Retraction Notice

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William of Ockham on the Instant of Change

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Abstract

Ockham's approach to the problem of the instant of change as it is found in the *Summa logicae* 1, chapter 5, and 11, chapter 19, is usually described as “purely logical,” narrowing the treatment of “begins” and “ceases” to simplistic cases. The aim of this paper is to complement our knowledge of Ockham's position on the problem of the instant of change by analysing the treatment of the problem he gives in his questions on the *Physics* 98–101. In these passages, Ockham adopts a “physical approach” in order to deal with problems related to the continuity of alteration and the production of the form of the mix from elementary qualities. To solve these problems, he is compelled to give up one of the most important claims at the basis of the logical approach that he adopted in the *Summa logicae*, namely that the distinction between permanent and successive entities is not relevant in the assignment of truth-conditions to propositions containing the aspectual verbs “beginning” and “ceasing.”

Keywords

William of Ockham – Walter Burley – Thomas Wylton – instant of change

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According to Norman Kretzmann, the problem of beginning and ceasing can be broadly described as “the problem of assigning temporal limits to a process of change measured against a continuum.”¹ Kretzmann describes Ockham’s approach to the limit decision problem as it is found in *Summa logicae* I, chapter 75, and II, chapter 19, as a “purely logical approach which narrows the treatment of ‘begins’ and ‘ceases’, rejecting or ignoring the physical strand and most of the problems and technicalities it gives rise to in the hybrid approach.”² My aim in this paper is to complement our knowledge of Ockham’s position by analysing the treatment of the problem he gives in his questions on the *Physics* 98–101. To my knowledge, these texts have never been studied nor ever quoted in the literature on the subject.

In these passages, Ockham develops a very different picture from his treatment in the *Summa logicae*. Indeed, he seems to have changed his mind, adopting a “purely physical approach” in order to deal with problems related to the continuity of alteration and the production of the form of the mix from elementary qualities. To solve these problems, he is compelled to give up one of the most important claims that lie at the basis of the logical approach he adopted in the *Summa logicae*, namely that the distinction between permanent and successive entities is not relevant in the assignment of truth-conditions to propositions containing the aspectual verbs “beginning” and “ceasing.”³

In order to establish my point, I will proceed in three parts. First, I will present the problem at issue and the topology of time on which Ockham’s physical approach to the problem of the instant of change is based. Second, I will explain why Ockham had to change his approach and I will compare it to the one adopted by Thomas Wylton and Walter Burley. Finally, I will present and justify his solution to the problem of the instant of change.

1 The Topology of Time

1.1 *The Problem at Issue*

At the beginning of question 98 of his questions on the *Physics*, Ockham reminds the reader of the problem that arises in establishing the temporal limits

1 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, at 102.

2 Kretzmann, “Incipit/Desinit,” 117.

3 Edith Sylla doubts that Ockham changed his mind or gave up his claims about permanent and successive things. See her paper in this volume. I cannot deal with her concerns here due to length constraints, but I shall endeavor to do so in the future.

of the contradictory conditions involved in changes that may be regarded as changes from one state to its contradictory opposite. That is, in many cases where some x changes, it may be regarded as changing from being not- P to being P , or vice versa. Is there a first instant at which it is true to say that x is P after having been not- P ?⁴

A simple solution to the problem would be to deny that time is continuous and to accept that one instant can succeed another without any intermediate instant, i.e., to accept indivisibles of time. But Aristotle refuses such a solution. The assumption of the continuity of time implies that no instant has an immediately preceding or immediately succeeding instant.⁵ Consequently, the whole period of time during which x is not- P and the whole period of time during which x is P must be mutually exclusive and non-overlapping. The instant of change can therefore be only one of two things: the last instant in which x is not- P or the first instant in which x is P . Aristotle chooses the second alternative. He claims that, in a change between contradictory conditions, there is no last instant in which x is not- P , but only a first instant in which x is P .⁶ Thus, Aristotle's solution to the difficulty is to say that the change is instantaneous and the instant belongs to the posterior time with respect to the changing object.⁷

The question, then, is the following. Does the instant of change belong to the earlier period (in which x is not- P) or to the later period (in which x is P)? As Paul Spade reminds us,

logically or mathematically, it makes no difference. You can divide up the temporal continuum either the one way or the other and get things to work out consistently, as long as you do pick either the one way or the other, and don't try to have it both ways at once. But this latitude does not make our question any easier; it makes it harder. If the logic and

4 Guillelmus de Ockham, *Quaestiones in libros Physicorum Aristotelis*, q. 98 (ed. S.F. Brown, *Opera Philosophica* VI, St Bonaventure, NY, 1984, 659-3-9).

5 Aristotle, *Physics* VI, ch. 1, 231b6-10.

6 More precisely, in *Physics* VIII, ch. 8, 263b9-15, Aristotle says that there is a first instant of being in generation but not an ultimate instant of not-being.

7 For a detailed analysis of Aristotle's treatment of the limit decision problem, see R. Sorabji, "Aristotle on the Instant of Time," *Proceedings of the Aristotelian Society*, Supplementary Volume 50 (1976), 69-89, reprinted with revisions in *Articles on Aristotle*, ed. J. Barnes, M. Schofield, and R. Sorabji (London, 1979), vol. 3, 159-177; R. Sorabji, *Time, Creation and the Continuum* (London, 1983), 403-418.

mathematics of the situation do not decide the issue, then what does? That is our question.⁸

Aristotle maintained that time is continuous in the way a geometrical line is continuous.⁹ Temporal instants, somewhat like geometrical points, are not real but theoretical entities.¹⁰ They are like geometrical points in that time is not made up of instants although it is infinitely divisible into shorter times; between any two instants there are infinitely many instants.¹¹ Consequently, as an instant of time, the instant of change cannot be a thing as my leg or a tree is. What is the ontological status of the instant of change according to Ockham?

1.2 *The Metaphysics of the Instant of Change*

For Ockham, an instant is not an indivisible thing joining the limits of two temporal parts together to make them continuous with each other.¹² According to this view, which has been dubbed “anti-indivisibilism,”¹³ it is not necessary to stipulate the existence of indivisibles such as points or instants in order to account for the limits between temporal intervals. Does it then follow that the word “instant” must be banned from ordinary and scientific language? Ockham does not think so. He maintains instead that to say that an instant is indivisible amounts to saying that a thing is neither further divisible nor prolonged,¹⁴ i.e., it is temporally closed. More precisely, to say that Socrates begins to be white at instant *t* is to say that a whiteness is (in Socrates) at *t* after not having been before *t*.¹⁵ “Instant” is thus a nominalisation of a time adverb that cannot have nominal value.¹⁶ This adverb is a syncategorem that temporally determines a nominal group or a verb that refers to a persisting object.¹⁷ More precisely, it

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- 8 P. Spade, “How to Start and Stop: Walter Burley on the Instant of Transition,” *Journal of Philosophical Research* 19 (1994), 193–221, at 196.
 - 9 Aristotle, *Physics* VI, ch. 2, 232b24ff.
 - 10 Aristotle, *Physics* IV, ch. 13, 222a10ff.
 - 11 Aristotle, *Physics* IV, ch. 10, 218a18ff.
 - 12 Ockham, *Quaestiones in libros Physicorum*, q. 57 (ed. Brown, 553.112–117).
 - 13 For references and a more thorough explanation of Ockham’s position on permanent continuous magnitudes, see M. Roques, “Introduction,” in Guillaume d’Ockham, *Traité sur la quantité; traité sur le corps du Christ* (Paris, 2014), lxi–lxxxv.
 - 14 Guillelmus de Ockham, *Brevis Summa libri Physicorum* VIII, c. 4 (ed. S.F. Brown, *Opera Philosophica* VI, St Bonaventure, NY, 1984, 131.85–91).
 - 15 Ockham, *Brevis Summa libri Physicorum* VIII, c. 4 (ed. Brown, 132.92–96).
 - 16 Ockham, *Quaestiones in libros Physicorum*, q. 57 (ed. Brown, 553.119–121).
 - 17 Ockham, *Brevis Summa libri Physicorum* VIII, c. 4 (ed. Brown, 553.117–119).

refers to that persisting object of which one part of a contradiction is first true after having been false.¹⁸

Ockham explains that an instant is a measure in the sense that it establishes a relation between two changes, such that it allows one to know the quantity of the one on the basis of the quantity of the other. The word 'instant' signifies that two successions coexist. This type of coexistence is specified in the following way. Any temporal part that precedes the instant of change coexists with an indefinite number of facts. Only the instant of change coexists with a unique fact, the fact that describes that a part of the contradiction is true after having being false.¹⁹ In this way Ockham can avoid questions pertaining to the very idea of continuity as far as time is concerned. Indeed, time is said to be continuous in a weak sense only because it coexists with something that is continuous in a weak sense, i.e., successive.²⁰

The temporal series that is the yardstick for assigning temporal limits to changes is described as the time that measures the being of a thing. Ockham says that this temporal series is in a relation of coexistence with the thing measured.²¹ This relation of coexistence may be described in two different ways. If both the measure and the measured are things, they are really distinct from each other, and they are of the same species, since only a motion can measure a motion, and only a permanent thing can be the measure of another permanent thing. If either the measure or the measured is a product of the mind, they are at least not identical, since they are not of the same ontological kind, the one being a real thing and the other a being of reason.²²

As a consequence, the extrinsic first or last instant is described as being an "imaginative entity" that is outside the temporal series that coexists with the being of the thing,²³ while the intrinsic instant is described as the first or the last instant of a temporal series that coexists with the thing measured.²⁴ By saying that extrinsic instants are imaginary, Ockham means that they are not real in any sense of the term. We can talk about extrinsic instants, and for many purposes such talk is a convenient fiction that abbreviates a long discourse.

18 Guillelmus de Ockham, *Quaestiones in librum secundum Sententiarum*, q. 10 (ed. G. Gál and R. Wood, *Opera Theologica* v, St Bonaventure, NY, 1981, 217.14-16).

19 Ockham, *Quaestiones in librum secundum Sententiarum*, q. 10 (ed. Gál and Wood 218.2-7).

20 Ockham, *Brevis Summa libri Physicorum* VIII, c. 4 (ed. Brown, 132.97-99).

21 Ockham, *Quaestiones in libros Physicorum*, q. 98 (ed. Brown, 660.34-35).

22 Ockham, *Quaestiones in librum secundum Sententiarum*, q. 10, (ed. Gál and Wood, 164-167).

23 Ockham, *Quaestiones in libros Physicorum*, q. 98 (ed. Brown, 659.16-20).

24 Ockham, *Quaestiones in libros Physicorum*, q. 98 (ed. Brown, 660.34-35). See also Ockham, *Quaestiones in librum secundum Sententiarum*, q. 10, (ed. Gál and Wood, 213.7-19).

But such talk is simply a kind of shorthand for talk about intervals. It can be analysed away in terms of temporal intervals alone.

By distinguishing between imaginary and non-imaginary instants, Ockham suggests that we cannot analyse away all talk of instants in terms of temporal intervals alone: intrinsic instants are not imaginary and thus some talk of instants is irreducible. Let us examine in what sense an intrinsic instant can be said to exist.

1.3 *The Metaphysics of Succession*

In his questions on the *Physics*, Ockham uses the distinction between permanent things, i.e., things whose parts exist simultaneously, and successive entities, i.e., entities whose parts exist only successively.²⁵ Standard examples of permanent things or states are a man and being white; standard examples of successive things or states are a motion and becoming whiter. The medieval distinction between permanent and successive is one of the core elements in the physical strand of the so-called hybrid approach to the limit decision problem.²⁶ For instance, in William of Sherwood's *Syncategoremata*, a permanent thing is defined as having all of its parts at one and the same time (*quorum partes sunt simul*), whereas a successive thing does not have all of its parts at one and the same time, but at different times.²⁷

Ockham introduces this distinction in the following way:

The difference between successive entities and permanent entities is the following: a successive [entity] never exists without having a part in the past and a part in the future, and when a part of the successive [entity] exists, the successive [entity] exists. A permanent [entity] is said to exist only when it has all of its parts existing at the same instant. And thus although a part of a permanent [entity] exists, the thing is nevertheless not said to exist; as a man is not said to exist when [only] his head exists.²⁸

25 According to Simo Knuuttila, the key distinction between *res permanentes* and *res successivae* was introduced into the debate through Averroes' commentary on *Physics* VI, texts 40-46: S. Knuuttila, "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. Asztalos (Stockholm, 1986), 245-266, at 256.

26 Kretzmann, "Incipit/desinit," 110.

27 See the edition in J.R. O'Donnell, "The *Syncategoremata* of William of Sherwood," *Mediaeval Studies* 3 (1941), 46-93, at 76.

28 Ockham, *Quaestiones in libros Physicorum*, q. 98 (ed. Brown, 660.46-52): "[...] haec est differentia inter successiva et permanentia quod successivum numquam est nisi quando aliqua pars eius praeteriit et aliqua est futura, et quando pars successivi est, ipsum

The distinction is the following. For a successive whole to be, it is sufficient that one of its parts be; for a permanent whole to be, it is necessary that all its parts be.

When dealing with the semantics of the aspectual verbs “incipit” and “desinit” in the *Summa logicae* II, chapter 19, Ockham affirms that the use of the distinction between permanent and successive has but a conventional meaning:

Now some writers assign exponents in different ways with respect to different kinds of things. Hence, they claim that such propositions should be expounded in one way with respect to successive entities and in another way with respect to enduring entities. But although this could be so insofar as the intentions of those who use these terms are concerned, still it does not seem very reasonable. Therefore, I claim that the propositions in question have the same exponents with respect to any kind of entity, but that the exponents of a proposition in which “begin” occurs are different from the exponents of a proposition in which “cease” occurs.²⁹

This idea is in conformity with Ockham’s well-known thesis according to which the very idea of a successive thing is contradictory, if by “successive thing” one means a temporal whole among whose parts one exists. Ockham’s thesis is warranted by a reductionist mereology, according to which a whole is nothing other than its parts, because for the whole to be it is necessary and sufficient that all of its parts be.³⁰ Since by definition a successive thing is such that some of its parts are not (namely, its past and future parts), it is impossible for a successive thing to be. Indeed, what is not cannot be a part.³¹

Does this distinction have the same meaning in the questions on the *Physics*? Clearly not, because in question 98 Ockham says that for a successive whole to

successivum est; permanens [autem] non dicitur esse nisi quando habet omnes partes simul existentes in eodem instanti. Et ideo quamvis una pars rei permanentis sit, tamen propter hoc non dicitur res esse; sicut homo non dicitur esse quando caput suum est.”

29 Guillelmus de Ockham, *Summa Logicae* II, c. 19 (ed. P. Boehner, G. Gál, and S.F. Brown, *Opera Philosophica* I, St Bonaventure, NY, 1974, 310.5-11), transl. A. Freddoso and H. Schuurman, in *Ockham’s Theory of Propositions: Part II of the Summa logicae* (Notre Dame, IN, 1980), 146.

30 Guillelmus de Ockham, *Expositio in libros Physicorum Aristotelis* IV, c. 18, §3 (ed. R. Wood, G. Gál, R. Green, and J. Giermek, *Opera Philosophica* V, St Bonaventure, NY, 1985, 199.122-126).

31 Ockham, *Expositio in libros Physicorum* III, c. 2, §6 (ed. V. Richter and G. Leibold, *Opera Philosophica* IV, St Bonaventure, NY, 1985, 431.10-16).

be it is sufficient that one of its parts be. It must be concluded that Ockham has weakened the conditions of existence for successive wholes in his treatment of the limit decision problem in the questions on the *Physics*.

We might think that Ockham has weakened his strong reductionist thesis according to which motion and time are not distinct from the thing in motion in order to deal with a problem he encountered when examining the limit decision problem. Let us see in the next two parts whether we can find a rationale for this distinction and what the consequences of Ockham's change of mind are.

2 A Complexification of Aristotle's Theory of Change

2.1 *Instantaneous and Successive Generations and Corruptions*

Ockham is led to further differentiation within the category of *permanens*. As regards permanent things, Ockham establishes a typology based on the nature of the change by which they come to be or pass away. Following Aristotle,³² Ockham distinguishes between motions that are continuous (i.e., all non-substantial changes in the categories of quality, quantity, and place) and changes that do not proceed gradually but take place all at once or instantaneously, called "generation" and "corruption." "Generation" means any acquisition by a subject of a thing that did not exist before. In this sense, there are not only substantial generations, as when matter is informed by a substantial form, but also accidental generations, as when a substance is informed by a whiteness.³³ Ockham therefore uses "generation" in a wider sense, for any production of a new thing in a subject, such that it is not from nothing.³⁴

Ockham goes one step further than Aristotle. He states that things produced by generation are distinguished from one another by the criterion whether their generation is instantaneous or successive. He claims that some permanent things are such that their generation is successive, i.e., one of the parts is produced before the other. The same distinction holds for corruption, which can be instantaneous or successive.³⁵ Ockham finishes question 101 by saying that the Aristotelian thesis according to which any permanent thing has a last extrinsic instant of existence is only partially valid. The Aristotelian thesis is

32 Aristotle, *Physics* v, ch. 1, 225a12-17.

33 Ockham, *Expositio in libros Physicorum* I, c. 15 (ed. Richter and Leibold, 150.10-18).

34 Guillelmus de Ockham, *Ordinatio (Scriptum in librum primum Sententiarum)*, d. 13, q. un. (ed. G. Etzkorn, *Opera Theologica* 111, St Bonaventure, NY, 1977, 417.17-23).

35 Ockham, *Quaestiones in libros Physicorum*, q. 100 (ed. Brown, 664.13-16).

limited to permanent things, such as a man and fire, which are generated instantaneously and not over time.³⁶ The modification of the Aristotelian solution is explicitly endorsed by Ockham.

Ockham gives a hint of what the distinction between instantaneous and successive generation means when he explains that a permanent thing generated successively has a first instant in a different sense than a permanent thing generated instantaneously, namely, in the sense that this composite thing exists at this instant and did not exist before this instant, although parts of it did. In this sense, Ockham thinks, it is possible to say that some generations or corruptions are continuous, namely, those that are successive. Indeed, roughly speaking, this corresponds to the idea that there will always be a part of a form that is acquired before any other part, until the parts are complete and form a "total form." However, the total form must be acquired all at once.

The difference between the passing into non-being of forms having a latitude of degrees and that of invariable forms is regarded by Ockham as the main ground on which the solution to the problem of the instant of change for permanent forms must be based. The idea that a form has a latitude of degrees, i.e., may vary in one sense or another, is in sharp contrast with the Aristotelian doctrine according to which forms are indivisible.³⁷ Where does this modification of the Aristotelian framework come from?

2.2 *The Origin of the Problem*

An issue raised by Aristotle and prominent in Ockham's time is the problem of the continuity of qualitative change. In his *Long Commentary on the Physics*, Averroes took Aristotle to actually deny the continuity of alteration.³⁸ Averroes's reading was very influential.³⁹ The medieval commentators had to determine whether qualitative changes are instantaneous or if some could also be continuous. The common view was that this kind of change is continuous

36 Ockham, *Quaestiones in libros Physicorum*, q. 101 (ed. Brown, 668.65-69).

37 Aristotle, *Metaphysics* VIII, ch. 3, 1043b32-1044a14.

38 Averroes, *De physico auditu libri octo cum Averrois cordubensis variis in eosdem commentariis* VI, comm. 49 (*Aristotelis opera cum Averrois commentariis*, vol. IV, Venice, 1562; reprint Frankfurt am Main, 1962, f. 278vK).

39 On this subject, see E. Sylla, "Averroes and Fourteenth-Century Theories of Alteration," in *Averroes's Natural Philosophy and Its Reception in the Latin West*, ed. P.J.J.M. Bakker (Leuven, 2015), 141-192. For more on Burley's position on the subject, see E. Sylla, "Walter Burley's *Physics Commentaries* and the Mathematics of Alteration," *Early Science and Medicine* 6 (2001), 149-184. For more on Gregory of Rimini's position, see C. Loewe, "Gregory of Rimini on the Intension and Remission of Corporeal Forms," *Recherches de Théologie et de Philosophie médiévales* 81 (2014), 273-330.

and not instantaneous. This raises a difficulty: Aristotle seems to hold that, in some sense, contraries are both present at some time in processes of intension and remission.⁴⁰ Aristotle's thesis finds support in two arguments put forward for the first time by John Duns Scotus. The first argument is that the remission of a quality cannot occur unless an agent introduces another quality incompatible with the quality to be remitted, which entails that contrary qualities will both be in the changing subject.⁴¹ The second argument is that when it is true to say that water gains heat, then it is also true to say that it loses coldness.⁴² In other words, the intension of a form and the remission of its contrary occur in tandem.⁴³

The starting point of Ockham's extension of the Aristotelian framework is to be found in his commentary on the *Physics*, when he has to explain Aristotle's idea according to which in the motion of alteration contrary propositions are true at the same time.⁴⁴ Ockham emphatically rejects this view.⁴⁵ He claims that alteration is the sum of two continuous motions, i.e., the remission of a quality and the intension of the contrary quality.⁴⁶ The last instant in which the thing is black is immediately followed by the first instant in which the thing is white.⁴⁷ There is no instant at which the thing can be said to be black and white. But, Ockham claims, this answer is not satisfying: in the standard

40 Aristotle, *Physics* VI, ch. 5, 236b17-18, On instantaneous alterations and their accidental continuity in Aristotle, see Sorabji, *Time, Creation and the Continuum*, 411.

41 Johannes Duns Scotus, *Ordinatio* II, d. 2, pars 2, q. 5 (ed. C. Koser, *Opera Omnia* VII, Vatican City, 1973, 330.2-6).

42 Scotus, *Ordinatio* II, d. 2, pars 2, q. 5 (ed. Koser, 330, 6-7).

43 Classic studies on the question of the intension and remission of forms are A. Maier, *Das Problem der intensive Grosse*, in eadem, *Zwei Grundprobleme der scholastischen Naturphilosophie* (Rome, 1951); E. Sylla, "Medieval Concepts of the Latitude of Forms: The Oxford Calculators," *Archives d'histoire littéraire et doctrinale du moyen âge* 40 (1973), 223-283; J.E. Murdoch and E. Sylla, "The Science of Motion," in *Science in the Middle Ages*, ed. D.C. Linberg (Chicago, 1978), 206-264; J.-L. Solère, "Plus ou moins: le vocabulaire de la latitude des formes," in *L'Elaboration du vocabulaire philosophique au Moyen Age*, ed. J. Hamesse and C. Steel (Turnhout, 2000), 437-488.

44 Ockham, *Expositio in libros Physicorum Aristotelis* VI, c. 6 (ed. G. Leibold, *Opera Philosophica* V, St Bonaventure, NY, 1985, 499.12-20).

45 Ockham, *Quaestiones in libros Physicorum*, q. 150 (ed. Brown, 806-808).

46 For Ockham's view on the intension and remission of forms, see M. Roques, "Quantification and Measurement of Qualities at the Beginning of the Fourteenth Century. The Case of William of Ockham," *Documenti e studi sulla tradizione filosofica medievale* 17 (2016), 347-380.

47 Ockham, *Expositio in libros Physicorum* V, c. 8 (ed. F. Kelley, *Opera Philosophica* V, 418.34-41).

opinion, only things produced instantaneously can have a first instant of existence, and in this change whiteness must be produced continuously, over time and not instantaneously.⁴⁸

Questions 98-101 on the *Physics* can be seen as an attempt to find a satisfying answer to this problem. In that sense, Ockham deals with the problem of the instant of change because of a difficulty encountered when dealing with a physical question. The motivation is neither logical nor semantic, but physical. In this sense, Ockham's questions 98-101 on the *Physics* are representative of the so-called "physical approach" to the limit decision problem.

2.3 *The Latitude of Forms*

When Ockham speaks of a "total form," he speaks of a form that has a latitude. Edith Sylla has shown that there were two main conceptions of latitudes in the fourteenth century.⁴⁹ On the one hand, there is Walter Burley's and Roger Swineshead's conception, which treats a latitude not so much as a physical reality, but rather as a "conceptual range determined by the various degrees of a species of quality that may be found in particular instances."⁵⁰ On this view, a latitude such as a range of degrees of heat does not really exist. What really exists are indivisible degrees. On the other hand, there are those Calculators like John Dumbleton and Richard Swineshead who have a realist conception of latitudes. On their view, latitudes are real because they are the same as the really existing maximum degrees, which contain all the lower degrees.⁵¹ Ockham does not provide an explicit account of how he understands latitudes. It is likely, however, that he adopts the realist conception; indeed, he says that "for the total being of the permanent thing, the being together of all the parts is required."⁵² The latitude of a form is identified with the maximum degree of the form, which is itself the sum of all the degrees and at the same time an individual form.

Ockham's modification of the Aristotelian framework is neither unique nor original. It is typically Walter Burley who is credited with being the first to recognize and systematically discuss the assignment of a limit to changes in forms

48 Ockham, *Expositio in libros Physicorum* VI, c. 6 (ed. Leibold, 501.75-85).

49 Sylla, "Medieval Concepts of the Latitude of Forms," 234.

50 Gualterus Burlaeus, *Tractatus de primo et ultimo instanti* (ed. H. and C. Shapiro, in "De primo et ultimo instanti des Walter Burley," *Archiv für Geschichte der Philosophie* 47 [1965], 157-173, at 171.18-23).

51 Sylla, "Medieval Concepts of the Latitude of Forms," 252.

52 Ockham, *Quaestiones in libros Physicorum*, q. 100 (ed. Brown, 665.68-70).

having a latitude.⁵³ Burley's discussion of these matters occurs in his treatise *De primo et ultimo instanti*, from a quodlibetal question held in Toulouse in the 1310s.⁵⁴ In this treatise, Burley offers the standard distinction between *res permanens* and *res successiva* and then proceeds to introduce a number of subdivisions into the category of permanent forms.⁵⁵ Among the various kinds of permanent forms he discusses are instantaneously existing permanent forms as well as permanent forms that do not have a first instant of existence. What Burley's discussion makes clear, therefore, is that by the early fourteenth century the standard thirteenth-century distinction between permanent and successive, found, for example, in Peter of Spain, had become both subtler and more elaborate.⁵⁶

Cecilia Trifogli has shown that Thomas Wylton, a former fellow of Merton College, is to be regarded as the main source for Burley's treatise.⁵⁷ Wylton's commentary on the *Physics* was probably written when he was *magister artium* in Oxford, i.e., before 1304-05, when he left England for Paris, eventually becoming Master of Theology. Burley criticized Wylton on physical issues at Paris in the 1310s in his *principia* (from which derives the *Tractatus primus*), and there is no doubt that he knew Wylton's question on the instant of change, entitled *An contingit dare ultimum rei permanentis in esse*, since there are several passages that occur, almost in identical form, both in Wylton's question and in

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- 53 On this subject, see L. Nielsen, "Thomas Bradwardine's Treatise on 'incipit' and 'desinit': Edition and Introduction," *Cahiers de l'Institut du Moyen Age grec et latin* 42 (1982), 1-83, at 29; Kretzmann, "Incipit/Desinit," 110, n. 33; N. Strobach, *The Moment of Change: A Systematic History in the Philosophy of Space and Time* (Dordrecht, 1998), 95.
- 54 See A. de Libera, "La problématique de l'instant du changement au XIII^e siècle: contribution à l'histoire des *sophismata physica*," in *Studies in Medieval Natural Philosophy*, ed. S. Caroti (Florence, 1989), 43-93, at 67, for the place of Burley's treatise in the history of the problem of the instant of change. For an extensive study of Burley's treatise, see P. Feltrin and M. Parodi, "Il problema del primo e ultimo instante in Walter Burley," *Medioevo* 9 (1983), 137-178.
- 55 Burlaeus, *De primo et ultimo instanti* (ed. H. and C. Shapiro, 164-166).
- 56 John of Holland and Thomas Bradwardine are other examples of this fourteenth-century trend. See C. Wilson, *William Heytesbury. Medieval Logic and the Rise of Mathematical Physics* (Madison, 1960), 32-38; Strobach, *The Moment of Change*, 95-97; Nielsen, "Thomas Bradwardine's Treatise," 22-30.
- 57 C. Trifogli, "Thomas Wylton's Question 'An contingit dare ultimum rei permanentis in esse,'" *Medieval Philosophy and Theology* 4 (1994), 91-141, at 108. For Wylton's biography and works, see L.O. Nielsen and C. Trifogli's introduction to their edition of Thomas Wylton, *On the Intellectual Soul* (Oxford, 2010), vii-xii.

Burley's treatise on the instant of change.⁵⁸ According to Trifogli, Wylton is not satisfied with Aristotle's solution to the problem of the instant of change for permanent things.⁵⁹ The bulk of his question is devoted to introducing subdivisions within the category of permanent things. The difference between the passing into non-being of forms having a latitude of degrees and that of invariable forms is regarded by Wylton as the main ground on which the solution of the problem of the instant of change for positive permanent forms must be based. Like Ockham after him, Wylton explains that the Aristotelian thesis according to which a permanent thing has a last extrinsic instant is only partially valid. Aristotle did not take into account the fact that some corruptions are not instantaneous but successive.⁶⁰

By the application to qualities of the notion of 'latitude', which was previously related only to extensive properties, there is an assimilation of the as-yet unmeasured intensive qualities to the paradigmatically measurable extensive qualities. The aim is the consideration of abstract problems of measurement in terms of arbitrarily assigned degrees ranging over intensive and extensive qualities alike. Ockham adopts Aristotle's intention to match the temporal continuum to the linear continuum and extends it to the qualitative continuum postulated by the theory of the latitude of forms.⁶¹ In this sense, Ockham's questions 98-101 on the *Physics* are a testimony, along with Burley's and Wylton's treatments of the same questions, of the "new physics" of the fourteenth century, which is based on the idea of measurement and calculation.

3 Ockham's Solution to the Limit Decision Problem

3.1 *The Standard Cases*

By the late thirteenth and early fourteenth centuries there are certain well-established rules for assigning temporal limits. Ockham's position on the standard cases is not original at all.

58 On this subject, see E.D. Sylla, "The Academic Context of Walter Burley's *Tractatus Primus*," *Schede Medievals* 51 (2013), 83-91. See also L.M. de Rijk, "Burley's so-called *Tractatus Primus*, with an Edition of the Additional *Quaestio* 'Utrum contradictio sit maxima oppositio,'" *Vivarium* 34 (1996), 161-191.

59 Trifogli, "Thomas Wylton's Question," 95.

60 Thomas Wylton, *Quaestiones libri Physicorum* VIII, q. 6 (ed. Trifogli, "Thomas Wylton's Question," 114, [2.1] and [2.2], 9-23).

61 On this subject, see N. Kretzmann, "Socrates is Whiter Than Plato Begins to be White," *Nous* 11 (1977), 7-15, at 5.

3.1.1 Successive properties

Successive things are almost always taken as being limited extrinsically and thus are assigned neither first nor last instants of being.⁶² This standard analysis finds its origin in Aristotle's thesis that it is impossible to maintain that motion begins to be, since everything that moves must have been in motion previously.⁶³ Ockham follows the common view.⁶⁴ He defends two theses:

- S1: A *successivum* that has an initial temporal limit has a first extrinsic instant.⁶⁵
- S2: A *successivum* that has a final temporal limit has a last extrinsic instant.⁶⁶

Ockham's argument is a simple *reductio ad absurdum*. If a *successivum* had a first intrinsic limit of its existence, it would have existed at that time. By definition, it must have at that time a temporal part that existed before and does not exist anymore. Consequently, the first intrinsic instant of the existence of the *successivum* is not its first instant, and this is contradictory.⁶⁷ Consequently, it has a first extrinsic instant. The same line of reasoning applies to the last instant of the *successivum*. Suppose that the *successivum* has a last intrinsic instant. At this instant, it has a temporal part that is future. Consequently, the *successivum* will exist after it has ceased to exist, which is absurd. This implies that a *successivum* has a last extrinsic instant.⁶⁸ In other words, the nature of the temporal limits of successive entities is derived from the definition of *successivum*.

Thus, for Ockham successive properties are extrinsically limited at both ends. This means that no continuous process can be immediately preceded or followed by any other process. Indeed, the instant of change between them would belong to neither of the times in which they are. Ockham is not able to assign a limit to two successive things, as when a slower motion is followed by a faster motion. This analysis confirms what has been called by Norman

62 For a discussion of the Aristotelian basis for these assignments, see Kretzmann, "Incipit/Desinit," 110-114; Nielsen, "Thomas Bradwardine's Treatise," 6-22; Strobach, *The Moment of Change*, 92-97.

63 Aristotle, *Physics* VI, ch. 6, 236b34.

64 Aristotle, *Physics* VI, ch. 5, 236a7-18.

65 Ockham, *Quaestiones in libros Physicorum*, q. 68 (ed. Brown, 661.63-72).

66 Ockham, *Quaestiones in libros Physicorum*, q. 99 (ed. Brown, 663.47-48).

67 Ockham, *Quaestiones in libros Physicorum*, q. 98 (ed. Brown, 660-661.52-62).

68 Ockham, *Quaestiones in libros Physicorum*, q. 99 (ed. Brown, 662-663.40-46).

Kretzmann the problem of the neutral instant: medieval views cannot handle one successive entity following another, if each is supposed to have no intrinsic limit.⁶⁹

Ockham follows neither Wylton's nor Burley's attempt to solve the neutral instant problem by introducing new properties, such as privations of successive entities, and assigning first and last instants to them.⁷⁰ Paul Spade finds Burley's solution to be *ad hoc*. He thinks that it could have been avoided simply if Burley had not distinguished between permanent and successive entities. He wonders why Burley made this distinction.⁷¹ Ockham's solution for permanent entities that are generated and/or corrupted successively may be an answer to this question. But let us first look at the other standard case, namely the case of permanent entities produced or corrupted instantaneously.

3.1.2 Permanent Entities Produced or Corrupted Instantaneously

In the case of permanent entities produced or corrupted instantaneously, Ockham defends two theses:

- P1: A permanent thing produced instantaneously has a first intrinsic instant.⁷²
- P2: A permanent thing corrupted instantaneously has a last extrinsic instant.⁷³

These are traditional answers. In *Physics* VIII, c. 8, Aristotle assigns the instant of transition to the posterior interval as its intrinsic limit.⁷⁴ Medieval philosophers generally follow Aristotle's assignment; thus, they typically hold that in the case of generation and corruption there is a first instant of "being" but no last instant of "non-being."⁷⁵ Opinions differ, however, on the last instants of permanent properties that are produced instantaneously.⁷⁶ In his *De primo et*

69 Kretzmann, "Incipit-Desinit," 114-116. See also Nielsen, "Thomas Bradwardine's Treatise," 14-15 n. 5 and 19-20.

70 For Burley's solution, see Spade, "How to Start and Stop," 204.

71 Spade, "How to Start and Stop," 204-205.

72 Ockham, *Quaestiones in libros Physicorum*, q. 100 (ed. Brown, 664.27-29).

73 Ockham, *Quaestiones in libros Physicorum*, q. 101 (ed. Brown, 666-667.11-13). A literal translation would be: "Every permanent thing corrupted suddenly, such that the corruption is measured by a determinate instant, has an extrinsic limit to its being."

74 Aristotle, *Physics* VIII, ch. 8, 263b15-26.

75 Kretzmann, "Incipit/Desinit," 108-114.

76 Nielsen notes that William of Sherwood, for example, claims that it is commonly held that permanent forms have last as well as first instants of being and then goes on to argue

ultimo instanti, for example, Burley presents and refutes an opinion that accepts last instants of *res permanentes*.⁷⁷ The motivation for these decisions is not quite clear.⁷⁸

Ockham explains that the generation by which the thing is produced and the existence of the thing that previously did not exist are simultaneous if the generation is instantaneous.⁷⁹ The same explanation is given for the instantaneous corruption of a thing.⁸⁰ The explanation is quite rough. In another question on the *Physics*, however, when criticizing Burley's *Tractatus primus*, Ockham gives a physical reason why it is so. The explanation is based on efficient causation. Every form that exists requires a cause of its being at each instant of its existence, and when a permanent thing ceases to be, the efficient cause of its being stops exercising its power. In other words, there is no efficient cause of corruption other than the ceasing of the exercise of the efficient cause of the existence of the form. There is therefore a last instant when the cause exercised its power. Is this instant extrinsic or intrinsic to the period of time in which the thing is? It is intrinsic, because at this time the thing is. Consequently, the first instant of the non-being of the thing, which is the instant in which it is corrupted, is extrinsic.⁸¹ Ockham thus says that, if we accept that there is no cause why something is not after having been, then we must accept that the last instant in which a thing is is extrinsic.

Let us go further. A permanent property corrupted instantaneously has no last intrinsic instant of being. Consequently, it cannot be followed by a successive property, but only by a permanent property. There are, therefore, some continuous changes that this analysis cannot account for, namely, the change by which a permanent thing is produced little by little continuously, in such a

against this position. See "Thomas Bradwardine's Treatise," 10-15. See also Strobach, *The Moment of Change*, 93; A. Tabarroni, "'Incipit' and 'Desinit' in the Thirteenth-Century *Sophismata* Collection," *Cahiers de l'Institut du Moyen Age grec et latin* 59 (1989), 61-111, at 75-78.

77 Burlaeus, *De primo et ultimo instanti* (ed. H. and C. Shapiro, 163 [objection] and 173 [reply]). Burley denies last instants of *res permanentes* in his *De puritate artis logicae*, *Tractatus longior* (ed. P. Boehner, St Bonaventure, NY, 1955, 62.8-11).

78 Kretzmann, "Incipit/desinit," 112-114, gives an epistemological motivation for not allowing last instants of any state whatsoever: a putative last instant *t* cannot be identified as a last instant at *t* already, as one can only say after *t* that *t* was in fact the last instant of the state in question. Nielsen, "Thomas Bradwardine's Treatise," 22, gives a metaphysical motivation based on the nature of substantial change.

79 Ockham, *Quaestiones in libros Physicorum*, q. 100 (ed. Brown, 664.30-34).

80 Ockham, *Quaestiones in libros Physicorum*, q. 101 (ed. Brown, 667.13-16).

81 Ockham, *Quaestiones in libros Physicorum*, q. 144 (ed. Brown, 792.121-126).

way that it has a first instant of its complete being. The theory must be implemented with other possibilities concerning forms having a latitude to have a real descriptive value.

3.2 *The Innovative Part of Ockham's Solution*

3.2.1 A New Case of Instantaneous Generation or Corruption

Before exploring these possibilities, a difficulty must be solved. Burley's account of the production of the form of the mix from the elementary qualities in his *Tractatus primus* lurks in the background to Ockham's account.⁸² Burley claims that the elementary qualities are the cause of the being of the form of the mix. Burley's position implies the metaphysical thesis that an accident can be the cause of a substance. Ockham is definitively opposed to such an un-Aristotelian idea and tries to prove that this idea is contradictory. For Ockham, Burley's position implies that the elementary qualities cause the being of the form of the mix at an instant at which they no longer exist. According to Ockham, this is incompatible with any sane view of efficient causation.⁸³

So, if Ockham is right, the agent that is responsible for the corruption of a quality is also responsible for the production of the form of the mix.⁸⁴ Ockham grants the consequence.⁸⁵ But now he has to account for the problem of the instant of change for the form of the mix. This is why he defends the following two theses:

- P3: A permanent thing produced in an undetermined instant has a first extrinsic instant.⁸⁶
- P4: A permanent thing corrupted in an undetermined instant has a last intrinsic instant.⁸⁷

82 For the generation of the composite from the elements, see A. Maier, "Die Struktur der materiellen Substanz," in eadem, *An der Grenze von Scholastik und Naturwissenschaft* (Rome, 1952), 1-140. For Ockham's criticism of Burley's *Tractatus primus* in the *Questions on the Physics*, see E. Sylla, "Walter Burley's *Tractatus Primus*: Evidence Concerning the Relations of Disputations and Written Works," *Franciscan Studies* 44 (1984), 257-294.

83 Ockham, *Quaestiones in libros Physicorum*, q. 144 (ed. Brown, 793.143-146). See also E. Sylla's paper in this volume.

84 Ockham, *Quaestiones in libros Physicorum*, q. 144 (ed. Brown, 792.131-135).

85 Ockham, *Quaestiones in libros Physicorum*, q. 144 (ed. Brown, 793.137-143).

86 Ockham, *Quaestiones in libros Physicorum*, q. 100 (ed. Brown, 665.51-53). A literal translation would be: "If there were such a permanent thing whose sudden generation is not in some determined instant, it would have a first extrinsic of its being."

87 Ockham, *Quaestiones in libros Physicorum*, q. 100 (ed. Brown, 667.21-23).

Let us begin with Ockham's argument in favour of P3. In the normal case any substantial form inserted in matter instantaneously requires an efficient cause at the instant in which it comes to be.⁸⁸ But the generation of the form of the mix is not standard, because there is no new cause of its being after the ceasing of the exercise of the cause of being of what precedes its existence, namely the elementary qualities. Consequently, Ockham says, the first instant of the being of the form of the mix is not determined. Since it is not determined, it is extrinsic. If it were intrinsic, it could be placed without doubt in a temporal continuous series, which is not the case.⁸⁹ This explanation is not really satisfactory, but the reasoning advanced in favor of P4 is clearer.

Regarding P4, Ockham defends the idea that, if a permanent thing that is instantaneously corrupted had one last extrinsic instant, then a certain temporal interval (the interval within which the thing is not) would at the same time be and not be. But this is absurd. The reason is the following. Let us suppose that this permanent thing is instantaneously corrupted without there being a first instant at which it is true to say that this thing is corrupted; let us further suppose that this thing exists only for an instant. If that is the case, then this permanent thing has one first intrinsic instant. Since it is instantaneously corrupted and it exists for only an instant, then after its first intrinsic instant it exists no more. The instant before its corruption it was true to say that the thing is. At this instant it is true to say that the thing is not. But this would amount to saying that the thing has a last extrinsic instant. Since it does not have a last extrinsic instant of its being, it necessarily has a last intrinsic instant of its being.⁹⁰

This is not the end of the story. Ockham has to account for the instant of change of forms becoming more or less intense.

3.2.2 Permanent Entities Having a Latitude

As regards permanent entities having a latitude, Ockham defends the following theses:

- P5: A permanent thing produced successively has a first intrinsic instant of its total being.⁹¹
- P6: A permanent thing corrupted successively has a last intrinsic instant of its total being.⁹²

88 Ockham, *Quaestiones in libros Physicorum*, q. 144 (ed. Brown, 789.13-16).

89 Ockham, *Quaestiones in libros Physicorum*, q. 100 (ed. Brown, 665.46-49).

90 Ockham, *Quaestiones in libros Physicorum*, q. 100 (ed. Brown, 667.23-31).

91 Ockham, *Quaestiones in libros Physicorum*, q. 100 (ed. Brown, 665.59-62).

92 Ockham, *Quaestiones in libros Physicorum*, q. 101 (ed. Brown, 667.36-37).

Ockham's argument in favour of P₅ is rather compressed. Suppose that a thing A is generated successively. We want to determine the nature of the instant D that is the instant of change between the time that precedes A's total being, called B, and the time in which A exists, called C. If A did not have its total being at D, a part would be missing. Consequently A would not exist in C. But in this hypothesis D is the first extrinsic instant of A's being. Since this hypothesis is impossible, D is the first intrinsic instant of A's being.⁹³ The argument is confirmed, because D, as the instant of change, is also the last instant of the successive motion that precedes A's total being, and consequently it is the last extrinsic instant of this successive motion. This implies that D is the first intrinsic instant of A's being.⁹⁴

Ockham's argument in favour of P₆ is the following. Let us call D the first instant of the non-being of A. At this instant D, no part of A is corrupted, because if this were the case, there would be an instant prior to D at which a part of A would be corrupted, and so on *ad infinitum*, since by hypothesis the parts of A are corrupted successively. Consequently the instant D of transition is the last intrinsic instant of A's total being.⁹⁵ The argument is confirmed, because the successive corruption of the parts of A has by definition extrinsic limits. Since the first instant of the successive corruption of the parts of A is also the last instant of A's total being, this implies that D, the last instant of A's total being, is intrinsic.⁹⁶ The justification Burley advanced in favour of the same thesis shows that Ockham's choice depends on the way he conceives of the latitude of the form.⁹⁷ Because the latitude of the form is nothing other than the individual form at the minimum or maximum degree, the last instant of the being of the form must be intrinsic.⁹⁸

In sum, Ockham's account of the continuity of intension and remission is thoroughly divisibilist. Ockham's account points to the fact that he denies that *minima*, i.e., the smallest possible degrees of a form, exist. Indeed, if *minima* existed, they could not be acquired continuously over the course of a period of time, but only in an instant. On his view, we need not alter the Aristotelian understanding of the continuum as applied to quantitative and local change to account for the continuity of the intension and remission of forms. The exact same story that we can tell about the continuity of quantity and local change

93 Ockham, *Quaestiones in libros Physicorum*, q. 101 (ed. Brown, 665.62-75).

94 Ockham, *Quaestiones in libros Physicorum*, q. 101 (ed. Brown, 665-666.76-82).

95 Ockham, *Quaestiones in libros Physicorum*, q. 101 (ed. Brown, 667-668.40-51).

96 Ockham, *Quaestiones in libros Physicorum*, q. 101 (ed. Brown, 668.52-58).

97 Burlaeus, *Tractatus de primo et ultimo instanti* (ed. H. and C. Shapiro, 171.35-41).

98 Burlaeus, *Tractatus de primo et ultimo instanti* (ed. H. and C. Shapiro, 171.21-27).

can be told about qualities. Aristotle's note that alterations are divisible only *per accidens* is abandoned in favour of a unified story of the continuity of qualitative, quantitative, and local change.

3.3 *Evaluation of Ockham's Position for the Logic of Time*

In his study of Ockham's logic of time and modality, Calvin Normore suggested that "the fundamental metaphysical premise of Ockham's and Buridan's divisibilism is the view that every element in a continuum is infinitely divisible into divisible parts, and in particular all of the parts of time have duration. One consequence of this is that if propositions are true (or false) at, or relative to, bits of time, their truth-value must be determined relative to temporal intervals."⁹⁹ Ockham's and Buridan's logic of time is opposed to Burley's, who accepts the existence of instants at which propositions are true or false. In Normore's view, Burley's logic of time seems to depend in some way on the distinction Burley draws between two kinds of being, i.e., permanent and successive beings, even if Normore does not explain in detail why and how this is so.¹⁰⁰

We saw that in his treatment of the limit decision problem Ockham admits of the irreducibility of some changes, the so-called successive changes, to enduring objects such as Socrates or any other thing in motion. Does this metaphysical assumption have a consequence for his logic of time and tense? I am not sure that it does. We saw that such changes are always extrinsically limited. That means, in a sense, that these processes, which are diminished beings since they are not things really distinct from the things that undergo them, are not really "true changes." Indeed, Ockham explains that the cause of the truth-value of a proposition is ultimately derived from the existence of an efficient cause that produces and conserves something in being. Let us grant that successive changes, i.e., processes, are caused by an efficient cause. When the efficient cause is not exercising its power anymore, the proposition stating that "a motion exists" is not true anymore. The starting point and the end point of these processes, however, are limited by something other than themselves, namely an enduring object beginning or ceasing to be something or to exist. These assignments are made by default, in order to account for what really changes in the world, i.e., permanent things (which may cause a continuous process to be, for example). This may explain why Ockham says that extrinsic limits are fictions of the mind. The kind of being to be granted

99 C. Normore, *The Logic of Time and Modality in the Late Middle Ages: The Contribution of William of Ockham* (PhD dissertation, University of Toronto, 1976), 279.

100 Normore, "The Logic of Time," 279.

to processes does not seem, in any case, to affect the principles on which Ockham's logic of time is based.

Nevertheless, Normore's hypothesis cannot be accepted without a slight modification. Indeed, Ockham accepts that some parts of time have no duration, namely the first and last intrinsic instants of instantaneous or successive changes of enduring objects. Of course, this does not mean that these instants are not dependent on the time interval they belong to. But the interval temporal logic that Normore speaks about is based on the idea that there is no fundamental asymmetry in time between past, present, and future: the present has a duration, as do the future and the past.¹⁰¹ This does not fit with what we saw, namely that some instants matter in the assignment of a truth-value. So either we accept that Ockham temporarily borrows a Burlean tense logic to solve certain physical problems related to the continuity of the motion of alteration, or we change the general picture we have of Ockham's tense logic.

Conclusion

I shall conclude by situating Ockham's reflection within the medieval discussions of the problem of the instant of change. Scholars distinguish two main strands in the medieval treatment of the limit decision problem: the physical strand and the logical strand.¹⁰² In the physical strand, 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.¹⁰³ In the logical strand, the objects of the analysis are propositions containing the terms "incipit" and "desinit," and they are analysed with logical

¹⁰¹ Normore, "The Logic of Time," 281: "A second reason for rejecting the instantaneous present is that it introduces an asymmetry into the theory of tense. We speak of time as divided into past, present and future. There can be no doubt that the past and future have duration. Why should we doubt that the present does? Buridan himself closely models his discussion of the present tense upon his intuition about the past and future."

¹⁰² See especially Wilson, *William Heytesbury*, 31-56; Kretzmann, "Incipit-Desinit," 103-121; J. Murdoch, "Propositional Analysis in Fourteenth-Century Natural Philosophy: A Case Study," *Synthese* 40 (1979), 118-138; Knuuttila, "Remarks on the Background of the Fourteenth Century Limit Decision Controversies," 251-258.

¹⁰³ Kretzmann, "Incipit-desinit," 103, describes the physical problem as follows: "Its basic ingredients are the theory of time as a continuum, the notion of indivisible instants, the doctrine of the instantaneous acquisition of the changed state, intrinsic or extrinsic temporal limits (first and last instants), and different analyses of change associated with different subjects of change."

tools.¹⁰⁴ The physical approach is clearly dominant in Ockham's questions on the *Physics*. The distinctions he draws in the category of permanent entities and the arguments he uses for establishing the main points of his solution all have a physical meaning. We also saw that Ockham's treatment of the limit decision problem was good evidence of the attempts made at the beginning of the fourteenth century to complement Aristotle's account, which was deemed insufficient. Like Wylton and Burley, Ockham examines the assignment of limits to the intension and remission of forms and to the change by which a substantial form is generated from elementary qualities.

104 Or metalinguistically, to use Murdoch's expression; see, for instance, Murdoch, "Propositional Analysis," 122.

Retracted