

Ockham's *Philosophia naturalis* and *Quaestiones in libros physicorum* in the Light of Prior's Tense Logic

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William of Ockham, for the first time, deals with the time problem in the *Philosophia Naturalis sive Summulae in libros Physicorum*.¹ This book, where time is related to motion, begins with an analysis of Aristotle.²

Firstly, it should be explained that motion is different from each permanent reality and it is strictly related to everything moving, to the experience³. So it is for time. Motion should be considered as something related to what has with beginning and an end. It is the act of moving because it is moving⁴ itself.

The measurement of time.

Time and motion, however, must not be identified with each other. The medieval writer specifies that they are not synonymous.

Time is contemporaneously everywhere and near everybody and it is always the same. Motion is only where it takes place and is not everywhere the same. It can be fast and slow. On the contrary, time is something that defines fastness and slowness.⁵

¹ William of Ockham, *Philosophia Naturalis sive Summulae in libros Physicorum*, London, The Gregg Press, 1963.

² Aristotle, *Phisica*, It. tr. *Fisica*, by M. Zanatta, Utet, Torino, 2000.

³ William of Ockham, *Philosophia Naturalis sive Summulae in libros Physicorum*, cit. part III, chapter V, pg. 53, “*motus non est aliqua res secundum se totam distincta à rebus permanentibus*”.

⁴ It also see in Aristotle, *Fisica*, cit. book VIII, pg. 343, verso 251a – 10, “*il movimento [...] in quanto mobile*”.

⁵ *Ibidem*, pg. 245-6, in which it says that time, as number, can not define fast or slow but only more or less, verso 220b – 13 “*‘il tempo [...] e poco*”.

Motion is slow when it happens in a long time and it is fast only if it happens in a short time⁶. Moreover, the passing of time is always the same. Time does not move but there is something that moves in it⁷.

According to Aristotle's definition, time is a measurement⁸. Ockham wants to emphasize what is measurement.

Time measures motion, quiet and itself, i.e. the temporal things because it determines their length.⁹ A thing is said temporal when it exists in time.¹⁰ Therefore, it must have a beginning and an end, it must be subject to generation and corruption. On the contrary, anything undergoes a sudden change does not coexist with time. This is true for everlasting things too that are not in time so they are not measurable by means of it. Eternity and time are different. Time cannot measure eternity because nothing changes in it. It has not a beginning and an end. Time measures only the things that have a length.

As far as the quiet is concerned time measures how a thing is motionless, namely it compares the length of quiet with a lot of things. It establishes what is motionless for more or for less time or if they are motionless in the same way. In fact, the English philosopher contests the authors according to whom time is an unknowable thing because through the application of a known quantity it is possible to understand the unknown.¹¹ He makes an example with the ulna and the cloth. The ulna is the least bone of

⁶ William of Ockham, *Philosophia Naturalis sive Summulae in libros Physicorum*, part IV, chapter IX, pg. 92, “*Velox est qui in parvo tempore multum movetur*” and “*Tardus qui in multo tempore pertransit parum*”. In the above definitions, you note the great intuition that fatsness is equal to space divided by time, namely $v = s / t$.

⁷ *Ibidem*, pg. 90.

⁸ Aristotle, *Fisica*, book IV, pg. 243, verso 219b – 5 “Il tempo [...] numero”.

⁹ *Ibidem*, pg. 248, verso 221b – 7-8, “Poiché il tempo è misura [...] è nel tempo”.

¹⁰ Aristotle, *Fisica*, book IV, pg. 249, in which it says that the being in time corresponds to be measured in time, verso 221b – 23-25, “Che l'essere nel tempo [...] della quiete”.

¹¹ William of Ockham, *Philosophia Naturalis sive Summulae in libros Physicorum*, part III, chapter VII, pg. 87.

the forearm, used as a measure unit in that time. If we don't know its exact measure, we can explain the application of the well known measure of the cloth to calculate it.¹²

Perception

The concept of measure, in Ockham's view, is related to the theme of perception. He is persuaded that our time perception allows us to perceive motion at the same time.¹³ We perceive motion by measuring its length through time. The perception of these realities occurs at the same time because they take place simultaneously.

Motion occurs across time. A person that does not perceive all the things that take place before and after does not perceive time, like the sleepers. Aristotle gives an example. He explains that time is connected to the change.¹⁴ In fact, when we don't sense the change, we don't perceive the passing of time. He tells about a legend: sleepers, next to heroes in Sardinia, contemplate their deeds in an eternal present.¹⁵ They connect the instants to each other, removing the perception of the means. As if they live in the eternity. i.e. in time as a totality without a scansion.

Time and soul

In the following *Quaestion in libros physicorum*, Ockham says setting himself against Aristotle and Averroes, that time is an *ens*.¹⁶ This is true because motion is an *ens*. There is something that is moving and therefore it exists. Motion is itself the mobile, that is, it is something that exists and occurs in the time. Therefore time moves and exists too. So we can assert that it is an *ens*.

¹² *Ibidem*, part III, chapter III, pg. 88, “*sicut per applicatione vlnae, cuius quatitas nota est semel, vel pluries ad pannu applicatur, et tunc notificatur de quatitate panni*”.

¹³ *Ibidem*, part IV, chapter XI, pg. 94, “*Quicumque percepit tempus, percepit motum*”.

¹⁴ Aristotle, *Fisica*, book IV, pg. 241, verso 218b – 20, “*«il tempo» [...] mutamento*”.

¹⁵ *Ibidem*, verso 218b 23-27, “*come neppure a coloro [...] nel mezzo*”.

¹⁶ William of Ockham, *Quaestiones in libros Physicorum*, partial edition edited by F. Corvino, in “*Rivista Critica di storia della filosofia*”, (1956), pg. 46-47.

The author specifies that time is not the motion but its form or anything else it can measure it. Time, Aristotle explains, involves the same things of motion¹⁷. These presuppositions concern greatness, experience and continuity.

The medieval author adds that time is the action of the soul to measure.¹⁸ The soul, indeed, through it, measures the before and after in the motion, i.e. the past and future. Therefore the measure, operated by time, aims to comprehend the soul. The act of measuring certifies the existence of time, makes it true and distinguishes it from motion.

In this book, there is another evidence of the difference between time and motion.

It concerns our time perception. This deceives us that time passes once quickly and another time slowly. But time is neither slow nor fast. We deceive ourselves because of the way in which we spend it. Actually, time changes because of our perception.

Continuous time, discrete time

In the later chapter, the text analyses one of the most important concepts in Ockham's time theory. He says that time has two realities¹⁹. An internal reality, related to the soul, and an external one, which is outside the soul and is not different from everything which is motion. However, these two realities don't exclude each other. In order to show it, the text evokes a thesis by Averroes thesis, that considers time as external to mind and whose action is in the soul. Therefore, it is in the soul when it must make quantification.

There is a possible reality, outside the soul, and an actual one, in the soul. Time has a material part, that it is in the motion, and a formal one, that it is in the soul. But time exists if and only

¹⁷ Aristotle, *Fisica*, cit., pg. 242-3.

¹⁸ William of Ockham, *Quaestiones in libros Physicorum*, cit., pg. 65, "tempus est anima et actum animae per quem numerat prius et posterius in motu".

¹⁹ *Ibidem*, 1957, pg. 47, "esse temporis extra mentem est in potentia propter subiectum proprium; et esse eius in anima est actu, scilicet quando anima egerit illam actionem in subiecto praeparato ad recipiendum illam actionem quae dicitur numerus".

if the soul exists. At this point, it is stated that time existence depends on motion and soul. So it has a double composition.

After that it deals with the question if time is continuous or discrete, Aristotle, in the *Physica*, excludes the second option in favour of the first one²⁰.

Ockham, on the contrary, does not prefer one or another one but he tries to unify them. Before all, he raises some doubts about the continuity of time. It is known that time is formed by parts such as moments and instants. Every one is different from the others and thus it is separated from them. But time is continuous because motion is continuous. In fact, the change in motion occurs in one perpetual way, it affects one existent thing in a given moment. Motion and time are in this way everlasting and unique. Motion is continuous and so is time which is its measure. In Aristotle's view, time is continuous through the present time. It represents the present moment that unites the past and the future because it is composed by the end of the past and the beginning of the future. It becomes an intermediary. The Greek philosopher argues that time is continuous through motion and thanks to the instant²¹. Similarly, the point makes the length continuous. There is not the dimension of the discrete.

Instant

Time is discrete because it is composed by a number of instants that represent a discrete infinity. To solve this problem, Ockham evokes Averroes. He says that time in some way is continuous and in some other way is discrete. As if it had two sides of the same coin. There are two names. One is continuity, that evokes motion, and the other one is the number.

²⁰ Aristotle, *Fisica*, It. tr. *cit.*, book IV, pg. 242 e book VI, pg. 284. In first part, Aristotle speaks about motion as greatness. In fact, everything moving, it moves toward something. Every greatness is continuous and so motion. If motion is continuous, time is also it. In second part, he shows continuity of time through concepts of fastness and slowness. These are verified by time and run made. Because of run of greatness is divisible, time is also it.

²¹ *Ibidem*, book IV, pg. 245.

Another question to be treated is related to the instant, that is complex. In the *Philosophia Naturalis*, it is said that instant is not time and it does not define the being because it is a change. Instant is the first motor that exists somewhere. The First motor must be intended as if it were in a definite place, in which it was not immediately found before and it will not be immediately found after.²² Two nows, *Nunc*, cannot exist contemporaneously. Otherwise, a *now* perishes and another *now* will immediately follow. Or else, the things would die or be corrupted in this now and in another. Moreover a now is not immediate in another but it lasts for a certain time without defining its being. The first motor, since it exists in a definite place, defines its being here. There is not a same everlasting *always*, i.e. the first motor does not always remain in the same place. Ockham considers time as a *continuum* and he does not believe in coexistence. Aristotle understands the present as one, different from another present and the first motor is right what moves. A thing is the present and another one is subsequent because the first motor exists and it is before in a place and after in another one. The first motor makes the time pass and leads the things from the present to the past without changing the thing itself. Therefore, an instant always remains the same and because of the first motor it changes place. Finally, given that the time is divisible, there are more instants in it²³. In addition an instant is not defined as time or a part of it but it is in the time.

The Franciscan logician, in the *Quaestiones*, says more than once that the instant is not time or its part. Instant is rather a time limit²⁴ and thus a lot of instants exist²⁵. The instant must be seen

²² William of Ockham, *Philosophia Naturalis sive Summulae in libros Physicorum*, part IV, chapter VIII, pg. 91, “*Ita istans non est nisi primum mobile existent alicubi secundum suas partes, vbi non erat ante immediate, vt hoc nomen, istans; non dicat nisi primum mobile existens in tali loco, vbi prius non erat immediate ante, nec immediate post erit*”.

²³ *Ibidem*, chapter IX, pg. 92, “*istans est terminus temporis, et tempus est divisibile, ergo sunt plura istantia*”.

²⁴ Aristotele, *Fisica*, It. tr., *cit.*, book IV, pg. 245, verso 220a – 23, “*l’istante è un limite, non il tempo*”.

as one and only the one into the time. It follows the passing of time and change, yet remaining always the same.

A final comparison between Aristotle and Ockham

Ockham agrees to all Aristotle's statements. He draws him by renewing him. He demonstrates again every conclusion, from the beginning, using other examples and argumentations. Then, he follows his different reasoning but he arrives to the same conclusions as his. The Franciscan does not take for granted none of the Philosopher's definitions. Moreover, he adds the discrete to the time dimension, not limiting to the sole continuity. The last difference concerns time as a number. According to the Greek author, time is only enumerated number, that is counted.²⁶ To the English logician, it is also enumerating number. That is, time counts and is counted, measured.

It is important to make a comparison between the English logician's two works. There is a different way to expose the concept. In the *Quaestiones*, the sentences are brief and the author presents directly his thought, without roundabout expressions and appearing synthetic. As a matter of fact, every expression has a pregnant meaning. The *Philosophia Naturalis* is different. The periods are long and the theory is not presented at the beginning but only at the end of the chapter. Sometimes the author tends to repeat. The writing method seems different. It must be stressed that the *Philosophia Naturalis* was in a first stage composed of ten

²⁵ William of Ockham, *Quaestiones in libros Physicorum, cit.*, "Si dicas quod {res} non <est> aliqua res distincta a mobili movens propter eandem, quia illa res quae manet eadem in toto tempore est res permanens, et ita illud instans erit res permanens, et non nisi primum mobile; igitur etc. : Ideo dico quod instans potest accipi dupliciter: uno modo pro primo mobili absolute, alio modo pro primo mobili existente in eodem gradu. Si primo modo intelligatur quaestio, dico quod unum et idem instans est in toto tempore, sicut idem est primum mobile absolute. Si autem intelligatur secundo modo, sic dico quod non est idem instans in toto tempore, quia primum mobile non semper est in eodem situ, nec aliqua pars primi mobilis semper coexisteret eidem corporis ambientis et quiescentis".

²⁶ Aristotle, *Fisica*, It. tr. *cit.*, book IV, pg. 243, verso 219b – 7-8, "il tempo è ciò che è numerato e non ciò con cui misuriamo".

parts. Only four parts have reached us. It could be supposed that these parts have been synthesised by someone or perhaps reorganized by more persons. This could explain the difference in the writing method. However, it should be underlined that it is just a supposition. It should be remarked that the ideas presented are compatible with the medieval logic's thought. If someone has reorganized the work, he has not changed its content.

A collation: Ockham and Prior

With regard to contemporary discussion, the most important point of contact between William of Ockham and Arthur Prior is being introduced. It consists in the relation between continuous time and discrete time. This temporal reality is denominated *metric tense logic*²⁷ by the modern logician and it is exposed in his principal work, *Past, present and future* at 1967. The way to resolve the question is the same. Each of them think that there are two different ways to interpret the reality. They are different ways of seeing the same thing. The modern logician adds other ways, like circular time and so on. He deals with the problem of value of the proposition on time that can rise by every postulate that's just been stated.

The term "value" must be intended as truth or falsehood values. The reader can, in fact, can feel confused in considering simultaneously assertions like "time is continuous" or "time is infinity" and so on. The author is afraid that one can think that there is a contradiction among these expressions. However, he clarifies that the propositions represent only the interpretation of reality and its parts. They should not be considered as absolute entities, but only as a way of speaking.²⁸ Then Prior passes to their axiomatization, according to the metric tense logic, we must use variables *m*, *n*, and so on as numbers that measure intervals.

²⁷ A. N. Prior, *Past, Present and Future*, Oxford, Clarendon Press, 1967, chapter VI, pg. 95-112.

²⁸ *Ibidem*, pg. 75, "such statements cease to carry such suggestion when they are interpreted as short-hand for statements which do not even appear to mention any such entity, but simply talk about what will have been the case, etc".

These numbers can be taken by real or only rational or whole numbers and so on. These numbers can be negative, positive and zero or greater or equal to zero, or only zero and positive, or only positive. Real numbers are all set of numbers. Therefore it is a set of numbers composed by whole, relative, rational and irrational numbers. Rational numbers are fractional numbers and whole numbers go from 0 to $+\infty$. It is easy enough, through these intuitive definitions, to find the connection between these set of numbers and the various time dimensions that Prior describes. For example, as for time, one can associate whole or rational numbers that do not represent continuity. On the contrary, as for continuous time, it uses the set of real numbers is used. Moreover, as for the dense time, the set of natural numbers can be applied. In fact, a set can be defined dense when, between two elements of the set, an intermediate can always be inserted. Therefore, the dense set has continuity power of the continuous, lacking the discrete in such a way. Thus, as we can consider the various type of numbers, we can evaluate the various forms in which we think of time.

Prior's "Okchamist solution"

It is also to be remembered that Prior evokes Ockham's assertion on *Tractatus de Praedestinatione*²⁹, in which he declares that if a thing is true in the present, it will remain so in the past. Nevertheless, the modern logician deals more with the problem of symbolizing the Ockhamist solution. Namely, the medieval philosopher's principle says that the truths about the past are necessarily applied only to those propositions regarding the past and are not equivalent to the future time ones. However, the Franciscan does not say that past time propositions which are equivalent to the future tense ones are never necessary. These

²⁹ Guglielmo d'Ockham, *Tractatus de praedestinatione et praescientia dei et de futuri contingentibus*, edited by Ph. Boehner, New York, St. Bonaventure, 1945, pg. 6.

would result necessary only if future tense ones were also necessary. At this point, the difficulty to find a symbology for this principle arises. The modern logician resolves the question incorporating the Ockhamist system with the Piercean one.³⁰ The Piercean system, named after Charles Pierce, represents a fragment of the Ockhamist one. In it, instead of variables, there are A-variables, namely, a subclass of variables. Moreover, F^{31} , namely the weak future, does not occur if it is not immediately preceded by L^{32} , necessarily. Therefore, the future must be considered as necessary. In this way it can be represented that it is still future. Above all, it can give sense to the Ockhamist expression “*It was to be*”, symbolized as $PmFnp$, and “*It was contingently to be*”, that becomes $KPmFnpNPnLFnp$. The symbol n represents tense intervals. Thus the past is so seen as contingent. Prior is persuaded that the Piercean system can provide instructions to the use of the Ockhamist tense system.³³ For example, the Ockhamist expression “*It was the case two hours ago that Eclipse would win an hour later*”³⁴ becomes through the Piercean system “*Eclipse won an hour ago*”.³⁵ In this way, it expresses the same meaning but in a more intuitive way.

In conclusion, the medieval logician and the modern logician agree on some points. There is a difference: the former is surely clever than the latter, showing a first class speculative mind; the latter reorganizes the speech of the first through refined

³⁰ A. Prior, *Past, Present and Future*, Oxford, Clarendon Press, 1967, pg. 130, “*We can in fact characterize the Piercean system as the fragment of the Ockhamist system*”.

³¹ A. N. Prior, *La logica del tempo e la continuità nell’ordine temporale*, It. Tr. by C. Pizzi, in *La logica del tempo*, Torino, Boringhieri, 1974, chapter 2, pg. 125. Prior symbolizes the weak future by F and the strong one by G .

³² A. Prior, *Past, Present and Future*, *cit.*, pg. 20, “...my symbolism was that of Lukasiewicz [...] and $L\alpha$ for ‘Necessarily α ’”.

³³ *Ibidem*, pg. 131, “The Piercean can, I think, even give instruction in the use of Ockhamist tenses”.

³⁴ William of Ockham, *Tractatus de Praedestinatione et Praescientia dei*, *cit.*, pg. 6.

³⁵ *Ibidem*.

techniques and he also deals with different perspectives than the *Venerabilis Inceptor*.

Selected bibliography

Ancient and Medieval Sources

- Aristotelis, *Physica*, rec. W. D. Ross, Oxonii, E Typographeo Clarendoniano, 1950; It. transl. Aristotle, *Fisica*, edited by M. Zanatta, Utet, Torino, 2000.
- Johannis Duns Scoti, *In librum primum Priorum Analyticorum. In librum secundum Priorum Analyticorum*, Parisiis, Apud Vivès, 1891.
- William of Ockham, *Philosophia Naturalis sive Summulae in libros Physicorum*, London, The Gregg Press, 1963.
- Quaestiones in libros Physicorum*, partial edition by F. Corvino, "Rivista Critica di storia della filosofia", Firenze, 1955, 1956, 1957, 1958.
- Tractatus de praedestinatione et de praescientia Dei et de futuri contingentibus*, edit. by Ph. Boehner, New York, St. Bonaventure, 1945.
- Summa logicae*, ediderunt Ph. Boehner O.F.M., G. Gál O.F.M., S. Brown, New York, St. Bonaventure, 1974.

Modern Works

- Hughes G. E. e Cresswell M. J., *An Introduction to Modal Logic*, London, Methuen, 1968; *Introduzione alla logica modale*, It. tr. by C. Pizzi, Milano, Il Saggiatore, 1973.
- Pierce Ch., *Collected Papers vol. I-VI*, edited by P. Weiss P. and Hartshorne C., Cambridge Mass, Harvard University Press, 1931, 1935; *vol. VII-VIII*, (edited by) A. W Burks., Cambridge Mass, Harvard University Press, 1958.
- Pizzi C. (edited by), *La Logica del Tempo*, Torino, Boringhieri, 1974.
- Prior A., *Formal Logic*, Oxford, Claredon Press, 1955.
- Diodorean Modalities*, "Philosophical Quarterly", vol. 5, (1955),
- Time and Modality*, Oxford, Claredon Press, 1957.
- Time after Time*, "Mind", vol. 67, (1958).
- Diodorus and modal logic: A correction*, "The Philosophical Quarterly", vol. 8 (1958).
- The runabout inference – ticket*, "Analysis", vol. 21, n. 2 (1960).
- Identifiable Individuals*, "Metaphysics", (1960).

Tense – Logic and the Continuity of Time, “*Studia Logica*”, vol. 13 (1962).

K1 e K2 and related Modal Systems, “*Notre Dame Journal of Formal Logic*”, vol. 5, n. 4.

(1964). *Conjunction and Contonktion Revisted*, “*Analysis*”, vol. 24, n. 6 (1964).

Time, existence and identity, “*Proceedings of the Aristotelian Society*”, vol. 66 (1965).

Postulates for tense – logic, “*American Philosophical Quartely*”, vol. 3, 1966.

Past Present and Future, Oxford, Claredon Press, 1967.

Stratified Metric Tense Logic, “*Teoria*”, vol. 33, 1967

Papers on Time and Tense, Oxford, Claredon Press, 1968.

Worlds, Time and Selves, London, University of Massachusetts Press/Duckworth, 1977.