Retraction Notice

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The Publisher notifies the readers that the following chapter from this book has been retracted:

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In July 2020, the Publisher was notified of alleged plagiarism in the article 'William of Ockham on the Instant of Change', *Vivarium* 55.1-3 (2017), 130-151, published online on 14 July 2017 and in print on 18 July 2017, and subsequently republished in the above-mentioned book.

The Publisher and the Journal Editors began an investigation into this article, and into other articles published by the same author in the Journal. The Journal Editors confirmed with co-author Magali Roques that the chapter reproduced passages without proper attribution. Further investigation revealed extensive plagiarism. The contribution to the chapter by co-author Frédéric Goubier has not been called into question.

The retracted book chapter will remain online to maintain the scholarly record, but digitally watermarked on each page as 'Retracted'.

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Introduction

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How does change work? If a thing moves from one state to another, when exactly does it start to be in its new state, and when does it cease to be in its former one? An easy answer would be that the last instant of a given state is immediately followed by the first instant of the new state. But if time is conceived as a continuum, there is always a third instant between two instants; in other words, there are no two adjacent instants. One has therefore to decide whether change takes place at the last instant before the thing is in its new state, the first instant at which it is in its new state, both the former and the latter, or neither of them. The first two options seem arbitrary, the third goes against the law of non-contradiction, and the fourth against the law of excluded middle. And if there is no instant of change, how can there be change at all?

The property of being an instant of change must be defined if we are to give an adequate description of it. The problem is not limited to the question of how to describe the instant of change. It also includes the question why a philosopher would prefer one description of the instant of change over the others. What kind of philosophical and/or scientific presuppositions should we favour?

What is sometimes called the “problem of the instant of change” has its roots in antiquity and was intensely debated by late medieval philosophers. It

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became popular again in the second half of the twentieth century when, once more, each option was considered, as well as the possibility that there is no such thing as a moment of change.

The Medieval Approach

The medieval approach to the problem of the instant of change is of special interest because of its thoroughness: not only did medieval philosophers and theologians examine a wide range of solutions to the problem; they also elaborated it in such a way that, in the middle of the fourteenth century, the Aristotelian approach was revised in order to accommodate types of change that Aristotle did not take into account in his *Physics*, such as changes in intensive magnitude. The medieval analysis of the problem of the instant of change thus shows not only an important systematization of Aristotle's doctrine, but also considerable development. Thus, Niko Strobach believes, "the level of argumentation in the thirteenth and fourteenth centuries is not regained until the twentieth century."¹

The standard medieval position basically follows Aristotle's and defends an "either-or" position, that is, the claim that the instant of change either belongs to the preceding or succeeding interval or to the interval measuring the change. This position goes beyond Aristotle, however. In particular, it is based on an innovation in the ontology of mobiles. Following Averroes, medieval authors distinguish between permanent and successive things.² By definition, a permanent thing is such that it exists only when all its parts exist at the same time, and a successive thing is such that it exists only when its parts do not exist all at the same time but successively.³ It is not easy to interpret the meaning of this distinction. Nevertheless, the distinction clearly implies that for medieval authors there is no universal solution to the problem of the instant of

1 N. Strobach, *The Moment of Change: A Systematic History in the Philosophy of Space and Time* (Dordrecht, 1998), 84.

2 Simo Knuuttila traces the origin of the distinction to Averroes' comments on texts 40-46 of book VI of the *Physics*: "Remarks on the Background of the Fourteenth Century Limit Decision Controversies," in *The Editing of Theological and Philosophical Texts From the Middle Ages*, ed. M. Azstalos (Stockholm, 1986), 245-266, at 254-256. Alain de Libera believes that the distinction also has roots in Augustine's *Confessiones* IX, ch. 10, no. 15: "La problématique de l'instant du changement au XIII^{ème} siècle: Contribution à l'histoire des *sophismata physica-lia*," in *Studies in Medieval Natural Philosophy*, ed. S. Caroti (Florence, 1989), 43-93, at 63-64.

3 For Burley's definition, see his *De primo et ultimo instanti* (ed. H. and C. Shapiro, *Archiv für Geschichte der Philosophie* 47 [1965], 157-173, at 164).

change, since the ascription or the denial of a first instant or a last instant to a state involved in a change depends on the permanent or successive nature of such a state.

The importance of the distinction between permanent and successive things cannot be stressed enough. Aristotle allows for motion over periods of time only. Consequently, for Aristotle there is a trivial solution for the instant of change of rest and motion: since there is neither rest nor motion at instants, there is neither rest nor motion at limiting instants. Medieval authors agree with the gist of Aristotle's position, but elaborate the analysis by using the distinction between permanent and successive things. For them, rest and motion, which are successive things, are limited extrinsically, which means that the instant of change belongs to the temporal interval that precedes them. This implies that this last interval cannot measure another instance of motion or rest, since they are limited extrinsically. Thus, no process can be immediately preceded or followed by any other process. This problem has given rise to the "neutral instant analysis" that was defended in the twentieth century by authors such as Richard Sorabji and Norman Kretzmann.⁴ Strobach has even characterized Sorabji's description of the instant of change as "an important attempt at a modernization of the Aristotelian and medieval approaches."⁵

Moreover, medieval philosophers and theologians paid great attention to the tense-logical analysis of the verbs *incipere* and *desinere*. Dozens of *sophismata*, such as "Socrates ceases to be not ceasing to be" (*Socrates desinit esse non desinendo esse*) or "Socrates ceases to know everything he knows" (*Socrates desinit scire quicquid ipse scit*), provided the main occasions to tackle the issue of the instant of change.⁶ Some authors, such as William of Ockham and

4 See R. Sorabji, *Time, Creation and the Continuum* (London, 1983), 403-421; N. Kretzmann, "Incipit/Desinit," in *Motion and Time, Space and Matter: Interrelations in the History of Philosophy and Science*, ed. P. Machamer and R. Turnbull (Columbus, OH, 1976), 101-136.

5 Strobach, *The Moment of Change*, 124.

6 For a list (albeit not exhaustive) of these *sophismata*, see S. Ebbesen and F. Goubier, *A Catalogue of 13th-Century Sophismata*, part II: *The Catalogue* (Paris, 2010). A few have been edited; see N. Kretzmann, "Socrates Is Whiter than Plato Begins to Be White," *Noûs* 11 (1977), 3-15, at 14-15; S. Ebbesen, "Three 13th-Century Sophismata about Beginning and Ceasing," *Cahiers de l'Institut du Moyen-Âge grec et latin [=CIMAGL]* 59 (1989), 121-180, at 133-180; A. Tabarroni, "'Incipit' and 'desinit' in a thirteenth-century sophismata-collection," *CIMAGL* 59 (1989), 61-111, at 89-111; A. de Libera, "Le sophisma anonyme '*Sor desinit esse non desinendo esse*' du Cod. Parisianus 16135," *CIMAGL* 59 (1989), 113-120, at 117-120; idem, "La problématique de l'instant du changement," 82-93. See also the study of P. Pérez-Ilzarbe, "Socrates desinit esse non desinendo esse: Limit-Decision Problems in Peter of Auvergne," in *Logic and Language in the Middle Ages. A Volume in Honour of Sten Ebbesen*, eds. J.L. Fink, H. Hansen and

John Buridan, attempted to work with periods devoid of any instant, which led them to investigate the formal properties of what in the twentieth century was called “interval semantics.”⁷ The first attempt to construe interval semantics, in Charles L. Hamblin’s article “Starting and Stopping,” refers to William Heytesbury’s *Regule solvendi sophismata*.⁸ From this perspective, it comes as no surprise that the medieval approach to the problem of the instant of change has attracted the attention of scholars, beginning with Curtis Wilson’s seminal work.⁹

A Little History

Curtis Wilson, Norman Kretzmann, and Simo Knuuttila proposed a narrative of the medieval solutions that has become so classic that it is discussed by contemporary philosophers along with the views of Russell and Hamblin.¹⁰ This narrative posits the succession of several phases depending on whether physical or semantic considerations are at the forefront. In the physical phase, the objects of the analysis are physical entities, namely first and last instants, and the tools of the analysis are physical theories, such as the continuity of time and the structure of change. In the logical phase, the objects of the analysis are propositions and they are analyzed with logical tools.¹¹

A.M. Mora-Márquez (Leiden, 2013), 287-303; and the formal reconstruction of some analyses in P. Øhrstrøm and P.F.V. Hasle, *Temporal Logic. From Ancient Ideas to Artificial Intelligence* (Dordrecht, 1995), 52-64.

- 7 See, for instance, P. Øhrstrøm, “Buridan on Interval Semantics for Temporal Logic,” *Logique et analyse* 27 (1984), 211-215; S.L. Uckelman and S. Johnston, “John Buridan’s Sophismata and Interval Temporal Semantics,” *Philosophiegeschichte und logische Analyse* 13 (2010), 133-147.
- 8 C.L. Hamblin, “Starting and Stopping,” *The Monist* 53 (1969), 410-425, at 425.
- 9 C. Wilson, *William Heytesbury: Medieval Logic and the Rise of Mathematical Physics* (Madison, WI, 1956).
- 10 Kretzmann, “Incipit/Desinit”; Knuuttila, “Remarks on the Background”; Wilson, *William Heytesbury*.
- 11 John E. Murdoch insisted on the importance of the problem of the instant of change for “the metalinguistic analysis of the problems of natural philosophy” characteristic of fourteenth-century physics, especially among the Oxford Calculators (e.g., Richard Kilvington, William Heytesbury, and Roger Swineshead), in particular in his “Propositional Analysis in Fourteenth-Century Natural Philosophy: A Case Study,” *Synthese* 40 (1979), 117-146, and “*Scientia mediantibus vocibus*: Metalinguistic Analysis in Late Medieval Natural Philosophy,” in *Sprache und Erkenntnis im Mittelalter*, ed. J.P. Beckmann, L. Honnefelder, G. Jüssen, B. Münxelhaus, G. Schrimpf, and G. Wieland (Berlin, 1981), 73-106.

According to Kretzmann, the earliest medieval discussion, logical in nature, occurs in twelfth-century treatises on fallacies. The words *incipit* and *desinit* are logically tricky and provide ample opportunity for fallacies, since, although both of them are affirmative and in the present tense, each contains both an implicit negation and an implicit reference to some time other than the present. In a second phase, the discovery of Aristotle's *Physics* led to a "hybrid approach," both physically and logically. Thus, Peter of Spain distinguishes between permanent and successive things and ascribes intrinsic or extrinsic limits to temporal periods depending on the nature of the things considered, i.e., permanent or successive.¹² In a third phase, a physical approach is developed. Burley's *De primo et ultimo instanti*, dated to the late 1310s, is often mentioned as a sophisticated representative of this approach.¹³ Burley is known for further elaborating the division into permanent and successive things by introducing the category of instantaneous things. Finally, a "purely logical approach" can be found in William of Ockham and, around the end of the fourteenth century, in Johannes Venator.¹⁴ In this approach, the distinction between successive and permanent things is rejected as irrelevant and the existence of instants is denied.

The narrative has been enriched by Simo Knuuttila and Anja Inkeri Lehtinen.¹⁵ They discovered a group of authors, including Landolfo Caracciolo, Hugh of Novocastro, and John Baconthorpe who, around 1320, developed a non-Aristotelian solution that has been compared to the "contradictory theory of change" proposed by Graham Priest in 1987.¹⁶ Kretzmann has given the misleading name "quasi-Aristotelianism" to this school of thought, erroneously thinking that these scholars misread the Aristotelian doctrine of instantaneous

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- 12 Petrus Hispanus, *Syncategoreumata* (ed. L.M. de Rijk, Leiden, 1992, 249-254). For a detailed analysis of the so-called "hybrid approach," see de Libera, "La problématique de l'instant du changement," 43-76. Alain de Libera shed light on the way the whole issue was framed by the rules of the thirteenth-century *sophismata* literature and showed that these rules, while allowing for concepts such as the distinction between successive and permanent entities, are of a fundamentally syntactic-semantic character.
 - 13 For Burley's definition, see the reference given in note 3.
 - 14 Kretzmann, "Incipit/Desinit," 117; Guillelmus de Ockham, *Summa Logicae* II, c. 19 (*Opera philosophica* I, ed. G. Gál and S.F. Brown, St Bonaventure, NY, 1974, 310-316); Johannes Venator, in Kretzmann, "Incipit/Desinit," 128-130.
 - 15 S. Knuuttila and A. Inkeri Lehtinen, "Change and Contradiction: A Fourteenth-Century Controversy," *Synthese* 40 (1979), 189-207; Knuuttila, "Remarks on the Background"; de Libera, "La problématique de l'instant du changement."
 - 16 G. Priest, *In Contradiction: A Study of the Transconsistent* (2nd ed. Oxford, 2006), 159-171.

transition.¹⁷ These authors rightly believe that the standard Aristotelian account of the instant of change cannot hold of instantaneous changes. They claim that at the instant when a thing changes from being P to being not-P, it must be both P and not-P. In order to preserve the principle of non-contradiction, they interpret the word “together” (*simul*) in the common formulation of this principle as referring not to temporal simultaneity but to simultaneity by nature.¹⁸ This discussion occurs mainly in theological contexts. Following Knuuttila’s suggestion,¹⁹ a strong interest has grown in the treatment of the problem of the instant of change in theological contexts such as mariology,²⁰ the theology of the Eucharist, the physics of angels and, in particular, the doctrine of creation, since it is in this last context that the alternative view on the instant of change was developed and criticized.

Contemporary Approaches

The problem of the instant of change is a flourishing topic today, for several reasons. First, solving the problem of the instant of change amounts to solving Zeno’s flying arrow paradox and, more generally, to taking a stance on Russell’s reductionist analysis of the ontological status of motion. Indeed, Zeno’s paradox and Russell’s view that talk of rest and motion can be completely reduced to talk of places at times both presuppose that a complete description of the world can be given by a sequence of instantaneous states.²¹ Second, given the common epistemological assumption that instants are not empirically acces-

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- 17 Kretzmann, “Continuity, Contrariety, Contradiction, and Change,” in *Infinity and Continuity in Ancient and Medieval Thought*, ed. N. Kretzmann (Ithaca, NY, 1982), 270-296, at 274. See William Duba’s paper for the theory and its origins.
 - 18 The solution was criticized by John of Jandun, Francis of Marchia, Francis of Meyronnes, Francisc Marbres (a.k.a. “John the Canon”), and Michael of Massa: Knuuttila and Inkeri Lehtinen, “Change and Contradiction,” 189-190 and 195-199.
 - 19 Knuuttila and Inkeri Lehtinen, “Change and Contradiction”; Knuuttila, “Remarks on the Background.” Knuuttila and Inkeri Lehtinen quote in particular *Sentences* commentaries, book I, d. 17 on the increase and decrease of charity; book II, d. 1 on creation and d. 2 on angelology; book III, d. 1 on the incarnation and d. 3 on the immaculate conception; and book IV, dd. 10-12 on transubstantiation.
 - 20 Cf. S. Brower-Toland, “Instantaneous Change and the Physics of Sanctification: ‘Quasi-Aristotelianism’ in Henry of Ghent’s *Quodlibet* xv q. 13,” *Journal of the History of Philosophy* 40 (2002), 19-46. See also C. Trifogli, “Giles of Rome on the Instant of Change,” *Synthese* 96 (1993), 93-114.
 - 21 See for instance Priest, *In Contradiction*, 172-181.

sible, the problem of the instant of change represents a privileged theoretical test case in order to explore the logical properties of the semantic model adopted to formalize time and change. In particular, it presupposes giving an answer to the question whether tense logic must be based on instants or on time periods²² and it helps define the relation between tenses and aspects. Third, the recent revival of Aristotelian metaphysics has brought to the fore the question of the nature of time and change and has led to further investigation into the metaphysical presuppositions of Aristotle's treatment of the problem of the instant of change, as compared to metaphysics such as Lewis'.²³

Four possible options for the description of the instant of change have been proposed by philosophers during the twentieth century. Richard Sorabji, Anthony Galton, Robert Pargetter, and Franck Jackson defend the either-or option, like most medieval authors. Graham Priest, following Hegel, develops a paraconsistent logic for the both-states option by restriction of the principle of non-contradiction. Charles L. Hamblin sacrifices the law of the excluded middle by choosing the neither-nor option. Brian Medlin and Roderick Chisholm, following Brentano, develop a position unknown to medieval philosophers and theologians, the either-way option.²⁴ Finally, David Bostock, Norman Kretzmann, and Niko Strobach defend a compromise solution, often called the "Neutral Instant Analysis." A neutral instant must be posited only for changes between two positions, e.g., from rest to motion. For other changes, such as from P to not-P (called "Cambridge changes" in the literature), they opt for the either-or option. Both non-contradiction and the excluded middle remain valid without restriction.²⁵

The Present Volume

The studies collected in the present volume are based on the papers presented at the workshop "Limit Decision Problems: Medieval and Contemporary Perspectives" held in Berlin on 20-21 November 2015. The workshop constituted

²² See Hamblin, "Starting and Stopping."

²³ D. Lewis, *On the Plurality of Worlds* (Oxford, 1986).

²⁴ Strobach, *The Moment of Change*, 146, describes the either-way option as follows: "It is correct to say that the old as well as the new state obtains at the limiting instant, although only in a certain sense, so that no contradiction results."

²⁵ This presentation is based on Strobach, *The Moment of Change*, 124-197, and on Ludger Jansen's excellent review of it in *Philosophiegeschichte und logische Analyse* 4 (2001), 205-211.

the first attempt at tackling the different aspects of a subject that until then had been the object of seminal but isolated forays. The topic and the different issues it involves are nevertheless too wide to be conveyed in a single volume; we have therefore decided to focus on one of the most interesting aspects of the “problem of the instant of change,” namely the physical and metaphysical challenges it raises, the presuppositions in these areas it exposes, and the historical connections it allows us to make. Some papers thus explore the different implications of the medieval choice for an either-or option; others provide new, and at times critical, insights on the both-states approach and its context. All offer new takes on the traditional historiography presented above and give, sometimes thanks to new texts, a more complex and faithful picture of an intricate network of theories and discussions.

We have also chosen to further enrich this approach with contributions in contemporary philosophy. The two traditions display remarkable overlap, both in the way they state the different aspects of the issue and with respect to the solutions they find. This is especially true of the ‘both-states’ approach, which is as controversial today as it was in the fourteenth century. We hope that the arguments provided by the contemporary discussion offered here can help shed light on some of the physical and metaphysical stakes in both contemporary and medieval debates, such as the choice of an eternalist model of time or the nature of the distinction between permanent and successive things.

The present volume is not so much a *status quaestionis* as an attempt to open new avenues for research into medieval logic, physics, and metaphysics, together with a proposal for a dialogue with contemporary philosophy on a shared set of issues.