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Between Ancient and Modern Times: the Theory of Motion in the 14th Century

The impulse to this talk has been provided by the growing interest in the study of medieval philosophy of nature that produced numerous editions of commentaries on Aristotle's *Physics* followed by many studies dealing with medieval physics and its links with the seventeenth century physics. These studies reveal the importance of medieval science and argue for its role in developing modern theories. Since medieval philosophers of nature never abandoned the realm of Aristotelian physics nor rejected the principles laid down in his natural philosophy, it is interesting to answer the question whether the various methods that they applied to surmount the inconsistency of Aristotle's theory made them stand any closer to modern science. It is here that we see the Oxford Calculators (Richard Kilvington, Thomas Bradwardine, Roger Swineshead, John Dumbleton, Richard Swineshead)– the fourteenth century logicians, mathematicians and philosophers of nature. They are best known for their new movement theory and, especially for the Mean Speed Theorem, later used by Galileo to establish a proper rule of accelerated motion.

From the point of view of modern, Newtonian physics focused on establishing rules of local motion in both dynamical and kinematical aspects, Aristotle's *libri naturales*, seem to be full of superfluous and vague speculations. The use of 'motion' as the concept synonymous to 'change' allows for the inclusion of problems concerning alteration, augmentation, generation and corruption into the field of natural philosophy. Consequently, local motion, which is the main subject of modern physics, is curtained by discussions of different kinds of changes, (e.g. becoming white, or change from not being into being). Aristotle's rules of motion, formulated in Book VII of his *Physics* not only mix kinematic and dynamic aspects of motion and they are far away from mathematical precision and can hardly be called laws of dynamics. Aristotle's *modus operandi* in science resulting in separation of mathematics and physics makes it difficult to describe physical phenomena properly. The readers of Aristotle's *Physics*, however, receive the book that describes the world at large, where each event can be explained by the same set of rules. On one hand, Aristotle claims he can explain the structure of the physical world and give a convincing explanation of its phenomena. On the other hand, because of the numerous *aporiae*, he leaves his readers with many doubts concerning particular problems. Medieval philosophers noticed this incongruity of Aristotle's *Physics* and tried to overcome the difficulties. One of the most popular methods in philosophy of nature, which was the novelty of the 14th century and might be treated as the first attempt to overcome inconsistency in Aristotelian theory, was to apply both logic and mathematics into physics. This procedure solved many problems in natural philosophy and allowed to

use mathematics as the proper language of physics. Oxford Calculators were the vanguard of mathematical physics in the Middle Ages.