at least suggest stood behind Jordanus' work, begins, "Cum scientia de ponderibus sit subalternata tam geometrie quam philosophie naturali, oportet in hac scientia quedam philosophice, quedam geometrice probari." See Moody and Clagett (1960), p.151. Duhem (1905–1906), vol. 1, pp. 128–32.

<sup>6</sup> Henry of Langenstein, *Expositio prologi Bibliae*; Vienna, Österreichische Nationalbibliothek CUP 3900, fol. 49vb. See Steneck (1975).

<sup>7</sup> James G. Lennox (1986) attempts to tie Galileo to the tradition of the mixed sciences and presents a stimulating discussion of Aristotle's position but fails to consider whether the tradition received by Galileo was in fact developed further by medieval scholastics. William Wallace's recent research (in particular [1981] and [1984]) has demonstrated that Galileo's early work was heavily influenced by Jesuit scholars at the Collegio Romano. But a glance at the sources cited by one of Galileo's chief Jesuit sources, Paulus Valla, suggests that the tradition upon which Valla and perhaps his colleagues were drawing was developed in medieval commentaries on the *Sentences*, not exclusively the *Posterior Analytics*.

<sup>8</sup> McMullin (1978), esp. at 211–12.

<sup>9</sup> Duhem (1987), p. 340.

<sup>10</sup> Pomponazzi (1525), fol. 6va, 9va–vb; Buonamici (1591), p. 525.

<sup>11</sup> By my own count, based on surviving commentaries listed in Lohr (1967–1974), there were some thirty-six commentaries on the *Posterior Analytics* produced at Paris during the period, against only sixteen at Oxford.

<sup>12</sup> Concerning this latitude, see Glorieux (1941) at 1863–1865.

<sup>13</sup> Muckle (1958). The date of Holcot's work has been the subject of much discussion. See Courtenay (1987), p. 252 n. 5 and 268–69.

<sup>14</sup> Paris, BN lat. 15880, fol. 36ra–38vb; BN lat. 14514, fol. 277vb–280rb. Concerning Halifax, see Courtenay (1987), p. 272.

<sup>15</sup> Oxford, Oriel College 15, fol. 3ra–4va. This prologue is best treated as an anonymous one, since Fitzralph's authorship has been rejected by Leff (1963), p. 176.

<sup>16</sup> One might also add Stephen Patrington's *Repertorium diversorum auctororum* (Florence, B. Laurenziana MS Plut. XVII sin. cod. 10) to this list. Patrington's work, written before 1389, is a handy source for investigating particular topics discussed in the fourteenth century, since it is preceded by an index of topics which he excerpted. While it contains a good deal of material on *scientia* (Sections 35a–36a; pp. 33–35) and especially *scientia large et proprie* (Section 35b2; p. 34), Patrington does not seem to have included subalternation.

In all such cases, however, an element of caution is in order. While such treatments of *scientia* do not contain explicit references to subalternation, they are frequently valuable for ancillary materials. For example, in Halifax's treatment just mentioned, it is clear that his position on the definition of speculative and practical sciences is somewhat flexible, and thus coordinates with the flexibility in the definition of subalternation that will be discussed below. The prologue in Oriel 15, fol. 3rb contains a definition of *scientia* that might be compared with the one reviewed retrospectively by Thomas Claxton early in the next century.

A somewhat more useful discussion is found in Walter Chatton's *Reportatio* from about 1322–23. See below, note 38.

<sup>17</sup> Kuhn (1970), pp. 87–88.

<sup>18</sup> Courtenay (1987), pp. 251–58.

<sup>19</sup> Adam Wodeham: forthcoming, d. I, q. 3, pp. 226–50 at 246. I should like to thank Dr. Wood for allowing me prepublication use of her edition. I have examined the section of Cambridge, Gonville and Caius College MS 281(674) that contains this portion of the text (fol. 137ra–rb), and one might note that the argument based on subalternation seems to have been singled out in the margin for special attention by one reader.

<sup>20</sup> Robert Graystones, *Questiones super Sententias*, Prologue, q. 3; London, Westminster Abbey MS 13, pp. 141b–143a. Like many of the questions in this commentary, question 3 contains a lengthy addition to article 2 which is to be found at pp. 156b–157b. Graystones lectured on the *Sentences* probably around 1322. For a description of the manuscript, see Robinson and James (1909), p. 72. For a list of the questions contained in the text, see Kennedy (1986). Concerning Graystones's career, see Emden (1957–1959), vol. 2, p. 814 and Tachau (1988), pp. 161, 209.

<sup>21</sup> In the earliest catalogue of Durham College books, we find the record “. . . Lyncolniensis super librum posteriorum et expositio super metaphisica ex procuracione eiusdem”, where Graystones is identified in the preceding record; Blakiston (1896), p. 37. The volume was also included in the catalogue made ca. 1390: “Lincolniensis super libros posteriorum et Fernandus super methephisicam in j volumine.” See Salter *et al.* (1942), p. 243. Given Graystones's use of Grosseteste's commentary in his commentary on the *Sentences*, it would be interesting to inspect this volume, and the further identification of Fernandus de Hispania as the author of the second commentary would facilitate this. But Fernandus's *Metaphysics* commentary survives in only one known copy, Oxford, Merton College MS 281, which unfortunately seems never to have contained Grosseteste's commentary on the *Posterior Analytics*.

<sup>22</sup> Concerning Reading's career, see Livesey (1989), esp. chapter I. For a discussion of Reading's use of Grosseteste, see chapter II.1.

<sup>23</sup> Thus, for example, Cowton refers to the thing superadded to the object of the subalternating science, a feature of Grosseteste's theory that becomes virtually universal in the fourteenth century. See *In Sententias. Prologus*, q. 2; Theissing (1970), p. 262, lin. 4–6. William of Nottingham's discussion of subalternation occurs in q. 1, a. 3 of his commentary; Cambridge, Gonville and Caius College MS 300(514) fol. 4ra–5rb. At fol. 5ra, he notes, “semper scientia subalternata addit aliquam rationem extraneam super subiectum scientie subalternantis”. Somewhat more perplexing is William of Alnwick's treatment in Prologue, q. 5, a. 1 (Assisi, B. Communale 172, fol. 29v–34r). Alnwick neither cites Grosseteste explicitly nor uses arguments suggesting familiarity with his commentary. But the discussion occurs in response to Aquinas's position, and elsewhere, in question

1, it is clear that Alnwick's position on subalternation is governed by his underlying contention that the real problem of faith and reason lay not in this or that mechanism of subalternation, but in their compossibility at all. This question has been edited by d'Souza (1973); note especially the brief discussion of subalternation there at p. 475.

<sup>24</sup> Despite Grosseteste's authority, some aspects of the theory were open to modification. The anonymous author of Merton College MS 103 (produced around 1300) cites Grosseteste in his treatment of subalternation (fol. 216ra–216va), but also gives four conditions for subalternation, the second of which is (fol. 216ra–rb): "Secunda condicio est quod principia scientie subalternantis descendant in principia scientie subalternate et in omnes conclusiones eius, ita quod nulla sit conclusio in subalternata quin possit probari per principia subalternantis, et propter hoc medicina non subalternatur geometrie, quia non quoad omnes conclusiones dependet ex principiis geometrie, licet quoad aliquas, ut quod vulnera circularia tardius sanantur." But under such a condition, it is difficult to see how a science should be subalternated simultaneously to two superior sciences.

<sup>25</sup> Robert Grosseteste (1981), pp. 148–50. For a more complete discussion of Grosseteste's theory of subalternation, see Laird (1983), chapter II and Livesey (1989), chapter II.2.

<sup>26</sup> Robert Graystones, *Questiones super Sententias*, Prologue, q. 3; London, Westminster Abbey MS 13, p. 142b: "Confirmatur per Philosophum I *Posteriorum*; scientia subalternata semper est de ente per accidens, unde Lincolniensis ibi et est c. 12, 'sciendum quod scientia inferior superaddit condicionem per quam appropriat sibi subiectum et passiones superioris scientie. Et sunt in conclusione scientie subalternate, sicut due nature, natura scilicet quam accipit a superiori et natura propria quam superaddit.' Hec isti."

<sup>27</sup> Note, for example, that the discussion of subalternation first appears at *Posterior Analytics* I.7, where Aristotle introduces the topic by appealing to the three elements of demonstration: the conclusion, the axioms, and the underlying genus. And medieval scholars, John of Reading especially, drew special attention to Aristotle's discussion in I.28 on the unity of science and its cohesion. Much the same can be said of Aristotle's discussion in I.13, where the theory of subalternation is most elaborate.

<sup>28</sup> It would take us too far afield to discuss Aureol's positions on both issues. I have discussed them and the objections made by Ockham and Reading in Livesey (1989), chapter III.4 and in Livesey (1985).

<sup>29</sup> For the latter, see *Metaphysics* IV.2 1003<sup>b</sup>19–23 and especially *Categories* VIII 8<sup>b</sup>28–34.

<sup>30</sup> Peter Lombard (1971), T. I, pars ii, p.55; Augustine (1962), I, c. 2, n. 2 (p.7).

<sup>31</sup> John of Reading, *Scriptum in I librum Sententiarum*, Prol. q. 6; Florence, BN Centrale, Conv. Soppr. D.IV.95, pp. 86–87. I have edited the text of this question in Livesey (1989).

<sup>32</sup> For a more extensive discussion of this argument, see Livesey (1989), chapter II, section 6.

<sup>33</sup> Duhem (1913), p. 442: "La solution des sophismes se présente donc comme un légitime exercice de Logique, tant qu'elle demeure un exercice. Mais la gymnastique qui ne se propose plus simplement de fortifier et d'assouplir le corps, la gymnastique qui cesse d'être un moyen et se prend pour une fin, devient acrobatie; de même, en toute étude, l'exercice artificiel qui perd de vue l'objet réel pour lequel il a été combiné devient une acrobatie; ainsi la casuistique morale ou juridique peut dégénérer en acrobatie, ainsi la solution des problèmes peut prêter à l'acrobatie mathématique et la solution des sophismes à l'acrobatie logique.

Au temps de Guillaume Heytesbury, cette acrobatie logique était le *sport* en vogue à l'École d'Oxford."

<sup>34</sup> William of Ockham (1970), Prol., q. 1 (pp. 14–15). William of Ockham (1974), III, ii, chap. 21 (pp. 541–42). The influence of Ockham's ideas on subsequent writers in the fourteenth century has been a hotly debated topic. Duhem, of course, regarded Ockham as a seminal figure for much of the scientific work of the fourteenth century, a position that found a number of supporters in subsequent generations of historians. Weisheipl (1968) in particular and Herman Shapiro (1957) attempted to show the relationship between Ockham's positions on crucial physical and metaphysical issues and the calculatory tradition. But more recently, Courtenay (1987) and Tachau (1988) have called attention to the fundamental differences between Ockham and his reputed followers, arguing that the existence of an 'Ockhamist school' may have been assumed too quickly. On the issue of subalternation, one can find early opponents of Ockham, such as Chatton (see note 38 below), whose arguments seem to derive more from an underlying disagreement about *metabasis* than from the mechanism of subalternation. Such a fundamental debate is one that very likely will be with us for some time, but certainly one additional piece of evidence that needs to be considered in greater detail is the commentary on the *Sentences* found in Merton College MS 284.

From the paper on which the text was written, it is clear that the commentary was produced after 1340, and based on other considerations, probably before the mid-century. The text seems to have been a notebook of some anonymous student, who selected excerpts from other previous commentaries, perhaps as a way to prepare for his own. But what is also clear is that Ockham's position figures prominently, and when other positions are given, Ockham is granted the last word. The text itself closely resembles the *Ordinatio*, although it differs in ways that led Gerard Etzkorn (1987) to suggest that the author may have been using the lost *Reportatio* of book I.

Unfortunately, the sections of Prologue, qq. 1, 11, and 12 that contained material on subalternation were not excerpted by the author, leading one again to the fact that about the middle of the century the topic seems to have suffered a decline in interest. But question 2 of MS 284, corresponding to question 2 of Ockham's prologue, contains much material on the definition of *scientia* and the distinction between *quia* and *propter quid* demonstration, issues that were central to both Aristotle's and Ockham's ideas about subalternation. In particular, at fol. 7v, an objection to Ockham's theory of cognition is made, viz., if Ockham were correct, only one experience would be necessary to know a principle of art and science; Ockham's resolution is likewise given, that if the principle falls under the most specific species, then certainly only one experience suffices. But if the principle falls under what is common to several *species*, several experiences are required, following what Aristotle says in *Posterior Analytics* II on induction. Likewise, at fol. 9v, Ockham notes the fundamental distinction between *quia* and *propter quid* demonstration: the same thing is proved, but through different media. At fol. 10r, he follows up what has been said about individual and universal cognition by defining particular and universal demonstration, providing examples of each, the second of which relies heavily on the temporal element in the demonstration. And Ockham's tendency to reinterpret Aristotle is also exemplified shortly thereafter (at fol. 10r), when in the context of Aristotle's statement that to know is to understand the cause of the thing, Ockham notes that not every demonstrable should have a cause properly speaking; rather, it suffices that there should be something prior to which the thing agrees primarily in predication.

<sup>35</sup> John of Reading, *Scriptum in I librum Sententiarum*, Prol. q. 6; Florence, BN Centrale, Conv. Sopp. D.IV.95, p. 86: "Scientia ergo de superiori et inferiori nec est una nisi sit genere relato, nec se habet sicut scientia subalternans et subalternata. Assumptum – quod scilicet scientia de inferiori non subalternetur scientie de superiori, non sic proprie subalternata illi et complete, licet aliquo modo posset forte dici – patet."

<sup>36</sup> Oxford, Balliol College MS 63, fol. 67r–85v at 70r: "Unde si non sit hic proprie subalternatio, est tamen hic quedam subalternatio que similitudinem habet cum subalternatione." F. Pelster (1955, at pp. 30–31) concluded that the author was an Augustinian at Oxford, and while Roger Mynors suggested that MS 63 as a whole probably was produced not long after 1330, it is somewhat difficult to determine the date of this commentary. At fol. 69r, it refers to Peter Aureol, which places the text after 1317; but other than William de Ware, whose commentary is still earlier than this, the other authors cited in the text cannot be identified. It is clear that elsewhere the author was relying upon Aegidius Romanus for his information about subalternation, although as I have noted above, there is a heavy dose of Grosseteste in the commentary as well. The author notes that there are three modes of subalternation: (1) in which the inferior science serves (*famulatur*) the superior science, (2) in which the inferior science adds a condition to the subject of the superior, and (3) in which the inferior and the superior sciences consider the same truth, the former *modo grosso*, the latter *modo subtili*. (1) and (3) are mentioned by John of Reading in question 7 of his prologue, immediately after discussion of Richard Conington's theory (Florence, BN Centrale, Conv. Sopp. D.IV.95, p. 93); in the text, the position is not attributed to a specific author, and may well have been a common one at Oxford at the time.

<sup>37</sup> Graystones, *Questiones super Sententias*, Prologue, q. 3; London, Westminster Abbey MS 13, p. 143a: "Respondeo negando hanc consequentiam. 'Visio lineae in verbo est perfectissima eius cognitio. Ergo subalternat sibi omnes alias notitias de verbo.' Sed oportet addere quod visio in verbo esset causa aliarum cognitionum quod non est verum in proposito. Unde eadem conclusio potest cognosci perfectius et imperfectius ut forte metaphysicus, quia cognoscit per tres causas aliquam conclusionem, cognoscit perfectius quam geometer, qui cognoscit per unam causam tantum. Ipsi enim considerant multas eandem conclusionis cum scientia unius conclusionis; una non est subalternata alteri eiusdem conclusionis, ut cognitio quam habet geometer de alia cognitione ad illam quam habet metaphysicus de eadem, ut enim prius habitum est. Subalternans est principium respectu subalternate, et eadem conclusio non potest esse principium respectu sui ipsius. Maior etiam non est verum nisi intelligitur sic, quod resolutio in cognoscentibus non stat nisi ad perfectum cognoscibile vel perfectissimam cognitionem illius generis. Non enim potest geometer resolvere ulterius quam permittit sua facultas, sed oportet quod resolutio sua stet in prima limites suos".

<sup>38</sup> In his *Reportatio*, Prologue, qu. 1, a. 3, Chatton refers to Ockham's view that while the same proposition cannot be proven in distinct sciences when one defines science as the habit of one conclusion, it can so pertain to different sciences when science is taken as a collection of habits. Thereupon, Chatton divides his response into two parts, one restricted only to theology, the other to sciences in general, and with respect to the latter, he argues that such propositions proved in distinct sciences are not similar *in essendo* but rather in *significando*. "For although by possessing several sciences, one can apply premises which one forms according to concepts formed in the other, nevertheless the practitioner in any science . . . will form the conclusion from cognitions of a different



*ratio* in being from the conclusion of any other science.” And in direct response to Ockham’s argument, Chatton observes that even supposing that the conclusions are subordinated (he does not use – here or elsewhere – the term subalternation), still the conclusion is proved through middle terms of different *rationes* by different practitioners. See the text edited by Reina (1970), at 296–302.

<sup>39</sup> For details on Claxton’s life, see Emden (1957–1959), vol. 3, p. 426. Claxton was at the Oxford Convent by 1404 and a regent master in 1413. His commentary gives a retrospective look at the previous century, and thus offers not merely a picture of current views, but also fifteenth-century criticisms of the early fourteenth-century positions outlined in this paper.

<sup>40</sup> Courtenay (1987), p. 363.

<sup>41</sup> Cambridge, Gonville and Caius College, MS 370(592) fol. 10v–14r.

<sup>42</sup> *Ibid.*, fol. 14r: “In ista questione, sic procedam: primo enim declarabo materias tactas in titulo questionis nude, aperte, et vere, ut studentes intelligant. Veteres enim theologi sicut in loquendi logica plurimum defecerunt. Sic veritates inventas vel quas crediderunt se invenisse in culto et imperito modo loquendi sequentibus se tradiderunt. Unde et parvus error in principio in maximum dilatatus est, qua ex causa Philosophus III *Metaphysice* c. 11 in textu commenti 6. Veteres philosophos, theologos ut orpheum, ysidum, et philosophos etiam reprobant naturales qui adinventas veritates sub tegumentis poeticis vel mathematicis a sequatibus suis velaverunt. Opiniones autem paucas tangam, quia solum eas que merito fame aut propinquitatis ad veritatem tangende sunt. Alie enim scita veritate faciliter reprobantur, quia sicut falsitas inconueniens plurimis se involuit, ut patet ex sententia Philosophi I *Celi et mundi* dicentis parvus error in principio maximus est in fine, sic et veritas semper facile vincit et se declarat.”

<sup>43</sup> *Ibid.*, fol. 16r–v.

<sup>44</sup> *Ibid.*, fol. 28v.

<sup>45</sup> *Ibid.*, fol. 28v.

<sup>46</sup> *Ibid.*, fol. 28v–29r.

<sup>47</sup> *Ibid.*, fol. 29r: “Ex hiis patet quod ad hoc quod aliqua scientia sit alteri subalterna son solum oportet quod sit de subiecto eodem de quo est scientia cui subalternatur sed quod habeat equipollenter aliquod principium proprium primum cuius subiectum sit per se inferius ad subiectum et predicatum per se inferius ad predicatum primi principii illius scientie cui subalternatur. Verbi gratia, philosophia medicinalis subalternatur philosophia naturali quia sub isto principio eius primo ‘corpus est mobile’ habet primum suum principium proprium ‘corpus animale est mobile ad infirmitatem vel sanitatem vel neutralitatem,’ sicut perspectiva sub hoc principio geometrie, ‘figura est terminata,’ capit hoc principium sibi proprium ‘linea visiva terminatur ad oculum faciens visionem,’ et ideo perspectiva subalternatur geometrie, licet secundum aliquas eius partes subalternetur philosophie naturali capiens istud principium suum sub primo principio eius dicto ‘animal est mobile ad visionem a corpore lucido sibi obiecto.’ Similiter ars de ponderibus capit proprium principium suum hoc, scilicet ‘corpus gravius elevat levius’ sub primo principio philosophie naturalis, et ideo sibi subalternatur. Et sic de musica que capit hoc suum principium, ‘ex proportione 1 ad 4 fit diapason et plenus tonus,’ sub hoc principio arismetice, ‘omnis numerus est alteri proportionalis’ et ideo sibi subalternatur, et sic de aliis”.

<sup>48</sup> Thus, at fol. 31v, Claxton resolves an objection that his notion of unity of science is too strong, allowing all the sciences in the world to be one numerically in the way that

geometry is one; he replies that although all the sciences in the world might be one by aggregation, this is not the way that geometry is one, since sciences are said to be one not merely by aggregation, but by aggregation *and coordination* to one first principle, and such coordination is not found in diverse sciences.

Claxton's objections to Holcot and Ockham occur in the response to the sixth principal argument, at fol. 32r and 35v.

<sup>49</sup> Ibid., fol. 36r: "Sexta conclusio est hec: Viatorum theologia non est sanctorum theologie subalterna. Probatur ista conclusio sic. Nulla est facultas vel scientia alteri subalterna nisi cuius principium habet se ex additione tam aperte subiecti quam aperte predicati vel realiter vel equivalenter ad primum principium alterius vel cui subalternatur. Sed non sic se habet theologia viatorum ad theologiam beatorum. Ergo non est sibi subalterna. Patet consequentia et maior ex premissis et minor sic probatur. Idem est subiectum theologie viatorum et theologie beatorum, et utriusque theologie primum principium alteri equipollet. Ergo primum principium theologie viatorum non est inferius primo principio theologie beatorum, scilicet ea inferioritate que requiritur ad subalternationem. Patet consequentia et antecedens per hoc, quod utriusque theologie est primum principium 'Deus est summum bonum possibile.'" He then sums up his earlier remarks that subalternation is not merely dependent on a simple relationship of superiority and inferiority of certainty: "Septima conclusio est hec: licet viatorum theologia sit inferior id est imperfectior quam beatorum theologia, non tamen est ei subalterna. Ista conclusio patet ex premissis".

<sup>50</sup> Jaki (1984), pp. 393–400.

<sup>51</sup> For example, at fol. 35v.

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