

# Bridging Mainstream and Formal Ontology: A Causality-Based Upper Ontology in Dietrich of Freiberg

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## Abstract

Ontologies are some of the most central constructs in today's large plethora of knowledge technologies, namely in the context of the semantic web. As their coinage indicates, they are direct heirs to the ontological investigations in the long Western philosophical tradition, but it is not easy to make bridges between them. Contemporary ontological commitments often take causality as a central aspect for the ur-segregation of entities, especially in scientific upper ontologies; theories of causality and philosophical ontological investigations often go hand-in-hand, and were essentially inseparable in medieval thought. This constitutes the foundation for a bridge, and this article analyzes the causality-based ontology of the late medieval philosopher Dietrich of Freiberg from the viewpoint of today's upper-ontology engineering. In this bridging attempt, it offers a translation into English of the first part of Dietrich's *De origine* (abbreviated title) that is a compromise between traditional scholarly translations of medieval Latin philosophical texts and contemporary ontology.

**Key words:** Mainstream ontology; Formal ontology; Upper ontology; Ontological commitment; Medieval idealism; Dietrich of Freiberg; Causality-based ontology

## 1 Introduction

It appears that today “ontology” is not ontology. Since the 1990s, when this word emerged in the field of computing, the need has been felt to distinguish ontology as a branch of philosophy, now called *philosophical ontology*, from *computational ontology*.

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While there are some important aspects that indeed make them distinct subjects to some extent, the fact that they largely share the same vocabulary and the same methods at the level of *upper ontology*, or the segregation of the most basic and general concepts, calls for bridges to be built between them.

Anyone who had to peruse the Aristotelian *Categories* (Aristotle, sd/1963), the Kantian *Critique of Pure Reason* (Kant, 1781/2007), or Husserl's *Logical Investigations* (Husserl, 1913/2000) knows that philosophical ontology is not for the faint of heart. This holds especially for the medieval texts: Medieval philosophers like Boethius or, much later, Thomas Aquinas and Duns Scotus are well known today for their ontological investigations, but the intricacies of their texts do not contribute to a wider fame, which explains the rare invocations of these authors not only in the field of computing, but also in contemporary philosophy. However, my view is that this undesirable state of affairs is greatly due to the lack of work in philosophical ontology explicitly aiming at an audience in computational ontology, and the unpreparedness of this to go deep into what can be very specialized literature. I here propose to begin to change this state of affairs by showing how a particular medieval text can be (made) relevant to contemporary ontology, namely to the effort of constructing, or—perhaps more adequately put—engineering, upper ontologies.

This author is now known as Dietrich of Freiberg, a disciple of Albertus Magnus, and a worthy opponent of Thomas Aquinas. The text I set out from is his ontological *magnum opus*, boldly entitled *Treatise on the origin of the categories* (*Tractatus de origine rerum praedicamentalium*, in Latin; abbreviated *De origine*), whose first part I here provide in a translation into English. The medieval philosophy scholar who reads my translation will certainly notice—and perhaps frown at—what might be seen as idiosyncratic translations, but the goal was to produce a translation that is a compromise between medieval ontology literacy and contemporary ontological investigations.<sup>1</sup> In any case, the reader literate in Latin can check the original text (Dietrich von Freiberg, sd/1983), but I am satisfied that Kurt Flasch and Burkhard Mojsisch, two well-known medieval philosophy scholars with an acknowledged expertise in this author and in particular in this treatise of his (e.g., Flasch, 2007; Mojsisch, 1977), thoroughly reviewed my first translation a few years ago and approved it for publication (see Augusto, 2011).

In this article, besides the mentioned translation, I elaborate briefly on the main current distinctions between the so-called philosophical and computational/scientific ontologies, I suggest a more appropriate—at least *ad-hoc*—distinction, and I analyze the main aspects of upper ontologies in both fields, showing both commonalities and real differences. This is Part 2 of this article. In Part 3, in which the translation is given, I also analyze the context of the *De origine*, and then extract the top level of an upper ontology from this text. Finally, in Part 4 I offer some comments on the

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<sup>1</sup>For instance, the medieval Latin *res* in philosophical texts is typically translated as (*a*) *reality*; I here translate it directly as *thing*. This accounts also for my translating *res praedicamentalis* as simply *category*, rather than *categorial reality*, as would be expected in a more orthodox translation (e.g., Colli, 2010, renders *res praedicamentalis* as *realtà predicamentale* in Italian); in effect, *category* simply abbreviates the rendering of *res praedicamentalis* as *categorial thing*, which, in my view, is the right translation if we consider the distinction between things of first and of second intention, central in late medieval philosophy and foundational in Dietrich's text. That I now translate it simply as *category* rather than as *categorial thing*, as I did in my translation into Portuguese a few years ago (Augusto, 2011), is a result of the abovementioned aim of a compromise.

work done and on work to be done.

## 2 Ontologies and Ontological Commitments

### 2.1 Current Distinctions in Ontology

Ontology, broadly conceived, is the investigation of what entities (there) are.<sup>2</sup> In the Western philosophical tradition, it can be said to have started with Parmenides' Poem (ca. 5th century BC). Aristotle, Kant, Meinong, Husserl, they all took ontology to some form of acme in this tradition. But they are not specifically known as ontologists; on the contrary, many (theoretical) computer scientists, software engineers, and scores of staff in large companies today call themselves ontologists, and more often than not are not familiar with the ontological work of the former. On the other hand, scholars working in ontology in the field of philosophy are often not familiar with the work of these ontologists, or even reject that this is related to *their* ontology. Some scholarly attempts have been made to bring these two sides together (e.g., Hagengruber & Riss, 2014; Poli & Seibt, 2010; Poli et al., 2010), but the waters have failed to mix.

This might suggest that the two fields are indeed distinct, and terminological strategies have been proposed to distinguish the two sides. For instance, writing "Ontology" (vs. ontology) with an uppercase initial to refer to ontology as done in the field of philosophy, or speaking of *ontologies* (vs. ontology) to mean the work being carried out in computing. When "*computational ontology*" (also: *formal ontology*) is used to refer to the latter, then the other side is called *philosophical ontology* (e.g., Hoekstra, 2009; Smith, 2003, 2014).

But the distinctions do not end here. Because most work in ontology today is actually done with applications in scientific fields in view, there is now the additional need to make sure that it is understood that this is *scientific ontology* (e.g., Smith, 2008).<sup>3</sup> One way to distinguish this from philosophical ontology is to call the latter *speculative ontology*, where the adjective "speculative" has a pejorative reading (Humphreys, 2013). As a matter of fact, in any field of application—and ontology engineering is now (becoming) ubiquitous—it appears that there is the need to distinguish *its* ontology making from the philosophical-based ontological investigations.<sup>4</sup> Below, I show why these distinctions are unwarranted, but before doing that I must introduce the main link between philosophical ontology and the current trends in ontology.

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<sup>2</sup>Instead of of the term "entity," we can use "being," but the former is closer to the Greco-Latin origins of this field of investigation in Western thought: *Ens* is originally the present participle of *esse*, to be; the *ts* are accounted for by the singular genitive form *entis* (literally: *of a/the being*) when the present participle becomes a noun, which in turn gave origin to the philosophical term "*entitas*," that which essentially defines or characterizes an entity. (Since I am at it, the noun *ontology* has its prefix *onto-* from the same grammatical phenomenon in Greek: *on*, *ontos*.) However, I shall use both terms, though with an obvious preference for "entity."

<sup>3</sup>A few examples, with references to online resources, of scientific ontologies: The Gene Ontology (GO) [1]; the Oral Health and Disease Ontology (OHD) [2]; the Modern Science Ontology (MODSCI) [3]; MO, the Microarray Gene Expression Society (MGED) Ontology [4]; OBI, the Ontology for Biomedical Investigations [5].

<sup>4</sup>See Merrill (2011) for a comprehensive study of this topic in scientific ontology making.

## 2.2 Ontology Levels and a Bridge

In a narrower conception, ontology is all about segregating the (kinds of) entities that compose reality or, more humbly, some domain. The term “entity” should be here taken in its broadest sense, as referring not only to *things*, either physical or abstract, but also to their *parts* and *properties*, and the *relations* things have with each other. This segregating activity bearing on entities has a very clear-cut objective in the field of computing, in which practical scientific and corporate applications are typically considered (e.g., Hoehndorf et al., 2015; Obrst et al., 2003). These constitute the so-called *domain ontologies*, which segregate entities of specific domains (e.g., medical conditions; automobiles; fishery), but more and more the need is felt for these ontologies to be based upon—even better: rooted in—what can be called *upper ontologies*.<sup>5</sup> These address the segregation of entities, their parts and properties, and their relationships from a more basic and abstract perspective, independently of the domain ontologies that may use them. For instance, the distinctions of *substance* and *attribute*, *part* and *whole*, *universal* and *particular*, are typically addressed at this *foundational* level.<sup>6</sup> All these upper-ontology components can be called *ur-elements* and we can speak of *ur-segregation* at this level.<sup>7</sup> These elements are well-known also by philosophers working in ontology, and thus it appears that the bridge between both sides is upper-ontology engineering.

A major commonality between upper ontology in computer science and in philosophy is the distinction between universals and particulars. This was actually a major problematic in medieval ontology (see Pinzani, 2018; Spade, 1994), though the problematic was not so much on the distinction itself, which was largely accepted (with some notorious exceptions; e.g., Boethius), but on the ontological status of the universals: Were these real entities, mere names, or even solely concepts in our minds? Depending on one’s view, one was a *realist*, a *nominalist*, or a *conceptualist*, respectively. Today, the distinction is often reduced to a question of *instantiation*: Universals are entities that can have instantiations; particulars cannot. For instance, “Socrates” and “Hypatia” are instantiations of the universal “Human,” but of course neither of them can be further instantiated. However, in the so-called computational/scientific ontology, too, the question of instantiation is not without problems: For instance, are sets universals or particulars? And are “three-angled polygon” and “three-sided polygon” the same or different particulars? If they are different, are the sets  $A = \{x|x \text{ is a three-sided polygon}\}$  and  $B = \{x|x \text{ is a three-angled polygon}\}$  two different sets? But if we denote an arbitrary three-angled/-sided polygon by  $\Delta$ , then extensionally we have  $\{\Delta_1, \Delta_2, \dots\}$ , which is a single set. And the problem is even more acute with respect to predicates: While a predicate like *IsAnimal*( $x$ ) allows

<sup>5</sup>This need has been so pressing that several committees have been organized for the creation of upper ontologies with a scope of application as broad as possible. Especially noteworthy are the upper-ontology candidates for the IEEE Standard Upper Ontology initiative SUMO (see Niles & Pease, 2001), UCO (e.g., Lenat et al., 1986), and IFF (Kent, 2004), as well as the WonderWeb modules DOLCE (Gangemi et al., 2002), OCHRE (see Masolo et al., 2003), and BFO (Arp et al., 2015; Grenon, 2003; Grenon et al., 2004).

<sup>6</sup>More fine-grained hierarchies can be conceived; for instance, an intermediary level between the upper and the domain ontologies is often considered, and below the domain ontologies one can posit application ontologies.

<sup>7</sup>The German noun prefix “Ur-” denotes firstness in time and/or (ontological) rank or status. For example, *Urozean* is translated as *primeval ocean*.

for many possible instantiations, thus appearing to be indisputably a universal, the limited instantiations of *IsPartOfPeriodontium* ( $x$ ) (see below) throws doubt on its ontological status as a universal. It does not seem possible to solve these issues without philosophical investigation, which can go as far as taking sides in the triple above (Realism – Nominalism – Conceptualism) or even in other tuples (see, e.g., Smith & Ceusters, 2010). On the other hand, philosophical investigation alone will not suffice to design computer-readable implementations of this distinction. So, maybe together they can (dis)solve this, as well as other issues in contemporary ontology.

### 2.3 An *Ad-hoc* Distinction

In effect, when one focuses on upper ontology as a specific branch of ontology the distinctions above appear unwarranted. To begin with, the aim of upper-ontology engineering is to come up with concepts that are—among other features—*philosophical* (e.g., Obrst, 2010); thus, the distinction computational vs. philosophical ontology does not really make sense. Additionally, although different methods might be employed by the two sides (see Smith, 2003), both in fact aim at segregating concepts into smaller and smaller disjoint classes of entities, i.e. classes with increasingly fewer members. For instance, in the top level of SUMO (Suggested Upper Merged Ontology) we can see the increasing segregation of classes shown in Figure 1.

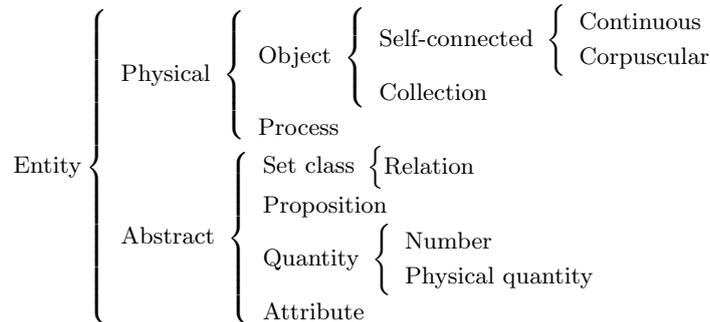


Figure 1: Top level of SUMO. (Niles & Pease, 2001.)

Compare this with Porphyry’s tree (Fig. 2), an ontological construct that accompanied the development of Western ontology since the Neoplatonist Porphyry, adapting the Aristotelian theory of the categories, first suggested it in the 3rd century AD (cf. his *Isagoge*: Porphyry, sd/2003; Spade, 1994) and until the late middle ages.<sup>8</sup>

The method applied by both is that of partition building and partition refinement.<sup>9</sup> In both cases, the classes are partitioned by means of relations such as “is

<sup>8</sup>See Studtmann (2021) for the roots of Porphyry’s tree in Aristotle’s segregation of the category *substance*.

<sup>9</sup>“Partition” and “refinement” are here to be taken in the mathematical sense: Let  $A$  be a set and  $A_i \neq \emptyset \subseteq A$ ,  $1 \leq i \leq k$ ; then, the collection  $\mathcal{P}(A) = \{A_1, A_2, \dots, A_k\}$  is a *partition* of  $A$  if (i)  $\bigcup_{i=1}^k A_i = A$  and (ii)  $A_i \cap A_j = \emptyset$  for all  $i, j = 1, 2, \dots, k$ ,  $i \neq j$ .  $\mathcal{P}'(A)$  is said to be a *refinement* of  $\mathcal{P}(A)$  if (i)  $\bigcup_i A_i \in \mathcal{P}(A) = \bigcup_i A'_i \in \mathcal{P}'(A)$ , (ii)  $|\mathcal{P}'(A)| > |\mathcal{P}(A)|$ , and (iii) for

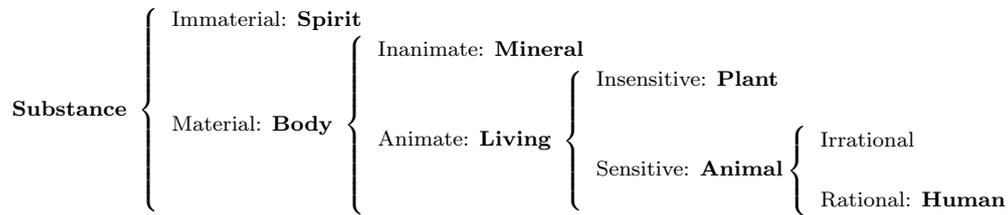


Figure 2: Porphyry's tree.

a,” “is constituted by,” “participates in,” etc., or their negations (e.g., “is not a”), so that we can reduce ontological concepts to only two: *classes* and *relations*. In both cases, this partitioning is expressed in a logical language.<sup>10</sup> These similarities between both ontological constructs do not sanction a distinction between philosophical and computational or scientific ontology, either.

But a distinction is needed for several reasons, the most significant of which has to do with computing machines. Without elaborating on this, I propose that we mimic a useful distinction in epistemology (see Hendricks, 2006) and talk of *mainstream ontology* (MO) and *formal ontology* (FO) to refer to work in the philosophical and in the computing/scientific fields, respectively. Just as in the case of epistemology, there is a real distinction that needs to be taken into consideration: In the same way that formal epistemology has as a major concern the application of knowledge in machines (Augusto, 2020), FO requires an ontology to be machine-interpretable, or at least machine-readable; this is the reason why both subjects require their constructs to be expressible in a formal language, preferably a logical one, that not only can represent knowledge as machine-readable constructs, but also allows for automated deduction over those constructs. Neither MO nor mainstream epistemology have such concerns.

## 2.4 Shared Conceptualizations

Ontology construction is first and foremost a dynamic process that implicates humans in general. In effect, every individual is believed to form and constantly change a semantic memory that, albeit personal, is to a great extent a conceptual construct constrained by the (largely linguistic) culture to which they belong, which, in turn, is geographically and temporally localized. I find it useful to refer to these constraints as the *Volks-* and *Zeitgeist*. What they constrain is the formation and change of *shared concepts*, or units of meaning that identify things in the world and, at least in most cultures, can be denoted by signs (e.g., Augusto & Badie, forthcoming). See Figure 3 for this *semiotic triangle*. (Note in this triangle that *reference*, the relation between signs and things in the world, is not affected by the constraints—or pressure—imposed

every  $A'_i \in \mathcal{P}'(A)$  there is an  $A_j \in \mathcal{P}(A)$  such that  $A'_i \subseteq A_j$ .

<sup>10</sup>In the case of Porphyry's tree, we have a segregation of *genera* (in bold; super-classes) into *species* (sub-classes) by means of *differentiae* (expressible by the relation “is not a”). These, together with the *proprium* and the *accidens*, are the universals for medieval thought. To be sure, this is but a fragmentary and localized example of what is in fact a very large and diverse body of knowledge that spans several centuries. See Gabbay & Woods (2008) for an overview of medieval logic.

by the *Zeit-* and *Volksgeist*; as we know since Saussure's *Cours* was first published in 1916, this relation is purely conventional.)

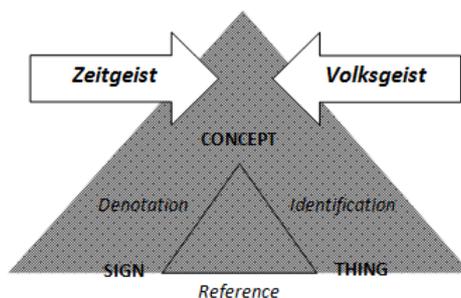


Figure 3: The semiotic triangle.

For instance, by verbal communication and reading of non-scientific texts (magazine articles, pamphlets, etc.), most humans acquire a shared concept of disease that helps them to realize that they might need medical attention of some specific sort, say, by a dentist. One such shared concept is that of pyorrhea, which people believe might affect them when their teeth loosen in adulthood. By using the language of standard first-order predicate logic, we can formalize this belief as  $Affects(pyorrhea, tooth)$ , an instantiation of  $Affects(x, y)$ , where  $x$  denotes the medical condition and  $y$  does so for the body part that is affected by/in the condition. Some fine-graining is possible, with some people actually believing that pyorrhea affects the tooth root, and not the crown directly. This shows that people usually share the conceptualization that a tooth has a root and a crown as parts; formally, we could write  $HasPart(tooth, crown)$  and  $HasPart(tooth, root)$ .

When this natural, spontaneous process of shared conceptualization without which human communication is not possible (or is at least greatly disturbed; see Badie & Augusto, forthcoming) is replaced by a strategic process meant to restrict concepts as they are shared by a specific group of humans (e.g., experts) to a specific context, then we talk of a consensual (knowledge) construct (see Fig. 4); if this is expressed in a formal language meant to allow for machine-readability, then we have the orthodox conception of a FO (e.g., Borst, 1997; Guarino et al., 2009).

Retaking the example above, in technical vocabulary “pyorrhea” is replaced by “periodontitis,” a coinage that is accounted for by the fact that this dental condition, which is in fact a bacterial condition, affects the tissues surrounding and supporting the teeth—the periodontium—and not the teeth themselves; patients with this condition may in fact lose healthy teeth. In order for a group of experts in the context of dental medicine to formulate the belief  $Affects(bacterialPlaque, periodontium) \equiv IsDentalCondition(periodontitis)$ , they have to share the same conceptualizations of all the classes and relations in this equivalence. This requires both a taxonomy of medical conditions which includes dental conditions and an anatomical taxonomy as fine-grained as to include the several components of the periodontium, to wit, gingiva, cementum, alveolar bone, and periodontal ligaments, and this specifically for all the 32 teeth of an adult human.

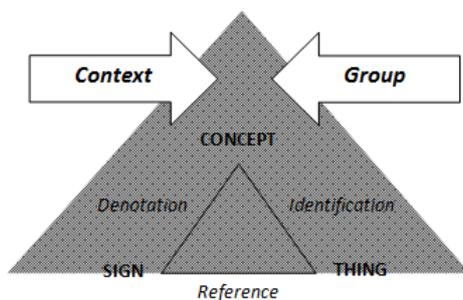


Figure 4: The semiotic triangle in FO.

For instance, OHD [2] has a shared conceptualization of a tooth that is far more complex than that of a lay person:

is-a: Organ with organ cavity

subclasses: Molar tooth, Premolar tooth, Canine tooth, Incisor tooth, Primary tooth, Secondary tooth

regional part: Crown of tooth, Root of tooth

attributed part: Crown of tooth, Root of tooth, Apex of tooth, Cavity of tooth, Enamel, Cement, Dentine, Dental pulp, Periodontium

physical state: Solid

As seen above, sufferers of periodontitis more often than not do not know that there is some oral “entity” called the periodontium, which is the locus of their condition. OHD contrasts with this by proposing the following profuse conceptualization for the periodontium, which considers an exhaustive discrimination of the periodontia into constituents, the ligaments in the following example, and this for all the teeth of an adult human:

is-a: Set of ligaments

member of: Mandibular dental arcade, Set of periodontia

member: Periodontium of right lower second premolar tooth, Periodontium of left lower first premolar tooth, Periodontium of left lower second premolar tooth, Periodontium of right lower first premolar tooth, Periodontium of right lower first molar tooth, Periodontium of left lower canine tooth, Periodontium of left lower first molar tooth, Periodontium of right lower canine tooth, Periodontium of right lower second molar tooth, Periodontium of left lower lateral incisor tooth, Periodontium of left lower second molar tooth, Periodontium of right lower lateral incisor tooth, Periodontium of right lower third molar tooth, Periodontium of left lower central incisor tooth, Periodontium of right lower central incisor tooth, Periodontium of left lower third molar tooth

This is then further fine-grained for skeletal ligaments:

is-a: Skeletal ligament

subclasses: Periodontium of lower central incisor tooth, Periodontium of upper lateral incisor tooth, Periodontium of lower lateral incisor tooth, Periodontium of upper first premolar tooth, Periodontium of upper second premolar tooth, Periodontium of upper third molar tooth, Periodontium of lower first molar tooth, Periodontium of lower first premolar tooth, Periodontium of lower third molar tooth, Periodontium of upper central incisor tooth, Periodontium of upper canine tooth, Periodontium of lower second premolar tooth, Periodontium of lower canine tooth, Periodontium of lower second molar tooth, Periodontium of upper first molar tooth, Periodontium of upper second molar tooth

constitutional part: Epithelial cell of Malassez

regional part: Collagen fiber of periodontium

Finally, the periodontium of every tooth is subject to further specification. I leave here a single example:

is-a: Periodontium of lower central incisor tooth

constitutional part of: Right lower central secondary incisor tooth

member of: Set of mandibular periodontia

This shared conceptualization, now at the FO level, constitutes the basis of an ontology for oral health and dental conditions aiming at allowing for a uniform analysis of dental health records and also at facilitating translation of texts in oral medicine. But OHD is a domain ontology; the types of classes it considers for the above instantiations and the relations for those classes (“Is a,” “Is a subclass of,” “Is a regional part of,” etc.) are shared conceptualizations at the level of an upper ontology.<sup>11</sup> At this level, a shared conceptualization is the result of an ontological commitment.

## 2.5 Upper Ontologies and Ontological Commitments

It is often useful to define *ontological commitment* formally (e.g., Guarino, 1998), but it suffices here to see this as the (consequences of the) ontological choices that are made with respect to the basic, or most general, categories and their relations. For instance, the axioms for primitive relations and functions in DOLCE (Descriptive Ontology for Linguistic and Cognitive Engineering) consider parthood (“ $x$  is part of  $y$ ”), temporary parthood (“ $x$  is part of  $y$  during  $t$ ”), constitution (“ $x$  constitutes  $y$  during  $t$ ”), participation (“ $x$  participates in  $y$  during  $t$ ”), quality (“ $x$  is a quality of  $y$ ”), and quale (“ $x$  is the quale of  $y$  [during  $t$ ]”). From these axioms, it can be seen that DOLCE considers time to be foundational in the sense that the parthood and quale relations may be temporary, i.e. as taking place during time  $t$ , and both the constitution and participation relation are temporal relations. This entails that

<sup>11</sup>BFO (an “exploratory version,” according to the authors of OHD), in this case.

DOLCE's entities are *perdurants*, or 4D entities, i.e. entities that happen or extend in time ("space-time worms," in the literature). In this viewpoint, both a book and the reading a book are perdurants. Hence, we can say that DOLCE is 4D-oriented, or perdurantist. If, on the contrary, entities are conceived as being wholly present at any moment of their existence, then we speak of *endurants*, or 3D entities. SUMO (see Fig. 1) is a 3D-oriented, or endurantist upper ontology, as its ur-partition of physical objects into objects and processes indicates.

The spatial-temporal aspect can be considered foundational of an upper ontology with respect not only to its relations, but also to its entities. BFO (Basic Formal Ontology) distinguishes between the SNAP entities, which are 3D entities (specifically: biological objects), and the SPAN entities, which are 4D entities (biological processes), but does so with the aim of a compatibility between 3D and 4D entities (Grenon et al., 2004). (See Fig. 5.) As for relations, and just to compare with the above relations in DOLCE, BFO considers both trans-ontological relations between SPAN and SNAP entities (e.g., dependence, participation, termination, etc.) and intra-ontological relations (e.g., part-whole and topological relations).

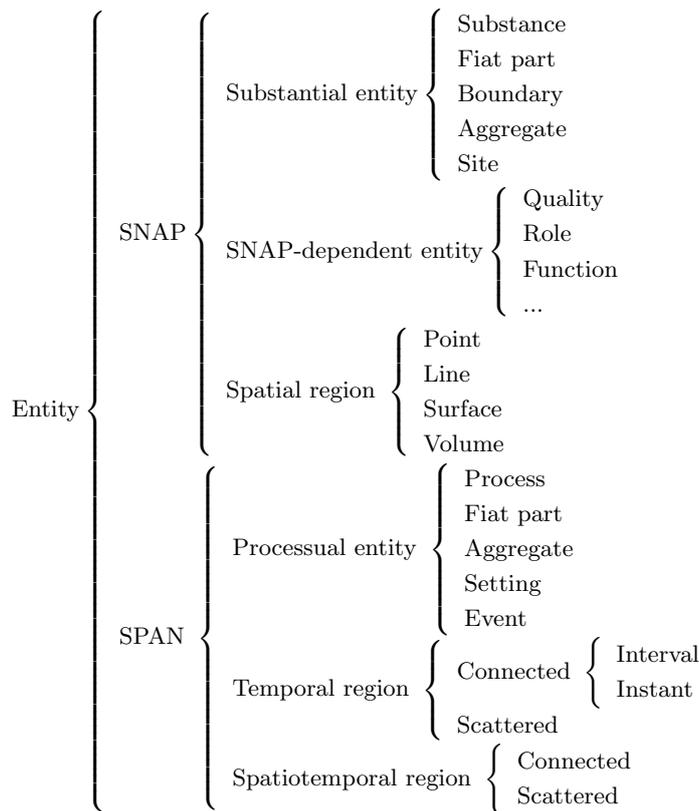


Figure 5: BFO: The principal categories.

Other consequences of one's ontological choices are reflected on the basic categories in different ways. For instance, DOLCE and BFO are said to be *multiplicative*

and *descriptive* upper ontologies, it being meant by this, respectively, that there is a profusion of categories in the sense that these can include anything that seems to be required and the categories are conceived by taking into consideration the cognitive abilities of humans. These choices are made evident with respect to BFO when Grenon et al. (2004) characterize the methodology used to design BFO as realist (reality and its constituents exist independently of our theoretical conceptualization thereof), fallibilist (our theories and classifications may be subject to revision), perspectivalist (there is a plurality of perspectives on reality, all legitimate), and adequatist (there is no single basic view to which all these perspectives can be reduced to). The opposite choices produce *reductionist* and *revisionist* upper ontologies, respectively: The former reduces the number of concepts to the fewest primitives believed to be sufficient for the derivation of the categorial or conceptual complexity that characterizes reality, and the latter bases its ur-partition on philosophical and scientific theories, rather than on human cognitive abilities. OCHRE, for instance, is said to be reductionist and revisionist. Interestingly, SUMO is categorized as being both multiplicative and reductionist.

## 2.6 Causality in Upper Ontologies

Causality is ubiquitous not only in science, but also in everyday reasoning.<sup>12</sup> Given the ubiquity of causal reasoning, it would be expected that upper ontologies would consider causality. In effect, causal relations or functions such as *principle* (“ $x$  is a principle of  $y$ ”), *origin* (“ $x$  originates  $y$ ”), or, more plainly, *cause* (“ $x$  is a cause of  $y$ ”) often feature in scientific upper ontologies (e.g., Kaneiwa et al., 2007; Rovetto & Mizoguchi, 2015). However, it is often considered at lower-level partitioning, below the *top-level* ur-segregations (e.g., Partridge et al., 2020). This ur-element segregation can be captured by what van Inwagen & Sullivan (2014) call *the “old” metaphysics*, constituted by being as such, first causes, unchanging things, categories of being and universals, and substance.

Do we need these ur-elements, in particular the “first causes,” in upper ontologies? Consider, for instance, a mathematical(-oriented) (upper) ontology (e.g., Gruber & Olsen, 1994; [6]). The ontological status of mathematical objects, including statements or propositions, is far from consensual, so that an upper ontology for a mathematical ontology will probably require a notion of mathematical being or entity, for which the ur-elemental being as such is required. This ur-element will, in turn, be associated to first causes: Seen as *real* entities, then one has the hard task of accounting for the apparently purely ideal (or abstract) existence of mathematical entities, a stance known as *platonism* in the philosophy of mathematics.<sup>13</sup> According to this view, mathematical objects lack causal powers, but they themselves are believed to have a natural cause, independent of their being known. If seen as mental *constructions*, however, then their cause must be the human mind, namely the mental practices involving them (e.g., Font et al., 2013), so that perhaps the human mind, too, might be required as a causal ur-element in an upper ontology that is conceived for a mathematical ontology.

<sup>12</sup>See the example above of pyorrhea / periodontitis.

<sup>13</sup>Also *Platonism*, with an uppercase initial *p*. See, e.g., Brown (2008) for both Platonism and constructivist approaches in the philosophy of mathematics.

### 3 Extracting an Upper Ontology from Dietrich of Freiberg's *De origine*

#### 3.1 Medieval Ontology as Upper-Ontology Making

Medieval ontology was essentially concerned with the main topics of what can be called the “old” metaphysics (van Inwagen & Sullivan, 2014; see above), with a special focus on the universals and the categories, both rooting in Aristotelian metaphysics. Although there was no explicit notion of an ontological commitment (even because there was no notion that one was “making” ontology), it is today possible to analyze medieval ontological constructions from this perspective. For instance, Porphyry’s tree (Fig. 2) can be said to be a reductionist and revisionist upper ontology: The frugality of categories it considers is obvious, and their selection is based on a philosophical theory, namely Aristotle’s theory of the categories. I think it is safe to say that it is an endurantist upper ontology, as time appears to play no role whatsoever in it. This is a feature that can be generalized perhaps to most medieval ontologies, the Christian belief in creation and its immutability being possibly to account for this, even if time was not absent from philosophical discussions, namely in its association with change (see, e.g., Porro, 2001; see also Rudavsky, 2000). Equally, most medieval ontologies can be said to be reductionist and revisionist; despite the frequent tendency to be “generous” to a fault with their partition refinements, this was basically not done (explicitly) from the viewpoint of human cognition and medieval ontologists were convinced that their distinctions had an authoritative basis.

In particular, up to the 12th century the theoretical stance underlying ontological investigations was *realism*, the ur-elements of reality being considered as having a real existence, as being products of *natural operations*.<sup>14</sup> Thus, ontology “making” was concerned with isolating all the real entities. These were not only the natural things, but also the forms in the *verbum*, so that one can speak of *realism of forms*, or *Platonism*. This changes in the 13th century with the emergence of a strong form of intellectualism (Augusto, 2009).

#### 3.2 The Context and Goals of the *De origine*

One of the major debates in medieval philosophical thought that spanned basically all the subjects, from logic and grammar to metaphysics and physics, concerned the universals (see Porphyry’s tree above): Are they real, i.e. natural kinds (Latin: *res*), or are they solely mental entities such as, say, names (*nomina*) or concepts? This question caused emotions to fly high, and on its reply depended the status of any ontological construct; this, in turn, impacted on their epistemic status. Fact is that with the discovery of both all the major texts of Aristotle and the works of the Arab Hellenizing philosophers, or *falasifa*, in the 12th century the association between ontology and epistemology became uncomfortable, as it created a tension between the Christian view of reality and its philosophical—i.e. Aristotelian and Arabic via Neoplatonism—explanation. What of divine creation in light of the Aristotelian causes? What exactly were the intellectual powers of humans according to the hierarchy of

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<sup>14</sup>Divine operations were related to the created world, so this fostered realism in metaphysics.

intellects transmitted by Arabic philosophy? What is the complete ur-segregation of entities?

The introduction in medieval Latin philosophy of the Arab theory of intentions provided a direct reply to the last question in the 13th century:

$$\text{Entity} \left\{ \begin{array}{l} \text{Natural} \\ \text{Mental} \left\{ \begin{array}{l} \text{Intention} \left\{ \begin{array}{l} \text{First} \\ \text{Second} \end{array} \right. \end{array} \right. \end{array} \right.$$

Briefly, reality comprised both natural entities and mental entities, or intentions. The entities of first intention were the concepts of natural entities, their *signs*, or what metaphysics calls today natural kinds, or even just their mental names, and the entities of second intention were essentially the universals (*genus*, *species*, etc.), seen thus as *signs of signs*.<sup>15</sup> It should be remarked that there is actually an ontological superiority of the first intentions with respect to the second ones, which were seen as mere *entia rationis*, beings of reason, with an inferior ontological status. Intention (*intentio*, in Latin) was conceived as something in the human soul or psyche that by nature signified something else (it so to say *tended* to the outer world, *tending* being the original meaning of the related Greek verb *enteinein*), but it could also be taken as understanding, or knowing.<sup>16</sup> So, we are here in the realms of both epistemology and ontology; in other words, the very first distinction of entities is one that concerns the cognition of reality. More specifically, Dietrich attributes to the things of first intention the ontological ur-phenomenon by means of which an entity firstly differs from nothingness in a formal way.

This, of course, is *epistemological idealism* (Augusto, 2005, 2006a), or, if one wants the benefit of reservations, *intellectualism*, a trend initiated in late medieval philosophy by Albertus Magnus and prolonged by the other Dominican scholastics (see Augusto, 2009). At the basis of this late medieval stance is an incipient representationalist theory of mind that has its roots in Aristotle (Augusto, 2006b). Figure 6 shows concisely the semiotic triangle for the conception of Dietrich's *De origine*.

So, what Dietrich of Freiberg had in mind when writing on the origin of the categories promised to be of impact. In his Introduction to this text, Dietrich began by stating the objective:

(Intr.,1) As the Philosopher says in his *Sophistical Refutations*,<sup>17</sup> when the common things are not known, it is inevitable that there lack the knowledge of the particular ones. Most common of all are the entity (*ens*) and those things that belong to an entity essentially. I speak of those things that belong to an entity essentially either as parts of an entity, or as passions and proper accidents essentially belonging to an entity as an entity.

<sup>15</sup>In Latin: *res primae intentionis* and *res secundae intentionis*. See Gyekye (1971) for the very complex adoption of this distinction in later medieval philosophy.

<sup>16</sup>I use here the terms *soul*, *mind*, and *psyche* interchangeably; the later medieval intellectualist reading of Aristotle's *De anima*, I argue (e.g., Augusto, 2006b), sanctions this interchangeability.

<sup>17</sup>Aristotle, *Soph. el.* I, 1, 164a21-2. I give here the references exactly as they are given by L. Sturlese in Dietrich of Freiberg (sd/1983). I refer the reader to this work for the complete references.

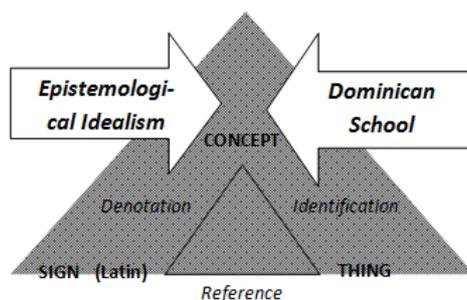


Figure 6: Semiotic triangle for the conception of *De origine*.

Interestingly, in only a few introductory sentences, Dietrich manages to use the main concepts of what today we call an upper ontology, either implicitly or explicitly: With respect to the former, Dietrich mentions the universals (“common things,” in the passage) to then mention the particulars explicitly; still in this manner he uses the terms “part,” “passion,” and “accident.” Also indirect is the reference to the essence of an entity. The aim is epistemological, i.e. all these ontological items are meant to allow for knowledge of both the universals and the particular things.

Dietrich goes on to state that the first parts of an entity are the categories, and thus he proposes to investigate them with respect to their origin and nature. For convenience, I here leave the translated paragraph:

(Intr., 2) But the genera of the categories (*res praedicamentales*) are the very first parts of an entity. Therefore, we must somehow examine them in general, that is, the origin and nature of the categories.

It must be remarked that the categories in the semiotic triangle of the *De origine* (see Fig. 6) were the ten original Aristotelian categories (*substance, quantity, quality, relation, place, time, position, state, action, and passion*), but they were typically considered from the viewpoint of the Porphyrian universals mentioned above (*genus, species, differentia, proprium, and accidens*). After briefly explaining what had led him to elaborate on a subject of such “exceedingly obscure difficulty”—some friends had asked him to write something on it, and since so many had written so much about it, he saw no reason why he should not oblige them—Dietrich states the topic of the first part of the *De origine*:

(Intr., 5) In the first part, the origin of the categories in general and, together with this, the nature and origin of the substance in particular are dealt with.

So, the first part of the *De origine* elaborates on the origin of the categories with a focus on the substance, the very Aristotelian “ur-category.” Before I give the translation of this text, I provide a brief elaboration on causality, as in fact Dietrich is going to write on the origin of the categories and of the substances from a causal viewpoint.

### 3.3 Causality, Medieval Ontology, and Dietrich’s “Bombs”

Augustine wrote in various passages—profusely so in his *Confessions* (Augustine, sd/1992)—that human knowing was an act of illumination in which humans were “illuminated” by divine grace with the forms in the *verbum*. Quite differently from Augustine, possibly the biggest philosophical *auctoritas* until the 12th century and who was very much influenced by the Platonic theory of ideas, Aristotle thought that in order to know the objects of reality one needed to know their *causes*. When the full extent of his thought reaches the later middle ages, the Augustinian *verbum* does not exactly lose its explanatory power with respect to how humans know the constituents of reality, as its elements are the universals, which according to Aristotle were to be found in the human soul (see Augusto, 2006b). But humans live in a world of particular things—i.e. instantiations of the universals—and the theory of illumination lost much of its spark to explain how we know these when the four Aristotelian causes provided what appeared to be a better epistemological account.

White (2018) starts an encyclopedia article on medieval philosophy and theories of causality with these words:<sup>18</sup>

Causality plays an important role in medieval philosophical writing: the dominant genre of medieval academic writing was the commentary on an authoritative work, very often a work of Aristotle. Of the works of Aristotle thus commented on, the *Physics* plays a central role. Other of Aristotle’s scientific works—*On the Heavens and the Earth*, *On Generation and Corruption*, and, of course, the *Metaphysics*—are also significant for the study of causation: so there is a rather daunting body of work to survey.

And, in effect, all these texts are (explicitly or implicitly) mentioned in the first part of the *De origine*. But not only these Aristotelian texts are mentioned or invoked: Commentaries thereon by Averroes, the most influential Arab commentator of Aristotle in the late middle ages, as well as texts from Avicenna, another influential Arab philosopher, and the Neoplatonist Proclus, to mention the most important *auctoritates*, feature abundantly in this treatise. In the translated text, the reader will have the opportunity to read what Dietrich of Freiberg thought their stances and theories were, and it suffices here to review briefly Aristotle’s four causes. According to Aristotle, every natural entity has a *material cause* (its matter, that which it is made of), a *formal cause* (its form, or the arrangement of its parts), an *efficient cause* (that or who makes it be what it is by means of acting upon it), and a *final cause* (what it is for).

Dietrich agreed with all these causes, but he wanted to add another one. To begin with, he considers the following basic distinction of causes:

$$\text{Cause} \left\{ \begin{array}{l} \text{Natural act} \\ \text{Mental act} \end{array} \right.$$

In other words, whatever exists is caused either by a natural act or a mental act. This is actually an ur-partition, which means that the disjunction is exclusive. In

<sup>18</sup>I refer the reader to White (2018) for the complete references of the cited works by Aristotle.

a progressive analysis of the kinds of entities that exist in relation to their causes, Dietrich of Freiberg concludes that seven of the Aristotelian categories have their causal origin in the mind or psyche (his first ontological “bomb”), but not as things of second intention; they are actually things of first intention, it being the case that it is in virtue of these that a thing, an entity, firstly differs from nothingness in a formal way (the second “bomb”). In other words, that a thing is, or can be, known.

### 3.4 *Treatise on the Origin of the Categories: Translation of Part 1*

*On the origin of the categories in general and, together with this, on the cause and origin of the substance in particular*

(1) The manner of originating or beginning an entity according to which that entity essentially depends on its very own principle is threefold.<sup>19</sup> By entity, I here mean that which is in itself, and which is complete in terms of the act that belongs to it according to its own genus; I also mean that which has the nature and the character of an entity in its essence, and not according to the sole designation.<sup>20</sup> I here mean to say the direct dependency that is considered in terms of some causal origin, not as it is in the entities that depend on others as on a necessary cause, or as any other possible manner of indirect dependency.<sup>21</sup>

(2) Such an entity, I say, in one way is originated or begins from something else in terms of cause; which indeed makes it so that such a causal principle is outside the essence of a thing, but it nevertheless assembles and constitutes that thing in its being in the manner of either an efficient principle, or an end.<sup>22</sup>

(3) In another way, a thing is originated from those principles that are in its essence and, out of these components that qualify it, it subsists thanks to that very essence; of this kind are the matter and the form in the composite things.<sup>23</sup>

<sup>19</sup>“Beginning” may appear odd here, but think of “beginning a drawing,” “beginning (to write) a book,” “beginning an argument,” etc.

<sup>20</sup>To be sure, a circular definition in the second part (after the semicolon) and the first part also needs clarification. Roughly, according to Aristotelian metaphysics an entity is either in itself (or essentially) or in another entity (or accidentally). What exists in itself, or *subsists*, i.e. has an independent existence, is a *substance* (from the Latin *substare*, to underlie); what exists in a substance is an *accident*. This said, accidents, too, as entities have their own *essence*, that which makes them be what they are. Also in Aristotelian metaphysics, there are two modes of being in which any entity can be, to wit, in *act* or in *potency*. For instance, and to put it simply, a piece of marble is a statue-of, say, a horse-in potency, whereas the statue itself is a statue in act. In this interpretation, to be in act for an entity is to attain the realization, or completeness, of its potency. Obviously, being in act can only be so from the viewpoint of the genus of an entity: An animal (say, a horse) can only be in act as a living animal, and not as a statue of an animal.

<sup>21</sup>Dietrich clarifies what he means by beginning or starting an entity: This must be taken in the sense of a *causal origin*, so that the caused entity *depends directly* on the cause.

<sup>22</sup>First type of cause: The Aristotelian efficient and final causes, here considered as extrinsic causes (or causes proper). I call them **OUT-causes**.

<sup>23</sup>Second type of cause: These are the Aristotelian material and formal causes, here taken as intrinsic causes (= principles). I call these **IN-causes**. Note that Dietrich speaks here of “composite

(4) And this difference between these two ways is considered by the Commentator in *On the Fifth Book of the Metaphysics*,<sup>24</sup> where he distinguishes the notions of principle, element, and cause according to the ways above, to wit: Causes proper are those which originate a thing from outside its essence; elements are actually those that do it from within a thing; principles are those that originate a thing both from outside and from within.<sup>25</sup>

(5) But there is a third way in which something takes the notion of its entity from something else, still unnamed—make up a name for it as you wish, as long as it agrees with its character and truth. More often than not one sees this way considered in terms of some analogy, as it will be evident below. This way is that in which something is a principle for another in such a way that by virtue of this very principle existing outside the essence of that whose principle it is, by virtue of that same principle does it, whose principle it is, nevertheless subsist formally, inasmuch as it takes from that same existing principle the notion of its entity or quiddity from our conception of it.<sup>26</sup> Hence, it falls in the definition of that entity stating what it is as an entity. And in this way are the things of a kind other than the substance inasmuch as they are entities, as it will be shown below, where this way will be distinguished.<sup>27</sup>

(6) The notion of entity is different according to these three ways, in terms of which it is reduced to some kind of these principles.<sup>28</sup>

(7) In fact, if an entity is considered in terms of its intrinsic principles, and this with respect to the second aforementioned way, then a thing formally has according to itself, absolutely, the notion of entity, which is the first of all intentions, by means of which a thing firstly differs formally from

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things,” or things with parts, which suggests that there are also simple things (i.e. things without parts). In any case, Dietrich states that the IN-causes are *qualifying*.

<sup>24</sup>Averroes, *In Aristotelis Met. V*, comm. 4, ed. Ponzalli 83.

<sup>25</sup>“The Commentator” (of Aristotle) was a usual way to refer to Averroes in later medieval philosophy, i.e. medieval philosophy in and after the 13th century, approximately. Note how Dietrich invokes the authority of Averroes to support his own exposition of a tripartition of causes, even if—as is the case—Averroes’ tripartition does not completely match his. But *auctoritas*, concretized in *auctores* or *auctoritates*, was a central concern for medieval philosophers.

<sup>26</sup>I.e., from our understanding or comprehension (*intellectus*, in Latin) of it. Still better: from our knowing or conceiving it.

<sup>27</sup>The *definition* of an entity (*definitio entis*, in Latin) is the same as its *essence* (*essentia entis*), though it tended to be used more frequently in logical writings. This is a central paragraph in this text: Dietrich introduces the third way of giving origin to, or causing, an entity. This is the way in which something’s *principle* (so, an IN-cause) is a *cause* (so, extrinsic to the entity that is thus originated, or an OUT-cause) with respect to some other thing, but thanks to which this other thing subsists formally. Dietrich calls them *extrinsic principles*, which can be a source of confusion; I call these the **OUTIN-causes**. As we shall see below, these are the causal origin of some—seven—of the Aristotelian accidents. The notion of *formal subsistence* is related to the *form* as the *entitas*, or quiddity (*quidditas*) of an entity, a core concept of medieval metaphysics that can be said to capture what (*quid*) a thing is, i.e. its complete definition, the collection of all its essential attributes. Importantly, this formal subsistence is “given” to a thing via the *conception* we have of it. Anticipating contents in part 5 of *De origine*, these OUTIN-causes are the principles of cognition in the human mind. So, Dietrich is laying out the path to elaborate on his view that the human mind can also be a causal origin for an entity.

<sup>28</sup>Three different causes, three different entities; Dietrich announces his ur-partition of entities according to the ur-partition of causes briefly elaborated on above.

nothingness.<sup>29</sup> For when something is said to be an entity, there is only a certain formal account thereof in terms of that intrinsic principle of itself by means of which a thing subsists formally and in terms of the act, which is the form in the composite things, or the essence in act alone in the simple things.<sup>30</sup>

(8) Concerning these simple essences, the Philosopher says in Book VIII of the *Metaphysics*<sup>31</sup> that there is no matter in them, either sensible or intelligible, each and every one of them being immediately one and an entity just like those entities that do not belong to their genus:<sup>32</sup> Which simply means that each and every one of these simple entities in terms of its essence is one and an entity without the participation of any extrinsic cause. Which is equally true of the composite things inasmuch as each and every one of them subsists formally in terms of its intrinsic principles, even if, because they proceed from the potency to the act, they also contain an extrinsic cause, as the Philosopher says in the same place.<sup>33</sup> Hence the Commentator in his *On Book XI of the Metaphysics*,<sup>34</sup> where the Philosopher<sup>35</sup> distinguishes between the intrinsic causes, which are the matter and the form, and the extrinsic causes, which are the end and the efficient cause, for the reason that the latter precede the thing while the former are simultaneous with it, says: “The causes by virtue of which a thing becomes an entity and a unity occur together with that which on account of them becomes the whole simultaneously, given that they have such a determination in the aggregate as do the parts in the whole.”<sup>36</sup>

(9) Thus, an entity is said to be in an absolute sense thanks to its essence in terms of its intrinsic principles. And because an entity said in these terms

<sup>29</sup>A central passage: An entity differs *formally* from nothingness, or non-being, thanks to the first intention, i.e. its mental conception (see Part 3.2 above). Note that Dietrich does not say that an entity exists *simpliciter* thanks to the first intention. So, we have here already two types of existence, one of them being at a solely formal level.

<sup>30</sup>The form, of the two IN-causes, has ontological superiority in the sense that it is the principle thanks to which a composite thing subsists formally; the simple things subsist formally thanks to their essence in act alone. The point to keep in mind here is that *form* can thus be equivalent to *essence*. But this requires us to think of form not in the sense that a chair has the form of a chair (the Aristotelian formal cause), but that an entity may exist solely formally. This notion of form is particularly interesting for mathematical objects, for instance, such as the numbers and geometric shapes.

<sup>31</sup>Aristotle, *Met. VIII*, 6, 1045a36-b1; 1045b5-6.

<sup>32</sup>Note the fact that there are two types of matter, intelligible or sensible.

<sup>33</sup>Aristotle, *Met. VIII*, 6, 1045b20-22.

<sup>34</sup>Averroes, *In Aristotelis Met. XII*, comm. 16, Venetiis 1562, 302vH.

<sup>35</sup>Aristotle, *Met. XII*, 3, 1070a21-22.

<sup>36</sup>This paragraph affirms the ontological superiority of the IN-causes: There are substances that are originated from them alone (the simple essences have as cause only the form) and even the composite things, in which there is a relation between the whole and the parts, could not subsist without them. The reason for this superiority is, according to Dietrich, the fact that they are required for a thing to subsist formally, and this is what first distinguishes a thing from nothingness (see above). On the other hand, Dietrich is also stating the latter's ontological status as entities, i.e. it is not because they have OUT-causes that they have a lower status when compared to the simple essences. The difference between both is that, as Dietrich writes in the next paragraph, the simple essences have no accidents, and are thus not subject to change.

does not contain any cause,<sup>37</sup> that is why it is free from all accidents entailing some nature or thing determining the very essence of a thing, thanks to which a thing is in some way in relation to change. And the reason for this is that each and every one of such accidents is some form and act of an entity that is a substance, even if in an accidental way; therefore, the relation of a substance to such a form is the relation of the existing in potency to the act.<sup>38</sup> Nothing, however, that is such can actualize itself; that is why a substance, according to the notion thanks to which it is an entity in an absolute sense by virtue of its essence, is not the cause of such accidents except in terms of the matter and of the subject. Thus, such forms become in a substance by virtue of a cause that is extrinsic to the essence of that which is the subject of such accidents, namely by means of a generator, if they are accidents essentially, or, if they are not, by a mover in some other way. And the Philosopher indicated this in *Of Physics* I,<sup>39</sup> where he says that the matter together with the form is the cause of those entities that are in substances, like the mother. Unless due to a more formal faculty, which is that of the agent, the mother is not a principle in generation; in the same way accidents are not in a substance unless thanks to another principle extrinsic to the subject.<sup>40</sup>

(10) Therefore, whatever things are in an entity in an absolute sense in terms of the essence, they are so in the absence of any extrinsic cause; and on account of this, properly speaking, such things do not have a real cause other than the essence of the thing in which they are, as are the one and the many and their differences.<sup>41</sup>

(11) And from this it also follows that such things do not entail any nature or any natural thing superadded to the essence, nor are they accidents proper, but properties of a thing due to whose inexistence a thing is not something better, as it is said in *Of Physics* II;<sup>42</sup> but that which is said to be a thing on account of them is essentially in terms of its quiddity and essence.<sup>43</sup> But this is not so in the natural things, in which case, from some accidents superadded to a substance, the notion of the good and of the proper in nature is considered in terms of the end, in relation to which

<sup>37</sup>OUT-cause.

<sup>38</sup>Dietrich relates the accidents to the substance as the relation of the existing in potency to the act. Interestingly, it appears that without the accidents an entity could not be in act. The entities meant here are not the simple ones, as these are not subject to change (e.g., the numbers?), but the composite substances.

<sup>39</sup>Aristotle, *Phys.* I, 9, 192a13-14.

<sup>40</sup>Another hard nut to crack, but the idea is that accidents exist in a composite substance not thanks to its IN-causes simpliciter (the matter and the form) but thanks to an *extrinsic principle*, or OUTIN-cause, where again the apparently contradictory combination “extrinsic principle” in (5) is meant.

<sup>41</sup>These—the one and the many and their differences—are not accidents, as they are in an entity in an absolute sense in terms of its essence, so thanks to IN-causes alone. These are called *properties*. See (11).

<sup>42</sup>Aristotle, *Phys.* II, 2, 194a3-7.

<sup>43</sup>That is, the properties belong to the quiddity or essence of an entity. In other words, theirs are IN-causes alone. Also, the entities meant here are the simple entities, so that in fact simple entities just are their properties.

an agent makes such accidents in a subject.<sup>44</sup>

(12) Therefore it is evident what the notion of entity is according to which it is considered as subsisting only in terms of its intrinsic principles, that is, that according to this alone it formally has the character of an entity; and this manner firstly and essentially befits a substance.<sup>45</sup> Hence, to reflect on this entity and its proprieties in these terms is the proper job of the metaphysician.<sup>46</sup>

(13) If, however, a thing is considered in relation to its causes, and this with respect to the first of the aforementioned ways,<sup>47</sup> then it falls off the said notion of entity. Indeed, according to this something is said to be an entity inasmuch as emanating from some productive principle with a view to some end. And according to this it has a natural character and denomination by virtue of the broad sense of the term ‘natural,’ so that one means nature not only inasmuch as it is a principle of change and rest, as in the *Physics*,<sup>48</sup> but also so that nature is said whatever is a principle of some real operation, subject, or end according to which the individual entities are said natural things. And according to this each and every entity is said to be a natural thing in relation to its causes,<sup>49</sup> namely inasmuch as it is from a natural act in relation to some end, which is by nature, in which it participates by means of its natural operation: indeed, an agent does not act essentially except with a view to an end; otherwise, its action would be merely by chance, as it is said in *Of Physics* II.<sup>50</sup>

(14) If therefore such a thing is by its essence originally able to be in relation to an end and to participate in the perfection of its end, the sort of things that the philosophers believed to be certain entities they called intelligences,<sup>51</sup> in such entities, I say, there must be no accident, because, as it is said in *On the Heaven and the World* II,<sup>52</sup> each and every entity is for the sake of its operation. Indeed, the operation is the end within, by means of which end an entity participates in an absolute way in the perfection of the end. If there were such entities, as the philosophers believed, and they according to them are by their essence the principle

<sup>44</sup>Contrary to the simple entities, the natural things have accidents, and these entail an OUT-cause, the end (the Aristotelian final cause).

<sup>45</sup>The substance is separated from the remaining nine Aristotelian categories: Substances have solely IN-causes, and it is thanks to these alone, namely to the form, that they can be said to be *formally* an entity. The importance of the adverb of manner “formally” in this text is crucial: Without subsisting formally, an entity cannot be *known* by the human mind (although, anticipating Kant, it can be *thought*; see (14) below).

<sup>46</sup>So, metaphysicians study *pure* substances, the natural things being outside the scope of metaphysics. The natural things–substances with accidents–fall, of course, in the scope of physics. In other words, the subject of the metaphysician is *formal existence*.

<sup>47</sup>OUT-causes.

<sup>48</sup>Aristotle, *Phys.* II, 1, 192b20-23.

<sup>49</sup>OUT-causes.

<sup>50</sup>Aristotle, *Phys.* II, 8, 198b34-199a12.

<sup>51</sup>E.g.: *Liber de causis*, prop.7 – 13, ed. Pattin, 149-64; Proclus, *Elem. theol.*, prop. 20, ed. Vansteenkiste, 273; *ibid.*, prop. 166-183, ed. Vansteenkiste, 514-521; Avicenna, *Metaph.* IX, 5, Venetiis 1508, 104v – 105r; Averroes, *In Aristotelis Metaph.* XII, comm. 38, Venetiis 1562, 321rF – vG; *ibid.*, XII, comm. 51, 336rD, 336vL – M.

<sup>52</sup>Aristotle, *De caelo* II, 3, 286a8-9.

of their operation,<sup>53</sup> there would be in them no nature extraneous to their essence, to which extraneous nature accidents belong: In vain would entities be that nature does not allow. Hence the Commentator in *On Metaphysics* XII says:<sup>54</sup> “One must know that substances are in two ways: A way in which it is impossible to avoid accidents, and another without any accident; the former is sensible, the latter, however, is intelligible.” And there he speaks of the separate substances according to his and other philosophers’ opinion.<sup>55</sup>

(15) But if there are such entities that are not originally able to attain the perfection of their end except by means of some altering and altogether motive change in themselves, in all such entities it is necessary to find other natures extraneous to their essences, which are the principles of such changes in an active or in a passive way.<sup>56</sup>

(16) But the principles of such changes essentially and immediately are qualities. Hence, it is necessary that local change precede in the natural things.<sup>57</sup>

(17) But before anything else continuous quantity is required in all the active and passive things, and in the altogether motive according to nature. In fact, it is only right that the agent and the patient should be simultaneous, as it is said in the first Book of *On Generation and Corruption*;<sup>58</sup> it is indeed necessary that they have in their parts both distinction and extension, which happens thanks to quantity, whence quantity is, according to its genus, the first of all accidents in nature. Hence, and for this reason, in relation to a first moved continuum it first and foremost befits the first body to be a continuous quantum, as the Philosopher says in the beginning of Book X of the *Metaphysics*.

(18) This is nature’s reason and intention in constituting those accidents that entail a natural thing. It follows that—if there are some entities, which are called accidents, which are principles neither of a natural nor of

<sup>53</sup>Cf. *Liber de causis*, prop. 8, comm., ed. Pattin, 152; *ibid.*, prop. 13, ed. Pattin, 162-164; Proclus, *Elem. theol.*, prop. 167 – 168, ed. Vansteenkiste, 514-515; Avicenna, *Metaph.* IX 4, Venetiis 1508, 104vaA.

<sup>54</sup>Averroes, *In Aristotelis Met. XII*, comm. 25, Venetiis 1562, 310rB.

<sup>55</sup>Averroes, *In Aristotelis Met. XII*, comm. 25, Venetiis 1562, 310rB-E. These entities called intelligences (*intelligentiae*, in Latin) were an object of heated debate in medieval philosophy: Were these motors of the cosmos the biblical angels? The Dominican scholastics, Dietrich included, tended to distinguish these. See Piron (2008) for a comprehensive study of this issue. Important in this paragraph is the fact that Dietrich appears to posit yet another type of cause: The end, taken in the sense of the Aristotelian final cause, is an OUT-cause, i.e. extrinsic to the essence of the entity; here, however, he speaks of an *intrinsic end* with respect to the intelligences, correlating this directly with their operation. I leave this issue without an answer (see Figs 8-9). What we can draw from this paragraph is that the intelligences do not have accidents, or “attributes,” and Dietrich appears to accept the Aristotelian ur-segregation between sensible and intelligible substances.

<sup>56</sup>The adjective “motive” has to do with *motion* (or *movement*) and *change* (*motus*, in Latin), a particularly equivocal concept in the sense that it translates the Aristotelian *kinêsis* (which includes change of place), but also *metabolê* (change, as in, for instance, being generated and getting older). This was a central concept for Aristotle, who saw it as the *sine-qua-non* notion to understand nature.

<sup>57</sup>Dietrich appears to say that *qualities* in a natural thing have OUT-causes, and they are in turn the IN-causes for *changes*.

<sup>58</sup>Aristotle, *De gen. et corr.* I, 7, 323b31-33.

a real operation, as are some relative determinations and that very entity that is the ‘when,’ and certain other entities—such entities are not from a natural act. For nature does not act unless in relation to an end, which is some nature, an end that a thing attains by means of its natural or real operation.<sup>59</sup>

(19) But as in entities there are only two kinds of principles, to wit, nature and the intellect, if such entities are not constituted by a natural act, it is necessary that they be of the other sort and be reduced to the other kind of cause, which is the intellect.<sup>60</sup> However, not in that way as those entities that are from an operation of the intellect in such a way that they are things of second intention, which do not belong to any kind of real entities in a determinate way: These truly are things of first intention essentially according to their own reasons classed in a genus, more precisely constituting some of the very ten genera from scratch. For not all entities that are from an operation of the intellect are things of second intention, but only those that are from an act of the intellect in such a way that they are the forms from the part of reason under which things become rational, and which are not considered to be something of a natural entity, reason why they are more conveniently said to be things of second intention and things of reason.<sup>61</sup>

(20) But these entities of which we speak are from an act of the intellect in such a way that the intellect determines them in relation to the natural things as certain forms and as manners of the natural entities, and this according to the different determinate natures of the different genera. Hence, it is also necessary that the natural entities fall in the definitive<sup>62</sup> notion of these as that which is the most formal in the definition, inasmuch as they are entities in that they take the notion of their entity from these that are natural entities. And because according to this manner they are something of the entities naturally real, which are things of first intention,<sup>63</sup> that is why they are also things of first intention classed in a genus according to their own notions, of all which entities the constituting principle is, nevertheless, the intellect. However, the end is not for them some nature, according to what nature is distinguished from those that are in the intellect, but their end can be said some perfection that is acquired

<sup>59</sup>The remaining seven of the Aristotelian accidents—relation, place, time, position, state, action, and passion—are not caused by a natural act. Note that they are caused by OUTIN-causes, because they were removed from the OUT-causes and they cannot be IN-causes, either.

<sup>60</sup>*Et voilà!* Dietrich is finally getting to the point. Recall that for Dietrich *principles* are what I call IN-causes; so, he is saying that the *ur*-IN-causes of an entity—and these alone—are either natural or mental.

<sup>61</sup>This is the paragraph in which Dietrich “throws the first bomb”: If the remaining seven accidents are not in a substance due to a natural act (i.e. due either to IN-causes or OUT-causes), then necessarily they must be caused by the intellect, as there are only two kinds of *ur*-principles, nature or the intellect. But these accidents are not mere things of second intention, or things of reason (*entia rationis*), by means of which things become rational and as they were typically spoken of; for Dietrich, these accidents truly are things of first intention. Where is Dietrich bound to?

<sup>62</sup>That defines.

<sup>63</sup>Is Dietrich putting the things of first intention on the same footing with the natural things, i.e. is he saying that they have the same ontological status?

by an action of the intellect.<sup>64</sup>

(21) That such entities are caused by an act of the intellect, as well as in which way and for what reason they are classed in a categorial genus, and also their difference with regard to the things of second intention, all these issues shall be examined below from the beginning of the second part and in turn.

(22) It is thus evident what the notion and manner of being is according to the consideration of its causes, and what sort of entities according to this do or do not exist in it according to what underlies its causes.<sup>65</sup>

(23) But with respect to the third aforementioned way of creating things dependent on some thing by essence, it must be observed that such a way cannot befit substances. In fact, substances have by themselves and absolutely the character of a complete entity, both with respect to the perfection of their formal act and with respect to the perfection of the end, and not from the fact that they are formally something of some thing or from some thing in terms of the form, in which consists the whole notion of this third way.

(24) Hence, this way is only to be found in those entities that are in substances. To originate a thing in such a way that the very principle is outside the essence or outside the substance of that whose principle it is, neither in the way of an efficient cause or of an end, but by means of which the thing formally has its essence, nor, however, from an act or form exemplifying it, but rather, so to speak, quiddifying it, this, I say, cannot befit but those entities whose essence consists in being something of some thing, namely in being a manner or a determination of some substance that really is an entity, or in being a property either of a substance or of some other thing of a different nature.<sup>66</sup>

(25) And because all such entities either truly are accidents or have the manner of an accident,<sup>67</sup> that is why regarding all of them we verify what the Philosopher says in the beginning of Book VII of the *Metaphysics*, to wit, that accidents are “entities, because they belong to an entity”.<sup>68</sup> In fact, their whole entity is none other than that they are something of an entity that is a substance. And this is the notion of the analogy that is considered between a substance and the actual accidents inasmuch as they sustain the categorization of an entity, as is said in Book IV of the *Metaphysics*.<sup>69</sup> Which analogy is not in terms of something that happens to a substance or to an accident, but each one of them is said an entity thanks to its essence. Indeed, the intention of being is the first and most formal of all intentions, and according to it a thing is first known as being

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<sup>64</sup>Dietrich does after all distinguish the natural things and the things of first intention, though the distinction is a very subtle one.

<sup>65</sup>So, Dietrich is quite finished with the top level of this causality-based upper ontology, to use contemporary jargon (see Part 2 of this article).

<sup>66</sup>Dietrich sums up his distinction substance vs. accident.

<sup>67</sup>Dietrich appears to say that properties have the manner of an accident.

<sup>68</sup>Aristotle, *Met.* VII, 1, 1028a18.

<sup>69</sup>Aristotle, *Met.* IV, 2, 1003b5-6.

formally distinct from nothingness. Which cannot be thanks to something that would happen accidentally to a thing.<sup>70</sup>

(26) Hence, a substance is said to be an entity by its essence in terms of absolute subsistence, but those entities that are in substances are similarly said to be entities by essence, though in relation to a substance.

(27) Not as in relation to a cause, though this is true, that is, that substances are the causes of accidents: In fact, every accident is said to be an entity by its essence, not involving any cause, as was said above.<sup>71</sup>

(28) Nor in relation to a substance as to a subject in terms of inherence, if one may speak like this. In fact, the relation to a subject in terms of inherence by nature and by the intellect is posterior to that which inheres; hence, those entities that inhere in substances do not have their entity from this relation.<sup>72</sup> According to this notion of inhering, out of such a form and a subject an entity is created accidentally, or relatively, whose principle, in that it is such an entity, is not only the subject but in fact the inhering form, precisely rather the very form, as it is in terms of the act the principle of such an entity. Hence, according to Avicenna to be in a subject is not the essence of an accident, but a natural property of its.<sup>73</sup>

(29) But each one of them is said to be an entity, because it is a certain manner or a determination of an entity, and this is the essence of each one of them. Hence, also the definitions saying what each one of them is are by addition, and a thing of a different nature joins in, which does not happen in substances, as is shown in Book VII of the *Metaphysics*.<sup>74</sup>

(30) Because in reality neither a substance nor those entities that exist in substances are formally said entities in relation to their causes, as was said, given that a substance is said an entity in terms of absolute subsistence and an entity in itself in terms of the intrinsic formal act, and the entities that exist in it cannot have this perfection with respect to their quiddity and essential subsistence, that is why they only have the character of an entity according to this third way of originating,<sup>75</sup> which is to those entities

<sup>70</sup>Every entity differs from nothingness thanks to the intention of being, which is the first and most formal of all intentions. Recall that there are only two intentions, first and second, and we have already been informed that the accidents are not things of second intention. This is actually the paragraph in which the “second bomb is thrown”: Accidents are in fact substances, too, Dietrich suggests. Even if they are substances only by analogy, the fact is that it appears that Dietrich is putting the causal powers of the intellect on the same footing with the causal powers of nature. (Note that no causal divine powers are at all mentioned in this text, an interesting aspect in a medieval text on the causes of the entities that compose reality.) And he does so from the viewpoint of knowledge. As I state in Part 2 above, this is epistemological idealism, and a (very) strong one, for that matter.

<sup>71</sup>Cf. (9)-(10). Dietrich is saying that it is not the substances themselves that are the causal origin of the accidents; as seen above, if these are taken in themselves, then they are substances, too.

<sup>72</sup>The relation between substance and accidents cannot be one of inherence, either, as this relation is posterior to the existence of that which inheres, both by nature and by the intellect.

<sup>73</sup>Avicenna, *Logica* I, Venetiis 1508, 9va, l. 54-60. To be sure, taken as substances, then accidents, too, have IN-causes, namely properties if the form alone is considered.

<sup>74</sup>Aristotle, *Met.* VII, 5, 1031a1-3. But a difference between the substance and the accidents does exist: It is the very essence, or definition, of the latter to be superadded to substances.

<sup>75</sup>OUTIN-causes.

that are in substances as a complement of the second way,<sup>76</sup> which is that more appropriate to substances.<sup>77</sup>

### 3.5 A Causality-Based Upper Ontology: The Top Level

In the first part of the *De origine*, Dietrich elaborates on the categories in general and on the substance, the first category in the Aristotelian list, in particular. The remaining nine categories are for Aristotle the accidents, or, in a more contemporary jargon, attributes of the substance. Both the substance and the accidents are entities. It is here relevant to isolate his definition of these most basic ontological concepts:<sup>78</sup>

*Entity:* That which is in itself and is complete in terms of the act that belongs to it according to its own genus; that which has the nature and the character of an entity in its essence, and not according to the sole designation. (1)

*Substance:* That which has by itself and absolutely the character of a complete entity, with respect to both its formal act and the perfection of its end, and not because it is something of some thing, or from some thing, in terms of the form. (23)

*Accident:* That which is in a substance thanks to an extrinsic principle. By analogy, it is also a substance. (25)

This is the starting point for Dietrich's ur-partitioning of reality. As would be expected from any medieval philosopher who was a reader of Aristotle and his commentators, the ur-partition of the entities separates the substance from the accidents, but we must pair it with the ur-partition mentioned above that includes the entities of the first and of the second intention, so that we might have the following ur-partition:

$$\text{Entity} \left\{ \begin{array}{l} \text{Substance} \\ \text{Accident} \end{array} \right. \equiv? \text{Cause} \left\{ \begin{array}{l} \text{Natural} \\ \text{Mental} \left\{ \begin{array}{l} \text{Intention} \left\{ \begin{array}{l} \text{First} \\ \text{Second} \end{array} \right. \end{array} \right. \end{array} \right.$$

Dietrich's ur-segregation—a tripartition—of causes, in turn, is as follows:

$$\text{Cause} \left\{ \begin{array}{l} \text{Natural Act} \left\{ \begin{array}{l} \text{OUT-Cause} \left\{ \begin{array}{l} \text{Efficient} \\ \text{Final} \end{array} \right. \\ \text{IN-Cause} \left\{ \begin{array}{l} \text{Form} \\ \text{Matter} \end{array} \right. \end{array} \right. \\ \text{Mental Act} \left\{ \text{OUTIN-Cause} \left\{ \text{Formal subsistence} \right. \end{array} \right.$$

Dietrich's terminological distinction *cause* / *principle* / *element* is not always consistent, reason why I call his principles, or intrinsic causes, **IN-causes**, and his causes proper, or extrinsic causes, **OUT-causes**; I call **OUTIN-causes** what he refers to as extrinsic principles. It is important to emphasize, as Dietrich does in (1), that causes

<sup>76</sup>The IN-causes.

<sup>77</sup>Dietrich sums up the idea of why the OUTIN-causes are necessary when ur-partitioning reality.

<sup>78</sup>See footnotes in the translated text for clarification of concepts.

here are not to be taken as *necessary causes*, but rather as causes in the sense that they entail a *direct dependency* with respect to an entity, or its principle. Dietrich sees the former as indirect dependency and he calls the latter *causal origins*, i.e. causes that make it so that an entity begins to exist as such from its own essence.

In (7), Dietrich introduces a new ur-distinction of entities, appearing to say that accidents exist only in the composite substances (i.e. they do not subsist without them),

$$\text{Entity} \left\{ \begin{array}{l} \text{Substance} \left\{ \begin{array}{l} \text{Simple} \\ \text{Composite} \{ \text{Accidents} \} \end{array} \right. \end{array} \right.$$

and again one may wonder if this is directly paired with the ur-segregation of causes.

But this possible equivalence that would pair substances, either simple or composite, with a natural cause, and the accidents with a mental cause, either of the first or of the second intention, is not concretized. Indeed, when Dietrich is finished with the ur-segregation of both causes and entities, he starts elaborating on the “attributes” of the latter, and he then starts to diverge from the *auctoritates* he so far appears to have followed by and large. The main novelty is that he separates the accidents in two classes, and does so according to their causes (Fig. 7): Quantity and quality are isolated from the remaining accidents as having solely IN-causes or OUT-causes, respectively; the latter accidents have solely OUTIN-causes.

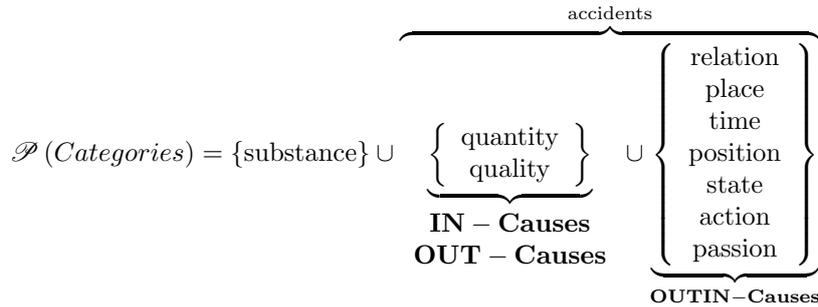


Figure 7: Dietrich’s causality-based ur-partition of the Aristotelian categories.

Figure 8 shows the top-level of Dietrich’s upper ontology. In this ur-segregation of the entity into simple and composite substances and their “attributes,” the intelligences pose a problem: They are said to have no accidents, and appear to have no other “attributes” whatsoever, being said to attain the perfection of their end by their own operation, or *intrinsic end*. But the end, in the sense of the Aristotelian final cause, is an OUT-cause. Is this “end within,” as Dietrich puts it, another type of cause? Moreover, if the intelligences have neither accidents nor any other kind of “attributes,” how can they be known? As a matter of fact, Dietrich appears to accept them at a purely theoretical level, referring to them as “the sort of things that the philosophers believed to be certain entities they called intelligences” (14), and suggesting the unlikelihood of their existence a few lines below this. We can consider these intelligences, as Dietrich appears to do, as purely theoretical entities like the ether, also called the fifth element or quintessence, which played a central role in physics until the late 19th century, namely in the theories of gravity and of the traveling

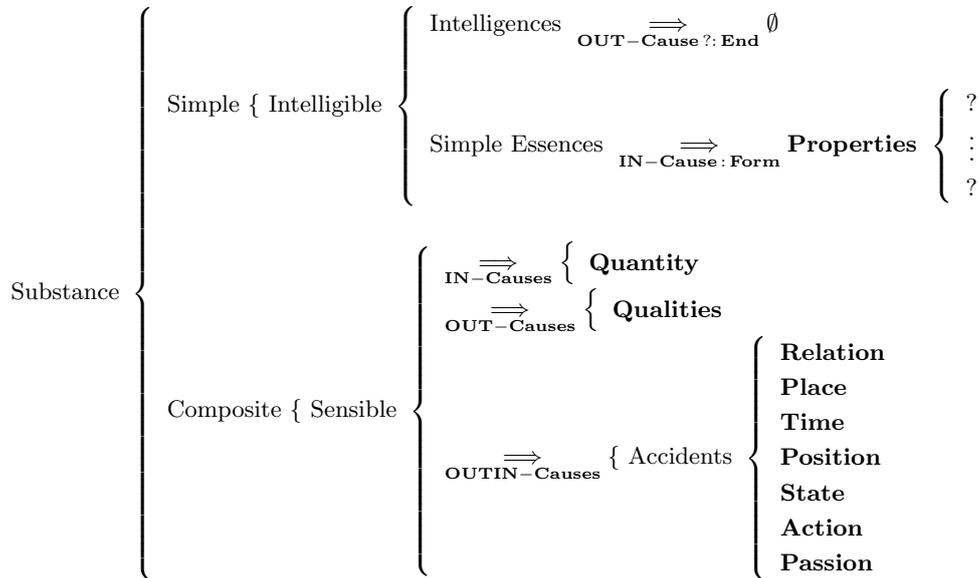


Figure 8: Ur-segregation of substances and their **attributes** by causal origin.

of light, and which resists removal from the (causal) ontologies of physics (see, e.g., Dirac, 1951). In effect, the fact that they appear to have no attributes whatsoever, or that they might have attributes that have so far eluded our cognitive abilities, might be theoretically useful to explain anomalies in physical models, to name just a possible application. I thus propose that we rename this potentially useful subclass of natural entities as *quintessences*, something already done by others in the field of natural science (e.g., Caldwell et al., 1998; Carroll, 1998; Cicoli et al., 2012; Zlatev et al., 1999), and leave open the question of their lacking of attributes or, if this is not an empty set, what they might be (like), namely in relation to their causal origin in their “end within” or operation.

Another question in this ur-segregation is posed by the properties of the simple essences, which Dietrich tells us are *not* accidents, but have the manner of accidents. He does not give any instance of a property in this first part of the *De origine*, but there might be an answer in the remaining parts 2-5. Also, if these simple essences are, as I think they are, mathematical objects like the numbers and geometric shapes, then an exhaustive listing of properties would be impossible (see, e.g., Korbmacher & Schiemer, 2018; Materna, 2007; Sfard, 1991). Suffice it for the time being to accept them as distinct from the accidents, which are exhaustively listed in Figure 8.

Focusing now on the ur-segregation of causes, Dietrich does not appear to consider more than the OUTIN-causes for the mental entities, but this poses the problem of what the causal origins of the things of second intention, as well as of things of first intention other than the accidents, if there are any, are. But these are the only new issues with this ur-partition, and as a matter of fact they might be (dis)solved in the remaining parts of the treatise (Dietrich will address the second intentions on part 2,

we are told). The proposed top-level of the causality-based upper ontology extracted from the first part of *De origine* is as shown in Figure 9.

## 4 Conclusions and Work to Do

Dietrich's original aim when writing the first part of the *De origine*, provided above in a translation from the Latin into English, was to elaborate on the origin of the categories in general and in particular on the substance, and in doing so he actually provided us with the top level of a causality-based upper ontology (see Fig. 9). Like most medieval upper ontologies—in the sense that we can today analyze medieval ontologies from this viewpoint—, this one is *reductionist*, with only a few ur-partitions, and *endurantist*, very little reference made to time except as an Aristotelian category. However, Dietrich considers time as an accident to be a mental entity, and this might suggest some anticipation of time, and possibly also space, as pure intuitions in the Kantian sense (see Kant, 1781/2007), a question undoubtedly worth researching into. Dietrich's, like most medieval ontologies, is also *revisionary*, based on Aristotle's highly complex metaphysics, but the exclusively revisionist character of this upper ontology is not certain: In later medieval philosophy, there is an emergent representationalist concept of the knowing subject that is assimilated by the Dominican scholastics, Dietrich of Freiberg in particular (Augusto, 2006a-b, 2009), and the fact that this upper ontology considers the very ur-segregation of entities to be that between natural and mental entities suggests a central role to the human mind. This aspect is not elaborated on in the first part of the *De origine*, but it is so in the remaining parts, and we can reach a definite conclusion in further work. My guess is that this upper ontology is both revisionary and descriptive.

The fact that it is a causality-based upper ontology rooting in a ur-segregation between natural and mental causes makes it of particular interest to today's effort of engineering upper ontologies for scientific domains, especially so for mathematics or other domains strongly rooted in mathematics. The numbers, for instance, if seen as simple essences, are real or natural entities that have only properties, whose causal origin is to be found in their IN-causes, namely in their form. Interestingly, in this particular point Dietrich can be said to advocate a realism of forms, or platonism. Quantity, another core concept in mathematics (though perhaps in applied rather than pure mathematics), however, is to be found only in natural composite entities, and has its causal origin in the IN-causes of the natural things, which correspond to the formal and material causes in Aristotle's metaphysics. But relations, central objects in contemporary mathematics, are here considered as mental entities, having as causal origin a novel notion of Dietrich's, the OUTIN-causes, or principles of something (thus *intrinsic* to this entity's essence) that are however *extrinsic* to something else, but without which this "something else," or entities like the relations, would not be able to subsist formally. I have argued (Augusto, 2006a) that these OUTIN-causes are the human mind's principles for the cognition of reality, and they are causal with respect to its objects in the sense that the objects *are* only insofar as they are *known*. This is epistemological idealism (Augusto, 2005), and a very strong form thereof, a topic that deserves more attention now in light of its import for (scientific) upper-ontology engineering.

The causality-based ur-segregation of entities carried out by Dietrich of Freiberg

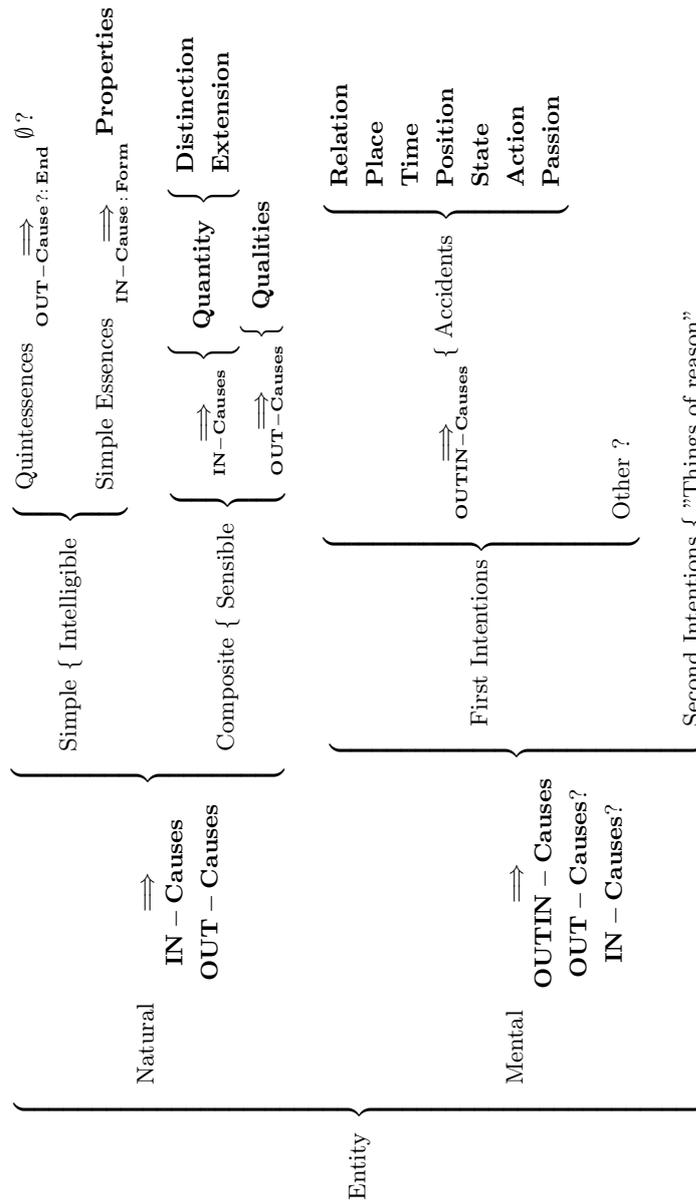


Figure 9: Dietrich's causality-based upper ontology: The top level.

impacts significantly on the whole of later medieval philosophy, and this also requires attention per se. For instance, the fact that he actually partitions the Aristotelian categories as shown in Figure 7 constitutes, in itself, an object for careful study, whose results promise to contribute to both our knowledge of this period in the Western philosophical tradition and today's ontological investigations in either MO or FO.

Importantly, Figure 9 shows but the *top level* of Dietrich's causality-based upper ontology, so that this might be more extensive or profuse. In paragraph (21) of the translation above, Dietrich tells us that in the second part of the *De origine* he is going to elaborate on the mental entities, namely those classified as categories, and also on how they differ from the things of second intention. I tackle these issues in a forthcoming article, in which I provide the translation of the second part of the *De origine*.

## Acknowledgments

My translation of *De origine rerum praedicamentarium* from the Latin into English was thoroughly reviewed by Kurt Flasch and Burkhard Mojsisch a few years ago. The many changes made after their review, namely those aiming at increased readability, might have introduced mistakes and inaccuracies.

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## Online Resources

- [1] <http://geneontology.org/>
- [2] <http://www.obofoundry.org/ontology/ohd.html>
- [3] <https://bioportal.bioontology.org/ontologies/MODSCI>
- [4] <http://mged.sourceforge.net/ontologies/MGEDontology.php>
- [5] <http://obi-ontology.org/>
- [6] <https://github.com/gruninger/colore>

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<sup>a</sup>Of the author's translation of *De origine* from the Latin into English