

On Substances, Accidents and Universals

In Defence of a Constituent Ontology¹

Barry Smith

phismith@buffalo.edu

Published in *Philosophical Papers*, 27 (1997), 105–127.

Introduction

This essay is an exploration of the ontological landscape of reality. Its aim is to construct an ontological theory which will do justice to reality, and more precisely to those portions or levels of reality which are captured in our ordinary, common-sense or ‘folk’ conceptual scheme.² We shall accordingly take as our starting point such examples of *individual substances* or continuants as human beings, oxen, logs of wood, icebergs, planets. In addition to substances the theory will have a place also for *individual accidents* – smiles, suntans, pains, beliefs – which inhere in substances, and also for *essential parts* of both substances and accidents, such as the humanity which

1. The theory of categories presented in what follows is a heavily revised and expanded version of the ideas set forth in Smith 1992. I should like to thank Alan Clune, Michael Gorman, Jorge Gracia, Shaun Cutts, Mariam Thalos, and the participants in the Greensboro meeting for helpful comments.

2. This scheme is outlined by Hoffman and Rosenkrantz in Chapter One of their 1994. Unlike Hoffman and Rosenkrantz, however, I am interested not in the scheme as such but in the reality which the scheme describes. The reality is indeed independent of the scheme: the discipline of paleontology, after all, describes the universe of mesoscopic objects as this existed before the evolution of human beings, and many other scientific disciplines, too, including anatomy and other branches of medicine, deal with mesoscopic objects in ways which dictate a conception of the latter as more than merely the products of ‘folk’ conceptions.

is an essential part of you, and the coloredness and extendedness which are essential parts of the redness of Rudolf's nose. Our theory of this ordinary reality will, accordingly, be broadly Aristotelian in spirit.

Some hints will be provided as to how the Aristotelian account of what we might call the mesoscopic world of individual substances and accidents might be extended in such a way as to comprehend also the micro- and macroscopic entities described by the various sciences. It must be admitted at once however that, while the means of extending the theory to certain disciplines, such as anatomy and geography, are already rather clearly understood, the task of extending it to physics remains a considerable challenge. This should not detract even one iota from the value to the realist of an ontology which begins with mesoscopic entities and their relations however. For mesoscopic entities do indeed exist, and the mesoscopic structures which they exemplify can be described, in realist fashion, even independently of how things will look when we are in a position to incorporate into our account the structures at finer levels of granularity.

In what follows, then, we shall restrict ourselves almost exclusively to the mesoscopic entities of common sense. Our approach to ontology is mereological. We examine the entities in the universe first and foremost in the light of the sorts of parts which such entities possess. Substances of the types listed above have first of all what we shall call substantial or material parts – for example your arm and my leg, the hemispheres of planets – which fall short of proper substancehood in being too small, just as aggregates of substances fall short of proper substancehood in being too large. Parts and aggregates of accidents, similarly, may be too small or too large to be counted as accidents proper. Those entities which do count as substances and accidents in the strict and proper sense will be the *atoms* of our theory. Atoms may be linked together to form molecules (the latter will be seen to bear a close resemblance

to the states of affairs of Wittgenstein's *Tractatus*).

Our theory will recognize not only individual parts (of substances and accidents), but also universal parts. Universals exist indeed only as parts, and we shall in fact embrace a strong mereological principle to the effect that all non-individual entities exist only as parts of individual entities. This implies the following:

Weak Law of Immanent Realism: If there is anything, then there is something individual of which it is a part.

The universal *humanity* (an essential part) relates to Tom or Dick as the universal redness relates to this or that individual redness. What follows is thus a constituent ontology of the sort described by Freddoso.³ A constituent ontology

aims at a general characterization of substances in terms of various types of constituents which are in some straightforward sense intrinsic to them and compatible with their status as unified wholes.

Here we would add only that the constituent ontology defended here will aim at a general characterization of accidents, too, in terms of various types of constituents (often in terms of constituents analogous to those found in the realm of substances). Accidents and substances will then be linked not as parts to wholes but through the special relation of inherence.

A non-constituent ontology, by contrast, aims at a general characterization of substances in terms of their relations to entities (e.g., Platonistically conceived universals or properties, including essences and natures) that have their being and reality independently of those substances. These natures and characteristics of substances are in some obvious way extrinsic to them and linked to them by the relation of exemplification or participation. On such a view all individuals are in some

3. See Alfred J. Freddoso, "Introduction to Ontology", Lecture Notes, Department of Philosophy, Notre Dame University.

sense lacking in intrinsic composition at any level other than that of material parts.⁴ Most contemporary philosophers, and practically all philosophers working within the analytic tradition, to the extent that they can be said to practice ontology at all, are non-constituent ontologists (where most scholastic philosophers were constituent ontologists in the sense defined). This is because standard approaches in analytic metaphysics take predicate logic – indeed specific features of the *language* of predicate logic – as their starting point in building an assay of the types of beings in reality. This yields what might most properly be called ‘fantology’ – a doctrine to the effect that Russell’s ‘F(a)’ and its cognates: ‘R(a,b)’, etc. provide a tool or ‘model’ sufficient for the purposes of ontological investigation. Set-theoretic semantics, possible world semantics, Montague grammar, situation semantics and like ventures are all experiments in fantology, from our present point of view. Since, from the fantological perspective, all generality is assigned to the ontological counterpart of the predicate, one talks, from this same perspective, of 1- and n-place ‘properties’ or ‘attributes’. The fantologists have indeed constructed entire Boolean hierarchies of negative, conjunctive and disjunctive properties or attributes by reading off ontology from their favored logical syntax.

The nominalistic metaphysics of tropes (or ‘instances’ or ‘abstract particulars’), too, is a form of fantology, resulting from the attempt to fold the ‘F(a)’-structure entirely into the realm of what is individual.⁵ Trope metaphysicians commonly commit what is from the Aristotelian perspective the further error of assuming that ordinary individual substances such as you or me are mereological sums or bundles of tropes. But to repeat: the (individual) parts of substances are arms and legs, which are every bit as substantial (in our technical sense: see below), and thus every bit as non-trope-like, as

4. Freddoso, *loc. cit.*

5. See for example Campbell 1990, Mertz 1996.

substances themselves.

Substance

The ontological marks of individual substances, as Aristotle conceives them, are as follows:⁶

(i) Substances are that which can exist on their own, where accidents require a support from substances in order to exist.⁷

(ii) Substances are that which, while remaining numerically one and the same, can admit contrary accidents at different times.⁸

(iii) Substances are able to stand in causal relations.⁹

(iv) Substances are 'one by a process of nature'. A substance has in the most typical case the unity of a living thing. It will be enough for my purposes to take this as meaning that the substance enjoys a certain natural completeness or rounded-offness, being neither too small nor too large – in contrast to the undetached parts of substances and to heaps or aggregates of substances.¹⁰

(v) A substance has no proper parts which are themselves substances.¹¹ A proper part of a substance, for as long as it remains a part, is not itself a substance, but is only possibly so; it becomes a substance only when it is somehow isolated from its circumcluding whole.

6. Compare the list provided by Novak 1963/64.

7. *Met.* 1028a30ff.

8. *Cat.* 4a10.

9. *Met.* 1041a9.

10. *Met.* 1040b5-16, 1041a28-31, 1052a22ff., 1070b36-1071a4; *Cat.* 1b5.

11. *Met.* 1054a20ff.

(vi) Substances (at least the substances with which we shall be dealing here) are bodies with magnitude. A substance is in other words an extended thing which occupies a place and which is such as to have spatial parts.

(vii) A substance is self-identical from the beginning to the end of its existence, and this existence is continuous: substances never enjoy intermittent existence.

(viii) There are no punctually existing substances, as there are punctual events (for example beginnings, endings, and instantaneous changes of other sorts).

(ix) A substance, finally, has no temporal parts: the first ten years of my life are a part of my life and not a part of me. It is accidents, not substances, that can have temporal parts. The parts of a substance, in contrast, are its arms and legs, its organs and its cells.

In what follows I shall be concerned primarily with those aspects of the category of substance which have to do with the status of substances as extended spatial magnitudes; thus I shall here leave out of consideration issues pertaining to non-material substances as also to substantial change and to temporal parts and temporal boundaries.

Accidents

The Aristotelian category of individual substance is intimately associated with the category or categories of individual accident. Examples of individual accidents include: individual qualities, actions and passions, a bruise, a handshake, an electric or magnetic charge. Accidents thus comprehend what, in modern parlance, are sometimes referred to as 'events'. Accidents are said to 'inhere' in their substances, a notion which will be defined more precisely in what follows in terms of the concept of specific dependence.

In contrast to Aristotle (and to the majority of constituent ontologists up to and

including Leibniz) I shall embrace a view according to which accidents may be either relational or non-relational. Non-relational accidents are attached, as it were, to a single carrier, as a thought is attached to a thinker and a headache to a head. Accidents are relational if they depend upon a plurality of substances and thereby join the latter together into complex molecular wholes of greater or lesser duration. Examples of relational accidents include a kiss, a hit, a handshake, a marriage, a conversation, a battle, a war. Some non-relational accidents, for example my present headache, might *prima facie* seem to be constituents of the substance in which they inhere. This is not true of relational accidents, however – which is one prime reason why constituent ontologists in the past have tended to deny the very existence of relational accidents (with consequences, such as the Leibnizian monadology, all too familiar). We shall in fact make the assumption in what follows that accidents are never parts of their substantial bearers. We shall conceive accidents after the pattern of occurrent entities, and thus as having temporal parts. Substances, in contrast, are continuants. My present headache is not a (spatial, material, substantial) part of me; rather it is a temporal part of that large and complex accident which is my life.

Individuals and Contingent Necessity

To be an individual, a *this*, is roughly speaking to be a full and genuine, one-off, part of the constantly changing order of nature.¹² Good candidate examples of non-individuals such as *vulpinity* or *redness* are entities capable of being exemplified by or realized in a multiplicity of individuals at different places and times.

Both individuals and non-individuals may be simple or complex. I adopt hereby a principle to the effect that a whole is individual if any part is individual (so that all the parts of a non-individual are themselves non-individual).

12. *Cat.* 3b10

I shall also assume, for present purposes (God might have other purposes), that no individual is such as to exist necessarily. From this it will follow that non-individuals, too, enjoy a contingent existence (they exist only for as long as, and to the extent that, there are individuals in which they are realized or exemplified). Truths about colors, triangles and numbers are thus contingent also (this is a bullet which all constituent ontologists must plainly bite, and without compunction). Red is, to be sure, a color, and this as a matter of necessity, but the necessity in question is a contingent necessity: it obtains only if there is something red. The act of promising necessarily gives rise to a mutually correlated claim and obligation on the part of promisee and promiser. This, too, is a contingent necessity, since it obtains only if an act of promising exists. The necessity involved in both of these examples is further what is sometimes called *de re* necessity: each individual instance of redness and each act of promising has, in virtue of its intrinsic structure as an instance of redness or act of promising, certain necessary features. It is this concept of *de re* contingent necessity which will be presupposed throughout this paper.

Some Basic Definitions

The basic entries in our projected table of categories will be defined in terms of the three primitive notions of: (1) *individual*, (2) *proper or improper part*, and (3) *is necessarily such that*. x , y , etc., are metavariables standing in for proper names of individuals and non-individuals. We define:

x is disjoint from y =df. x and y have no parts in common.

x is discrete from y =df. x and y are individuals which have no individual parts in common.

Jules and Jim are discrete from each other in this sense. If, however, they contain as parts in common universals such as *human* or *animate*, then they are not disjoint.

To capture at least part of what is involved in the notion of inherence, the relation holding between an accident and that which it is an accident of, we now put:

x is specifically dependent on y =df. (1) x is discrete from y , and (2) x is necessarily such that it cannot exist unless y exists.¹³

(We shall later introduce a notion of generic dependence whereby, if x is generically dependent on y , then it is not the specific individual y which x requires in order to exist but some item more or less like y ; a father is in this respect generically but not specifically dependent upon his son.)

My headache, for example, is specifically dependent on me (as also on my head). My headache and I have no (individual) part in common. Since I am not specifically dependent on my headache, it follows that the relation between my headache and me is a case of *one-sided* specific dependence only. As we shall see, however, there are also cases where entities stand to each other in relations of *mutual* specific dependence; consider for example the relation between the north and south poles of a magnet. Inherence in general is a case of one-sided specific dependence. We here leave open the question whether there are examples of one-sided dependence which are not examples of inherence.

A further relation we need for our purposes, in some respects the converse of that of specific dependence, is the relation of *separability*. We define first of all:

13. The centrality of the relation of dependence to the working out of a constituent ontology was first recognized by Husserl in his third Logical Investigation "On the Theory of Parts and Wholes" (1970). Husserl's ideas in this respect are discussed in detail in Smith (ed.) 1992, and also in Simons 1987.

x and y are mutually separable =df. (1) x is not specifically dependent upon any part of y, (2) y is not specifically dependent upon any part of x, and (3) x and y are discrete from each other.

x and y are, for example, a pair of stones. Separability may also be one-sided:

x is a one-sidedly separable part of y =df. (1) x is a proper part of y, (2) some part of y discrete from x is specifically dependent on x, (3) x is not specifically dependent on any part of y discrete from x.

x is for example a human being and y is the sum of x together with some one of x's thoughts. The human being can exist without the thought, but not vice versa. It can be seen to follow trivially from the definitions that only individuals are candidates for being either one-sidedly or mutually separable parts of other individuals.

On Being Atomic

We now wish to make a step towards defining the notion of an atom. Recall that the atoms of our theory, both in the realm of substances and in the realm of accident, should be neither too small nor too large. We might begin by defining the somewhat more general notion of an atomic entity. An atomic entity is either an atom (a substance or an accident) or it is an extended and connected part, a sub-region, within an atom. Atomic entities will thus stand to atoms as substantial (proper and improper) parts of substances stand to substances proper. We set:

x and y form a partition of z =df. (1) x and y are parts of z, (2) x and y are discrete from each other, (3) no part of z is discrete from both x and y.

We then set:

x is atomic =df. (1) x is an individual, (2) x has no one-sidedly separable parts, (3) there is no partition of x into mutually separable parts.

Atomic entities include both substances and accidents. Thus what is atomic need not, according to our definition, be independent (or in Aristotle's terms: 'able to exist on its own').

x is substantial =df. (1) x is atomic and (2) x is not specifically dependent on any other entity.

Boundary Dependence

We are still not home, however, for our definitions of 'atomic' and 'substantial' are satisfied by material parts of substances such as Darius's arm. That the latter is atomic follows from the fact that, if we imagine the arm as being divided, abstractly, into two parts, then these would have to share a common boundary, an individual part, and thus would not be discrete in the sense required by the definition of mutual separability. But the arm is not a substance either, at least not so long as it remains undetached. What we loosely refer to as Darius's arm¹⁴ becomes a substance only on becoming detached, when it acquires its own complete and exclusive boundary at some point of the detacher's choosing.

In order to arrive at a definition of substance, then, it is the notion of boundary which we shall need to take as our guiding clue, something that has not been done in standard treatments of substance in the literature of analytic metaphysics (perhaps because

14. Loosely, since the phrase 'Darius's arm' is systematically ambiguous in reflection of the plurality of ways in which the line between arm and torso might be drawn.

boundaries and the mereotopological structures that go together therewith become invisible when the world is viewed in terms of individuals and properties or in terms of sets and elements of sets). To this end we introduce a new sort of dependence (first discussed by Brentano and Chisholm¹⁵):

x is boundary dependent on y =df (1) x is a proper individual part of y , and (2) x is necessarily such that either y exists or there exists some part of y properly including x , and (3) each individual part of x satisfies (2).

x is for example the surface of an apple and y the apple itself. Clause (2) is designed to capture the topological notion of neighborhood. Roughly, a boundary of dimension n can never exist alone but exists always only as part of some extended neighborhood of higher dimension.¹⁶ There are no points, lines or surfaces in the universe which are not the boundaries of three-dimensional material things.

We now set:

x is a boundary =df. x is boundary dependent on some individual.

The intention is that all and only the (spatial) boundaries in reality will stand in the relation of boundary dependence to other entities in reality. The relation of boundary dependence holds both between a boundary and the substance which it bounds and also among boundaries themselves. Thus zero-dimensional spatial boundaries (points) are boundary dependent both on one- and two-dimensional boundaries (lines and surfaces) and also on

15. See the detailed discussion in Smith, forthcoming

16. See my 1996 for an outline of a formal theory of mereotopology on this basis.

the three-dimensional substances which are their ultimate hosts. Note that the relation of boundary dependence does not hold between an accident and its substantial carrier. Certainly my current thought satisfies the condition that it cannot exist unless I or some suitably large part of me exists. And certainly each individual part of my current thought satisfies this condition also. But my current thought is also specifically dependent upon me, and thus, by the definition of specific dependence it is not a part of me.

Substance Defined

The boundary (outer surface) of a billiard ball is a part of and is boundary dependent on the ball itself. We can now define:

x is a substance = df. (1) x is substantial, (2) x has a boundary, (3) there is no y that is boundary dependent on x and on some individual that has parts discrete from x.

Darius's undetached arm does not satisfy this definition, since the boundary between his arm and his torso is boundary dependent on the arm and on an individual that has parts discrete from the arm. To prove that no substance has a proper part which is itself a substance – and correlatively that no aggregate of substances is itself a substance – we point to the fact that the boundary of the included substance must, for at least some portion of its extent, lie within the interior of the including substance (for if it does not, then there is nothing which demarcates the former from the latter). This portion of the boundary of the included substance then however fails to satisfy clause (3) of our definition.

Certainly the above is not a fully adequate treatment of the category of substance. Thus it pays no attention to the dynamic, self-sustaining features of substance which Aristotle has in mind when he talks of substances as being 'one by a process of nature'. It can however enable us to begin to do justice to the tricky problems posed by the different ways

which substances have of sharing a common boundary. Consider the problem raised by a pair of billiard balls assumed to be momentarily in contact with each other. The sum of the two balls has proper parts, namely the balls themselves, each one of which is itself a substance. The boundary at which the balls are in contact, which is momentarily shared in common by the two balls, is not *necessarily* dependent for its existence on either ball; it can exist perfectly well even if one or the other is destroyed. The common boundary is thus (for as long as, and to the extent that, the two balls are genuinely in contact) not boundary dependent on either billiard ball in the sense required by our definition. Billiard balls therefore do not cease, on contact, to partake of the form of substance.

One implication of our definition is that unseparated Siamese twins form a single substance, an implication which some might find counterintuitive. To do justice to such counterintuitions we might modify our definition of substance in such a way as to embrace in addition to bodies also non-material substances, and to grant the latter individuating power in relation to the former. Alternatively we might modify our definition in such a way as to allow as substances entities which, even though not fully separated from other entities, yet enjoy a considerable degree of causal independence or dynamic integrity. The whole comprised of the mother-fetus pair might then comprehend two distinct substances on such a definition, a view which seems also to do justice to our intuitions according to which the neonate is on separation identical to (is the same substance as) the not yet separated fetus as this had existed an instant earlier.

Accidents vs. Accidentals

Parallel to the distinction between 'substantial' and 'substance', we have a distinction between 'accidental' and 'accident':

x is an accidental =df. (1) x is atomic and (2) x is specifically dependent on some

individual y.

This definition has the useful property that it allows us to recognize that there are accident-like entities which relate to undetached or quantitative parts of substances as accidents proper relate to substances taken as a whole. Consider the individual redness of the flag that is half red and half white, or the distinct thought-streams of unseparated Siamese twins. It is one virtue of the ontology of substantial and accidental entities here presented that it is able to cope with cases such as these. Such cases are of interest not least from the point of view of the history of metaphysics: Spinozism, for example, amounts to the view that *all* garden-variety substances are in fact substantials in our technical sense.

As the flag case makes clear, accidents and accidentals, too, may be pieced and they may be seen as possessing undetached extended parts analogous to Darius's undetached arm. Thus accidents and accidentals may also have spatial, as well as temporal, boundaries. In each such case, however, it seems that the spatial boundaries of accidents and accidentals are identical to, or at least such as to coincide exactly with, boundaries in or of the corresponding substance-carriers.

In what follows our attentions will be directed principally to accidents of substances. We shall define:

x is an accident of y =df. (1) x is an accidental of y, (2) y is a substance, (3) there is no substantial proper part z of y such that x is an accidental of z.

What is substantial is always part of some substance, and what is accidental is always part of some accident. From this it follows that the recognition of substantials and accidentals in a sense adds nothing new to the totality of what exists. Rather, it reflects cuts in reality

which are skew to those which pick out substances and accidents, and the latter, we suggest, are the more natural divisions. We cannot completely ignore what is substantial and accidental as such, however, for an adequate account of substances and accidents can be provided only on the basis of a treatment also of substantials and accidentals and of the corresponding internal boundaries. For it is part and parcel of what it is to be an extended substance that each substance is marked by the possibility of division along an indefinite number of interior lines of division.

Joints of Reality

The distinction between substances and substantials implies a parallel division between the boundaries of substances and the boundaries of substantials. The exterior boundaries of substances again are natural joints in reality, and it seems reasonable to assume that they are all equivalent, topologically, to the surface of one or other simply connected three-dimensional whole such as a sphere or torus.¹⁷ The boundaries of substantials, in contrast – for example the planar boundary between Darius’s arm and Darius’s torso – divide their host substances into parts in more or less arbitrary fashion. All extended objects allow an indefinite number of cuts or parsings of this sort. Indeed the unrestricted possibility of such parsing is, as Brentano pointed out (1988), a mark of what is continuously extended. Just as a complete assay of substances and accidents would perforce comprehend also all substantials and accidentals in reality, so this same complete assay would comprehend all the boundaries in reality, and it would of course comprehend also all the parts of such boundaries, including the zero- and one-dimensional parts.

Let *a* signify Darius’s arm, as it is, now, attached to the remainder (the torso) *t* of Darius. Then there is some boundary *c* running between *a* and *t*, and inspection reveals that *c* is

17. As Casati and Varzi (1994) demonstrate, the range of available options under this heading still remains astonishingly broad.

boundary dependent on and a part of both a and t by our definition above. Moreover, both a and t are as a matter of necessity such that they could not exist unless c existed. For any alternative delineation of Darius would capture not a and t but some more or less distant cousins.

How does Darius's arm relate to Darius, when once it has been actually removed from Darius's torso? Darius, as a substance, is self-identical from the beginning to the end of his existence. But neither before nor after the removal of his arm is Darius identical with any substantial part of himself (something which follows from the definition of substance). After the operation Darius (now minus arm) is still a substance in his own right. But a and a' (the arm after detachment) are non-identical, because a' is a substance and a is merely substantial. No such difference of category arises in the case of Darius before and after the loss of his arm.

Molecules

We can now define:

x is an atom =df. x is either a substance or an accident.

The world is the totality of atoms. Each atomic entity is a part of some atom. The relation of specific dependence is the bond which holds atoms together in *molecules* of different sorts. It is such molecules which serve as truth-makers for simple empirical judgments such as 'John is kissing Mary', 'Socrates runs', 'my nose is cold', and so forth.¹⁸

To capture the notion of molecule we define:

x is closed under specific dependence =df. no part of x is specifically dependent on

18. Smith 1987a contains a taxonomy of such molecular forms.

any entity discrete from x.

Everything substantial is closed under specific dependence in this sense. We now set:

x is a molecule =df. (1) x is closed under specific dependence, (2) x has discrete parts, (3) all atoms y, z which are parts of x are connected, directly or indirectly, by relations of specific dependence.

Substances are independent atoms, accidents are dependent atoms.

A dependent atom is an entity which is necessarily such that it requires some other discrete entity or entities in order to exist but not *vice versa*. The required entities are called the *carriers* or *termini* or *fundamenta* of the dependent atom. The simplest kind of molecular whole is thus exemplified by the sum of an individual non-relational accident and its corresponding carrier-substance.

If, as seems reasonable, we exclude the possibility of what we might call lazy atoms, which is to say atoms which do not enter with other atoms into molecules of any sort (*Tractatus*, 3.328, 5.47321), then it would follow that the world is not only the totality of atoms, but also the totality of molecules. Again, no contradiction arises here, since the two given assays of the totality of what exists reflect cuts at different levels. Unlike Wittgenstein (and Aristotle, and Gustav Bergmann) we are not disturbed by the possibility of ontological inventories which reflect different sorts or thicknesses of division in this way. The world is like a slab of cheese. It can be sliced in different ways. We have seen already that every extended thing is capable of being sliced along an indefinite range of different internal boundaries. This implies that the idea of a single universal diagram of reality is an idea that must be treated with caution. The results of slicing on more finely-grained levels are standardly recovered on higher levels as the constituents of unities on these higher levels.

A human being is a mereotopological sum of cells, but he is also a mereotopological sum of molecules and atoms. And the two sums are identical. This feature of the ontological structure of reality, too, is hardly comprehended by approaches to ontology of the set-theoretic sort. For if a human being is a *set* of cells, then it is thereby not also a set of atoms, molecules, etc.

Accidents of Accidents

It is possible (though we shall not pursue this matter formally here) that dependent atoms may themselves serve as carriers for further dependent accident-like entities of a higher order. For example the individual redness of my bruise is dependent on the bruise itself, which is in turn dependent on me. Such chains of one-sided dependence-relations must however come to an end after a finite number of steps. Dependent entities never occur alone, but are in every case constituents of larger wholes in which their carriers are also contained. Thus we can embrace the following:

Principle of Ontological Well-Foundedness: That on which a dependent entity depends is always such as to include one or more independent atoms as parts.

This may be also be formulated as the:

Strong Law of Immanent Realism: If there is anything, then there is a substance.

We would more precisely need to affirm that there is a finite number of dependence steps between dependent entity and independent carrier – that, leaving aside certain sorts of mutual dependence, every diagram of the dependence-relations holding together a given

molecule would have the form of a finite non-cyclical graph.

Essential Parts

Substances, as we have seen, may have substantials as proper parts. Accidents, correspondingly, may have accidentals as proper parts. Both substances and accidents may also, however, have *essential* parts, parts whose destruction leads necessarily to the destruction of the whole. Jim's individual humanity is an essential part of Jim. Hue, saturation and brightness are essential parts of the accident that is Jim's individual white or whiteness. Pitch, timbre and loudness are essential parts of Jim's present whistle.

To capture this notion of essential part we set:

x is an essential part of atom y =df. (1) x is an individual proper part of y, and (2) no part of x is substantial or accidental or a boundary, and (3) y is necessarily such that it cannot exist unless x exists.

Standardly one and the same atom can be partitioned into essential parts in a variety of different ways, each one of which captures some aspect of the atom's structure. The idea is that the internal structure of every atom could be represented exhaustively by a family of distinct complex partitions, representing cuts through reality of different sorts and on different levels, in which all essential parts would be eventually displayed.

The Packaging of Reality

There are, it will by now be clear, different sorts of parsings or articulating of reality. The first and most important type of parsing results when we follow the outer boundaries of substances, the primary joints of reality. These are boundaries *in the things themselves*, boundaries of a sort which would be present even in the absence of all articulating activity

on our part. We have seen the need to recognize also *internal* boundaries of substances which yield partitions into substantials.

Unlike outer boundaries, inner boundaries may, but they need not, correspond to any genuine heterogeneity (natural articulations) on the side of the bounded entities themselves. They may be purely arbitrary. Thus imagine a spherical ball made of some perfectly homogeneous metal. We can speak of articulations here (for example of the sphere into hemispheres) even in the absence of any corresponding genuine inner boundaries determined either by some interior spatial discontinuity or by some qualitative heterogeneity (of material constitution, color, texture, etc.) among the relevant object-parts. Hence we might say that there are not only genuine joints in reality, but also pseudo-joints, of the sort which divide, say, the upper and lower femur as these are depicted in atlases of surgical anatomy.

Let us call inner boundaries of the first sort – for example the boundaries around my heart and lungs – *bona fide* inner boundaries, inner boundaries of the second sort *fiat* inner boundaries – a terminology that is designed to draw attention to the sense in which the latter owe their existence to acts of human decision or fiat.¹⁹ The distinction between genuine and fiat boundaries applies not solely to inner boundaries but also to entities which play some of the roles of outer boundaries, too. National borders, as well as county- and property-lines, provide examples of fiat outer boundaries in this sense, at least in those cases where, as in the case of Colorado, Wyoming or Utah, they lie skew to any qualitative differentiations or spatio-temporal discontinuities on the side of the underlying reality.

Fiat Objects

When once fiat outer boundaries have been recognized, then it becomes clear that the genuine–fiat opposition can be drawn in relation to *objects* also. Examples of genuine

19. See my 1995

objects are: you and me, the planet earth. Examples of fiat objects are: Darius's arm, Darius's torso, all geographical entities demarcated in ways which do not respect qualitative differentiations or spatio-temporal discontinuities in the underlying territory – and not the least important reason for admitting fiat objects into our general ontology turns on the fact that *most of us live in one* (or in what turns out to be a nested hierarchy of such objects).

Dade County, Florida, the United States, the Northern Hemisphere, etc., are fiat objects of the geographical sort. Many geographical fiat objects will have boundaries which involve a combination of *bona fide* and fiat elements – thus the shores of the North Sea are *bona fide* boundaries, though it seems reasonable to conceive the North Sea as a fiat object in spite of this. Fiat objects will in general owe their existence not merely to human fiat but also to associated real properties of the relevant factual material. (Perhaps these considerations can help us to understand what Frege has in mind when he tells us that the objectivity of the North Sea 'is not affected by the fact that it is a matter of our arbitrary choice which part of all the water on the earth's surface we mark off and elect to call the "North Sea".' (*Grundlagen*, § 26))

Scattered Objects and Universals

The recognition of fiat objects can help us to do justice also to the fact that not all objects with which we have to deal, especially in the geopolitical and legal-administrative realms, are connected objects. Fiat articulation can create not merely fiat object parts within the interiors of genuine wholes, but also fiat object wholes (aggregates) out of genuine object parts. And then, while genuine objects are in general connected, the fiat boundaries which circumscribe constituent *bona fide* entities in this way are often boundaries of scattered wholes. Denmark and Polynesia are geographical examples of this sort; other examples might be: the Comanche Nation, the Polish nobility, the constellation Orion, the solar system.

The question now arises: Can we, as the nominalist would have it, include *universals* on this list and consign the species *red* and like examples to the realm of (delineatory) human creations? One reason to resist a positive answer to this question turns on our understanding of the role and nature of science. If the universal were a delineatory contribution of the mind along the lines suggested, then it would follow that our scientific conceptions would not give us information about the real world. For if the commonness reflected in scientific classifications were a feature solely of the organization of our concepts, apart from any real ground, then commonness itself would pertain only to how we talk and think about things. This would first of all carry the troubling implication that only linguistics and psychology, among all the sciences, could be in a position to yield general truths about reality. But then this in turn would imply that there are after all some genuine universals which are not, on pain of vicious regress, contributions of the mind, namely the universals studied by linguists and psychologists themselves.

Delineation is, be it noted, an immensely powerful faculty of cognition; the scope of delineatory intentionality, the effortlessness with which we can comprehend highly complex wholes, which may be scattered throughout the length and breadth of the universe, in both space and time, with a simple delineatory act ('the legacy of the Renaissance', 'the Austro-Hungarian Empire and its successor states', 'English poetry') is wondrous to behold, and bears comparison with the magic of single-rayed intentionality whereby, on the basis of a list of entries which might be drawn up entirely at random, we can be directed, in succession, to mountains in Siberia, teapots in Halifax, and black holes in the galaxy of Mog.

Certainly some factor of delineation dependence must be included in any adequate account of the ontology of universals. The color-spectrum, for example, is marked in its very nature by the fact that it is subject to an indefinite range of different possibilities of partition into distinct color hues. What is thus subject to partition cannot itself be the pure

product of partition, however, and it is not least for this reason that we need an account of the order of being of universals as entities independent of human cognition.

Universals as Common Natures

Two approaches to universals have been distinguished in the tradition, both of which deserve detailed treatment in any complete account:

1) the universal as that which is 'said of' a subject, exemplified in the relation of a predicate(-concept) to a subject(-concept),

2) the universal as a common nature, a *fundamentum universalitatis*, or in other words as the ground or basis for our correct application of concepts such as *oxygen* or *man* and thus as the ultimate truth-maker for judgments of similarity. Universals in this second sense are that which is investigated by sciences like biology or chemistry.

Where most twentieth-century ontologists have concentrated on the first, it is the second of these two alternatives in which we are interested here. We have argued that universals are instantiated in individuals. The universal is a *unum in multis*. It is not spread out in a physical sense among the things which instantiate it; it is real already in one object. Thus also it cannot depend for its existence on any act of comparison or on any relation of similarity. Universals are however dependent for their existence on that in which they are instantiated. The dependence at issue is a *generic* dependence, distinct from the types of dependence to which our attentions have been directed in the foregoing.

We can understand the relation of generic dependence in preliminary fashion by reflecting on the fact that, if Socrates is not available to serve as host for the universal *man*, then Plato or Brentano will do just as well. Each universal is in this sense generically dependent upon each instantiating host. A generic dependence of this sort can hold also between one substance and another. Thus while Darius is necessarily such as to require molecules of oxygen in order to exist, he is not dependent for his existence on any *specific*

molecules of oxygen. A form of generic dependence is involved also in the relation between a substance and its accidents. For while each accident is specifically dependent on some substance (its bearer), the dependence of the substance on its accidents is a weaker relation. A speck in the visual field need not be red, but it must, as a matter of necessity, have some color.

A number of distinct concepts of generic dependence would thus need to be distinguished in any full treatment of the matters in hand. The basic pattern is illustrated in the following:

x is generically dependent on y =df. (1) y is an individual, (2) x is part of y, (3) x is necessarily such that either y exists or there exists some z discrete from y containing x as part.

We might then define

x is a universal =df. x is generically dependent on some y.

Every universal is then possibly such that there exist individuals y and z which are (1) discrete from each other and (2) both such as to contain x as part.

A universal in this sense is generically dependent upon each one of its instantiating individuals. But how many universals does a given individual contain? To cite Freddoso once again:

is there within a human being a distinctive 'metaphysical' constituent corresponding to each of the natural-kind terms: 'substance', 'body' ('material substance'), 'living substance', 'sentient substance' ('animal'), 'rational', and, finally, 'human being' itself? Duns Scotus, for one, argued that there must be distinctive constituents of this sort (he

called them ‘formalities’) if scientific methodology and theories are to be well-grounded.²⁰

Coda: Aristotle’s Ontological Square

We might summarize our account of the ontology of mesoscopic reality by means of the following ontological square, which captures the notions at the heart of Aristotle’s theory:²¹

	do not require bearers	inhere in substances as their bearers
multiply located	<i>man, ox</i> universals in the category of substance III	<i>redness, wisdom</i> universals in the category of accident IV
simply located	<i>this man, this ox</i> individual substances I	<i>this redness, this wisdom</i> individual accidents II

Of the four entries in this table, the fantologist recognizes only **I** together with what is, from the Aristotelian perspective, a confused running together of **III** and **IV**. The trope ontologist recognizes only **II**. He seeks to do justice to **I** under the heading ‘bundles’.

References

20. Freddoso, *loc. cit.* See also Grajewski 1944 and Boler 1963

21. Compare Angelelli 1967, p. 11.

Angelelli, Ignacio 1967 *Studies on Gottlob Frege and Traditional Philosophy*, Dordrecht: D. Reidel.

Boler, John F. 1963 *Charles Peirce and Scholastic Realism*, Seattle: University of Washington Press.

Brentano, Franz 1981 *The Theory of Categories*, The Hague: Martinus Nijhoff.

Brentano, Franz 1988 *Philosophical Investigations on Space, Time and the Continuum*, ed. by R. M. Chisholm and S. Körner, Hamburg: Meiner, English translation by Barry Smith, London: Croom Helm, 1988.

Campbell, Keith 1990 *Abstract Particulars*, Oxford: Blackwell.

Casati, Roberto and Varzi, Achille C. 1994 *Holes and Other Superficialities*, Cambridge, MA and London: The MIT Press.

Chisholm, R. M. 1984 "Boundaries as Dependent Particulars", *Grazer Philosophische Studien*, 10, 87-95.

Frege, Gottlob 1884 *Die Grundlagen der Arithmetik*, Breslau: Koebner, English translation by J. L. Austin as *The Foundations of Arithmetic*, Oxford: Blackwell, 1959.

Grajewski, M. J. 1944 *The Formal Distinction of Duns Scotus. A Study in Metaphysics*, Washington: Catholic University of America Press.

Hoffman, Joshua and Rosenkrantz, Gary S. 1994 *Substances Among Other Categories*, Cambridge: Cambridge University Press.

Husserl, Edmund 1970 *Logical Investigations*, Eng. trans. by J.N. Findlay, London: Routledge and Kegan Paul, 1970.

Mertz, D. W. 1996 *Moderate Realism and Its Logic*, New Haven and London: Yale University Press.

Novak, M. 1963/64 "A Key to Aristotle's 'Substance'", *Philosophy and Phenomenological Research*, 24, 1-19.

Smith, Barry 1987 "The Substance of Brentano's Ontology", *Topoi*, 6/1, 39-49.

Smith, Barry 1987a “On the Cognition of States of Affairs”, in K. Mulligan, ed., *Speech Act and Sachverhalt: Reinach and the Foundations of Realist Phenomenology*, Dordrecht/Boston/Lancaster: Nijhoff, 189–225.

Smith, Barry 1995 “On Drawing Lines on a Map”, in Andrew U. Frank and Werner Kuhn (eds.), *Spatial Information Theory. A Theoretical Basis for GIS* (Lecture Notes in Computer Science 988), Berlin/Heidelberg//New York, etc.: Springer, 475–484.

Smith, Barry (ed.) 1982 *Parts and Moments. Studies in Logic and Formal Ontology*, Munich: Philosophia.

Smith, Barry 1992 “Characteristica Universalis”, in K. Mulligan, ed., *Language, Truth and Ontology* (Philosophical Studies Series), Dordrecht/Boston/London: Kluwer, 50-81.

Smith, Barry 1996 “Mereotopology: A Theory of Parts and Boundaries”, *Data and Knowledge Engineering*, 20, 287–303.

Smith, Barry (forthcoming) “Boundaries: An Essay in Mereotopology”, in L. Hahn (ed.), *The Philosophy of Roderick Chisholm* (Library of Living Philosophers), Chicago and LaSalle: Open Court.