Mertonians

The works of the Mertonians began, it seems, with Richard Kilvington's *Sophismata* (before 1325), and Thomas Bradwardine's *Insolubilia* and *Tractatus de proportionibus* (1328). (Bradwardine is better known for his theological work, *De causa Dei*, attacking Pelagianism. The Mertonians are identified as such from their more advanced logical works alone.) William Heytesbury built upon and systematized the work of Kilvington and Bradwardine in his major works, the *Regulae solvendi sophismata* (1335), and his *Sophismata*, which had considerable influence. Also in the 1330s, Richard Swineshead, wrote his *Liber calculationum*, and became known as 'The Calculator' from the book's title. Heytesbury, Bradwardine, and a number of other members of the school were in Merton College at Oxford at one time or another, and some modern writers refer to the school as the 'Mertonians'. This name was not used for them before the twentieth century, though. The school was known as the 'Calculators' in the fifteenth century. The notable logician, Walter Burley (1274/5–after 1344) contributed *De primo et ultimo instanti* and *Tractatus primus et secundus de formis accidentalibus* to the work of the school, and the lesser known Richard Billingham wrote his *Conclusiones*, while Roger Swineshead produced *De motibus naturalibus*. Heytesbury's *Regulae* seems to have attained the status of a standard survey, and is the basis for the anonymous *Tractatus de sex inconvenientibus*, and the *Summa logicae et philosophiae naturalis* of John Dumbleton (ca. 1310–ca. 1349). The tradition of the Oxford School seems to have faded out by 1400 in England, but it became quite popular in Italy. Heytesbury's *Regulae* and *Sophismata* influenced Peter of Mantua (d. 1400) in his *De instanti* and *Logica*, Paul of Venice (d. 1429) in his *Summa Naturalium* and *Sophismata*, Gaetano of Thiene (1387-1465), who commented on Heytesbury's works (probably 1422-30), and Paul of Pergula (d. 1456), who commented not only on Heytesbury, but also on a number of more minor authors. Heytesbury's works became part of the curriculum by statute at Padua in 1487, and editions of his works were printed at Pavia in 1481, and Padua in 1491 and 1494. In the early 16th century the works of the Mertonians were used at Paris by John Major (d. 1540) and the members of his school. With the Humanist reaction against medieval logical developments, the works of the Mertonians descended into obscurity.

These works arose within the context of logical disputation, *sophismata*, in which a decision was to be made on the truth of a proposed statement under certain given conditions. For instance, given that there is some weight Socrates can lift, and he can lift any smaller weight, and another weight Socrates cannot lift, and he cannot lift any greater weight, is there a greatest weight Socrates can lift? Here the issue becomes interesting once one notes that there might instead be a smallest weight Socrates cannot lift. Often, to resolve a problem, it was necessary to give an "exposition" of the statement under examination, that is, a clear statement of the truth conditions of the statement. So here one might exposit "there is a limit to Socrates's capacity to lift weights" as "either there is a greatest weight that Socrates can lift, or a least weight that he cannot lift," in order to avoid the argument, "from the assumptions, there is a limit to Socrates's capacity to lift weights, and therefore there is a greatest weight Socrates can lift." The puzzles considered by the Mertonians often concerned continua, and mathematical/physical questions about such matters as motions and acceleration and the measurement of capacities and of qualities. So, looking at it from a modern perspective, historians of science have sometimes seen the Mertonians' work as preparatory for the breakthroughs of seventeenth century physics. (See especially the work of Pierre Duhem and Anneliese Maier) In particular, they cite the mean-speed

theorem for uniformly accelerated motion, the notion of an instantaneous velocity, the articulation of the distinction between kinematics and dynamics, and the application of quantitative measurement to qualities such as heat, with the considerations of metaphysical difficulties to which such a move gave rise within the Aristotelian metaphysics.

To the medieval students who studied this material without the benefit of precognition, it was a part of advanced logic, in which they were expected to participate in disputations concerning *sophismata*, problem statements which could be argued to be either true or false (at least when using plausible fallacies, sometimes relying on the more difficult rules of argumentation taught in logic). The typical works of these authors consider examples of such *sophismata* on one topic or another, often following out a series of such *sophismata* on one theme, of increasing complexity and difficulty. The interest of these logical exercises lies in the fact that they were often used as tools for the investigation of poorly understood conceptual territory, rather than merely to pose problems for undergraduates. "Physical" *sophismata* cannot readily be separated from "logical" *sophismata*, for the exposition of a statement so that accepted logical rules can be brought to bear on it lay at the core of both. But some of the statements to be examined were native to mathematics, geometry, kinematics, or even dynamics, so that to posit a theory from which a given exposition of such statements followed was to do mathematics and the conceptual side of physics. The more traditional use of *sophismata* had focused on the development and application of rules of inference. The *Sophismata* of Kilvington involve beginning and ceasing, degrees of a quality such as whiteness, traversal of a space, comparisons of velocities, the attribution of a velocity to a thing in a given period of time, or of a quality to an extended thing, when the thing has different velocities at different times within the period of time at issue, or different degrees of the quality in its different parts. In the course of consideration of such questions, Bradwardine developed a theory of ratios based on Book V of Euclid, which he applied to the rations of all sorts of motions and qualities (a motions being considered a quality), and raising issues how motions and qualities that were not uniform were to be measured. Burley contributed discussions of the existence of a first or last instant of a motion or state of affairs, noting that a motion could begin, say, *without* a first instant of motion, and on the intension and remission of qualitative forms, arguing for a succession of forms of different intensity rather than the addition of some form to what is already there. It should be noted that the Mertonians considered cases they thought to be impossible within nature, usually because they involved an actual infinite in some way, but which present no logical contradictions if handled correctly. They are not doing empirical physics, but they may be laying a logical or conceptual basis for it, and even ruling out some theoretical moves as logically objectionable.

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