VAGUENESS AND IDENTITY

Joanna Odrowąż-Sypniewska

A Thesis Submitted for the Degree of PhD
at the
University of St Andrews

2001

VAGUENESS AND IDENTITY

JOANNA ODROWĄŻ-SYPNIEWSKA

Submitted in fulfilment of the requirements for the degree of Doctor of Philosophy in the School of Philosophical and Anthropological Studies

UNIVERSITY OF ST ANDREWS

JUNE 2001

DECLARATIONS

(i) I, Joanna Odrowąż-Sypniewska, hereby certify that this thesis, which is approximately 90.000 words in length, has been written by me, that it is the record of work carried out by me and that it has not been submitted in any previous application for a higher degree.

In the year 1999 I obtained the degree of *Doctor of Arts* at the University of Warsaw for a thesis entitled "Semantic paradoxes and the phenomenon of vagueness". In that thesis I was concerned with the semantic and epistemic conceptions of vagueness. The first chapter was devoted to supervaluationism, the second - to subvaluationism, the third - to Timothy Williamson's theory of vagueness, while in the fourth I tried to make the case for a new semantic theory of vagueness using Michael Tye's conception of a logic with three 'vaguely vague' truth-values and the theory of rough sets. I, Joanna Odrowąż-Sypniewska, hereby certify that the thesis I am now submitting is a new, different, work, and that no part of the 1999 thesis has been used in it.

date 17/10/01 signature of candidate .

(ii) I was admitted as a research student in September 1997 and as a candidate for the degree of PhD in September 1998; the higher study for which this is a record was carried out in the University of St Andrews between 1997 and 2001.

date 17/10/01 signature of candidate ....

(iii) I hereby certify that the candidate has fulfilled the conditions of the Resolution and Regulations appropriate for the degree of PhD in the University of St Andrews and that the candidate is qualified to submit this thesis in application for that degree.

date 17/10/01 signature of supervisor

(iv) In submitting this thesis to the University of St Andrews I understand that I am giving permission for it to be made available for use in accordance with the regulations of the University Library for the time being in force, subject to any copyright vested in the work not being affected thereby. I also understand that the title and abstract will be published, and that a copy of the work may be made and supplied to any *bona fide* library or research worker.

date 17/10/01 signature of candidate

I would like to express my many thanks to Dr Peter Clark and to Professor John Broome - my subsequent supervisors - and to Dr Katherine Hawley for their helpful comments and suggestions throughout the period of writing this thesis.

ABSTRACT

The main focus of this thesis is indeterminate identity and its relations to vague objects and to imprecise designation.

Evans's argument concerning indeterminate-identity statements is often regarded as a proof that vague objects cannot exist. In *chapter I* I try to argue that the argument may be refuted by vague objects theorists.

In *chapter II* I present various accounts of what indeterminate identity between objects may consist in and three different characteristics of it. I argue that there are objects whose identity is indeterminate and that such indeterminacy is ontic in the sense that it concerns individuation and spatio-temporal boundaries of objects. I also formulate the argument showing that (independently of Evans's argument) terms designating indeterminately identical objects cannot be precise designators.

Chapter III is devoted to problems concerning vagueness and identity-over-time. The indeterminate answer to the questions concerning diachronic identity in puzzling cases can be regarded as the correct response by both endurantists and perdurantists. However, while for perdurantists the whole vagueness of persistence conditions is a conceptual matter, for endurantists it deserves the name of "ontic vagueness".

Chapter IV focuses on questions concerning vagueness and identity-at-a-time. I offer a new solution to the problem of the many, according to which in each case in which the problem arises there is - contrary to appearances - only one (vague) object present. The problem arises because each such object has many precisifications, which

nevertheless have no ontological significance. I also propose a new account of what it takes for an object to be vague.

Chapter V deals with indeterminate identity in the domain of quanta. The first part investigates the various problems concerning identity and individuation of quantum particles, whereas the second part is devoted to analysis and critique of E. J. Lowe's example of alleged indeterminate identity-over-time between electrons.

TABLE OF CONTENTS

INTRODUCTION

1. Nobody questions the fact that our language is vague. Although no common agreement as to the nature of vagueness as a **linguistic phenomenon** has been reached and theorists quarrel about whether vagueness is semantic or epistemic, they at least do not doubt its existence. Vague expressions have been causing trouble for hundreds of years. And not only for philosophers but for ordinary people as well. For it is not entirely clear how to use those expressions; to which objects they apply. Is a man who is 1.75m tall or not? Should a man who has 3000 hairs on his head be called "bald" or "not bald"? Is pudding solid? It seems that such questions have no correct answer. There seems to be no sharp boundary between the tall and not tall, between the bald and not bald, and between things that may be called "solid" and those that cannot.

One of the most characteristic features of vague expressions, the feature that distinguishes them from all other expressions, is that they admit of borderline cases, i.e. cases of which it is doubtful whether a given expression applies to them or not. For each vague word there are some positive cases, i.e. cases which clearly possess the relevant property, some negative cases, i.e. cases which clearly do not possess the relevant property, and some borderline cases.[1] Since it is unclear whether or not

[1] It is often said that a word is *extensionally* vague if it has borderline cases, while it is *intensionally* vague if it could have borderline cases (Cf. Fine (1975), p. 266).

borderline cases should be included in one of the clear extensions, one does not know which truth-value should be ascribed to statements about those cases.

Imagine a row which consists of men standing in such a way that every man's scalp differs from the scalp of his predecessor in the row only by a single hair and which starts with a man with no hair on his head. The men at one end of the row are positive cases of "bald", the men at the other end are negative cases of "bald". However, we are not able to pinpoint the first negative case. It has not been determined how many hairs makes a person non-bald. The apparent lack of sharp boundaries between different kinds of cases makes vague expressions susceptible to sorites paradoxes. The so called sorites premise: "For every n, if a man with n hairs on his head is bald, then a man with n+1 hairs on his head is bald" seems to force one to conclude that even a man with 100,000,000 hairs is bald. Furthermore, it implies the existence of the phenomenon of higher-order vagueness. Not only is there no sharp boundary between positive and negative cases, but there seem to be no sharp boundary between positive and borderline cases either. Therefore, borderline cases of borderline cases must exist.

Semantic theorists argue that vagueness is a semantic phenomenon, due to some kind of deficiency in meaning. The most popular conception of this kind is supervaluationism.[2] The supervaluation theory claims that borderline cases exist because the meaning of vague expressions is under-determined. The meaning of each vague word admits of many precisifications. The statements containing vague words should be evaluated in admissible precisifications; they should be assigned determinate truth (falsity) iff they are true (false) in every admissible precisification of the vague

[2] *Locus classicus* of supervaluationism is K. Fine (1975). Another important semantic approach is the conception of the degrees of truth (see e.g. Edgington (1996)).

word they contain. Since statements concerning borderline cases have different truth-values in different precisifications, they come out truth-valueless (indeterminate).

According to this conception the reasoning leading to the sorites paradox commits a fallacy. Supervaluationists argue that the sorites premise "For every n, if a man with n hairs on his head is bald, then a man with n+1 hairs on his head is bald" is false, since in each precisification there is an n that falsifies it.

In order to accommodate higher-order vagueness supervaluationists introduce the relation of admissibility between precisifications. What is a matter of interpretation of first-order level is itself a matter of interpretation at the second-order level. Each second-order precisification determines for itself which first-order precisifications are admissible. In general, an (i + 1) precisification specifies which i-level precisifications are admissible. The admitting relation is reflexive, but non-transitive. It may be thus indeterminate whether something is true or false.

The epistemic conception of vagueness may be traced as far back as the times of Chrysippus. Recently Timothy Williamson has worked out a modern version of epistemicism.[3] According to the epistemic theory of vagueness borderline statements have one of the two classical truth-values. On this view there is something hidden from competent speakers of the language. Each vague term in fact has a boundary demarcating its extension. The problem is that this boundary is unknown and moreover unknowable to the speakers. The vagueness of a term consists in our not knowing where its boundary lies, not in a lack of any boundary. According to

[3] See Williamson (1994); in particular Chapter 8. A new - different - version of epistemicism has recently been offered by C. Wright (2001). Wright also takes vagueness to be a matter of ignorance, but he argues - contrary to Williamson - that we are not justified in claiming that bivalence holds and borderline statements have one of the determinate truth values (*NB* we are not justified in claiming that bivalence does not hold, either).

Williamson, vagueness is a case of inexact knowledge. The inexactness of knowledge is characterized by the holding of margin for error principles, where a *margin for error principle* is a principle of the following form: "'*A*' is true in all cases similar to cases in which 'It is known that *A*' is true".[4] Because of the limited exactness of our senses, knowledge which we gain by perception is inexact. And

"[w]hat distinguishes vagueness as a source of inexactness is that the margin for error principles to which it gives rise advert to small differences in meaning, not to small differences in the objects under discussion".[5]

The cause of the existence of borderline cases and of the existence of borderline cases of borderline cases is simply our ignorance. This ignorance has conceptual sources: it is due to the inexactness of our conceptual discriminatory powers. Because the extensions of vague words are not "stabilized by natural divisions", a slight change in use of these words will result in a small change in their meaning. Therefore, the boundaries of vague expressions are "sharp but unstable".[6] Since our powers of conceptual discrimination are limited, we are not able to distinguish such small differences in meaning and in consequence we are unable to point to the exact boundaries of vague expressions' extensions. Hence, we cannot know whether certain objects fall into the positive or the negative extension. Thus, the sorites paradox is not a paradox in fact, because one of the sorites premise is false, since the statement "There is an n, such that a man with n hairs on his head is bald, but a man with $n+1$ hairs on his head is not bald" is true. Higher-order vagueness arises because the KK principle (*If I know something, then I know that I know it*)

[4] Williamson (1994), pp. 226-7.

[5] Williamson (1994), pp. 230-231.

[6] ibid.

fails:[7] there can be borderline cases of borderline cases, for one may not know that one knows whether a given case is a borderline case.

The supervaluationist and the epistemic conceptions sketched above represent two main approaches to the phenomenon of linguistic vagueness.[8] As we have seen, they are completely different approaches, whose explanations of the nature of the phenomenon are incompatible. However, they agree at least as to the minimal conditions that any adequate theory of vagueness should fulfil, namely (a) it ought to say which truth-value the borderline statements possess; (b) it should resolve the sorites paradox; (c) it should explain the existence of higher-order vagueness. In the case of ontic vagueness even such 'basic' agreement has not been reached.

2. Ontic vagueness (ontic indeterminacy; vagueness *de re*; vagueness in the world[9]) is a rather perplexing matter. Some people claim that the very thought that the world could be vague is unintelligible.[10] Others admit that such an idea is comprehensible, but argue that it is trivial or at least insubstantive. Moreover, the question what it would take for a world to be vague remains unanswered. How are we to detect ontic vagueness? What are its characteristics? How can we distinguish it

[7] The general reason for the failure of the KK principle are margin for error principles. See ibid., p. 228.

[8] See however footnotes 1 and 2. I count the epistemic conception among the linguistic theories of vagueness, since although it claims that vagueness is a matter of our ignorance, it sees the source of this ignorance (at least partly) in language.

[9] In what follows we will be concerned merely with vagueness in *this* world, i.e. so-called modal vagueness and issues of transworld indeterminacy of identity will not be discussed.

[10] For instance, M. Dummett once wrote: "the notion that things might actually *be* vague, as well as being vaguely described, is not properly intelligible" (Dummett (1975), p. 111). However, later on he withdrew that remark and suggested that anything that could be described, could be described with perfect precision (see Williamson (1994), p. 250). But, in his 1995 paper, Dummett argues again that "[v]agueness is not a property of objects" and he adds: "It is nonsensical to speak of vague objects" (Dummett (1995), p. 209).

from mere linguistic vagueness? Is it material objects, properties, states of affairs, or all of these, which are vague?

My thesis is an attempt to find answers to some of those questions. In what follows we will be concerned almost exclusively with the question of whether there exist any vague material objects.[11] We will focus on spatio-temporally extended macro-objects and try to determine whether any of them could be called a "vague object". If we found some vague objects we would know for sure that the world itself is vague. In order to start looking we will have first to determine what it would be like for something to be a vague object.

Usually, a connection is made between vague objects and objects whose identity is indeterminate (vague). For instance, the main point of interest for Gareth Evans in his famous paper "Can there be vague objects?" is an indeterminate identity statement. Moreover Mark Sainsbury, in his article "Why the world cannot be vague", tries to make a case for the thesis that a sufficient condition for objects *a* and *b* to be vague is that they be indeterminately identical.

3. First of all, one has to determine what type of indeterminacy in identity one is talking about. Usually three kinds of indeterminacy are distinguished: epistemic, semantic and ontic. The view according to which indeterminacy in identity is epistemic is usually defended by theorists who take vagueness to be an epistemic phenomenon, whereas the semantic conception of indeterminacy in identity is usually put forward by the semantic theorists of vagueness. There is an important difference between the

[11] In particular questions concerning vague properties and vague states of affairs will be ignored. In what follows by "vague object" I'll mean "vague material object" or "vague thing" (i.e. vague spatio-temporal object having causal powers).

epistemic indeterminacy view on the one hand and the semantic and ontic indeterminacy views on the other. The epistemic indeterminacy view does not support the claim that there is no determinate answer to some questions about identity.[12] On the contrary, the claim that it is merely epistemically indeterminate whether an object *a* is identical with *b* means that either it is determinately the case that *a* and *b* are identical or it is determinately the case that they are not identical, yet we have no means of knowing which is the case. On the epistemic view in every case the identity relation determinately holds or determinately does not hold, only sometimes we do not and cannot know which situation occurs. Some identity claims are simply beyond our cognition. In fact, all identity questions have determinate answers. Therefore, according to epistemicism indeterminacy is not a 'genuine' indeterminacy. In fact epistemic theorists talk instead about *unclarity*. Since our task in this thesis is to investigate the relations between indeterminacy and identity, unclarity is of no interest for us. The reason is that the epistemicist view amounts in fact to the claim that there is no relation between identity and unclarity: identity belongs to the metaphysical realm, whereas unclarity has to do with the failure of our cognitional capacities. The fact that it is unclear whether *a* is identical to *b* has no impact whatsoever on the truth value of the statement "*a* is identical to *b*".

Semantic and ontic indeterminacy are different in this respect. By the claim that it is semantically or ontically indeterminate whether *a* is identical with *b* we mean that neither of the polar claims is correct, for it is neither (determinately) true nor (determinately) false that *a* and *b* are identical. If it is indeterminate whether *a* and *b*

[12] I believe this sentence is true of the kind of epistemicism advanced by Wright as well as that advanced by Williamson. However, the rest of the remarks concerning epistemic indeterminacy apply to the latter only. Wright would not agree, for instance, that the epistemicist can assert that in every case the identity relation determinately holds or determinately does not hold.

are identical, the statement "*a* is identical with *b*" either has some other truth value or has no truth value at all.

So, both semantic and ontic theorists agree that there are vague identity statements. The **semantic** view of indeterminacy has it that in each case of apparent indeterminacy of identity the indeterminacy is due to the vagueness of the names of the objects between which the identity is supposed to hold. Thus, if a given identity statement "$a = b$" is indeterminate in truth value it is because either "*a*" or "*b*" is a vague designator. There are many uncontentious examples, such as "The first non-bald man in the sorites series is Mr Brown" or "Sue is Harry's best friend".[13] In the sorites series which starts with bald men and ends with non-bald ones, it is indeterminate which man is the first bald man. If Mr Brown is somewhere on the border between the bald and the non-bald, it may be indeterminate whether the first non-bald man is Mr Brown, or not. The indeterminacy in question will be due entirely to the indeterminacy of the singular term "the first non-bald man". In the "Sue is Harry's best friend" case, "is a best friend of" is a vague relation. It is indeterminate whether it is Sue or George who stands in this relation to Harry. Since "Harry's best friend" is a semantically indeterminate singular term, there is no fact of the matter as to whether it is Sue or George who is Harry's best friend and hence "Sue is Harry's best friend" is indeterminate. The semantic vagueness theorist claims that an analogous explanation referring to the imprecision of singular terms is adequate in each case of indeterminate identity. In other words there is no more to the indeterminacy of identity statements than the indeterminacy of the designators featuring in those statements.

[13] This second example is due to Stalnaker (1988), p. 349.

The **ontic** vagueness theorist disagrees, of course. His claim is precisely that there is more to indeterminacy of the identity between objects than imprecision in the names of those objects. Now, there seem to be two options for the proponent of ontic indeterminacy. He can either argue that in indeterminate identity statements there is always ontic indeterminacy as well as semantic indeterminacy or that ontic indeterminacy is sometimes the only indeterminacy present in those cases. The problem with the option which says that both semantic and ontic indeterminacy are present is that if the given designator, "a", is semantically vague and refers indeterminately to, say, two objects, c and d, then there is no fact of the matter as to whether it is c or d which is relevant for the identity statement "$a = b$".[14] If "a" refers indeterminately to objects c and d, then "$a = b$" is indeterminate because it is indeterminate which object is designated by the term on the left hand side of the identity sign. In order to argue that there is also ontic indeterminacy in the example one would have to claim that both c and d are ontically indeterminately identical with b. It cannot be only one of c and d which is indeterminately identical to b, because since it is indeterminate which one is the subject of the identity statement, it would be indeterminate whether ontic indeterminacy is involved or not.[15]

In order to claim that ontic indeterminacy is the only indeterminacy present, one would have to argue that "a" and "b" are precise, but that the statement "$a = b$" is nevertheless vague. Only when the designators on the left and right hand sides of the identity sign are precise, can it be determined precisely which objects the identity statement is about and only then may it be assessed whether those objects are ontically

---

[14] Compare, however, Chapter II, where a different kind of semantic indeterminacy will be considered.

[15] And, of course, if "a" refers to more than two objects, than one has more objects to take into consideration.

indeterminately identical or not. The ontic vagueness theorist will argue that objects *a* and *b* are such that it is indeterminate whether they are identical, or, in other words, that **there is no fact of the matter** as to whether $a = b$.

It is thus clear that if one wants to make a connection between vague objects and indeterminate identity, one has to concentrate on the ontic indeterminacy of identity, for it is the only conception that may unequivocally lead one to vague objects.

4. It is sometimes claimed that in the case of semantic vagueness, indeterminacy should be consistent with each of the two opposite determinate verdicts.[16] *a* being a borderline case of redness should be consistent with both *a* being red and *a* not being red. It is argued that since indeterminacy is a matter of having left things open, it cannot exclude either of the two determinate verdicts. It seems to me however that matters are different with ontic vagueness. If ontic indeterminacy is to be interpreted as there being no fact of the matter as to whether something is the case, then it cannot be consistent with ontic determinacy. Either there is no fact of the matter whether something is the case or there is a fact of the matter that something (or its negation) is the case.[17] These are the only ontological possibilities and moreover they seem to be inconsistent possibilities. If *a* is ontically indeterminately

[16] Cf. Wright (1994), p. 138.

[17] I will ignore the issue of **higher-order vagueness** in my thesis. It seems to me that one can consistently deny the existence of higher-order ontological vagueness and claim that although it can be indeterminate whether or not there is a fact of the matter, this indeterminacy is merely epistemic. Of course, anyone who thinks that it can be ontically indeterminate whether something is ontically indeterminate has to acknowledge the existence of higher-order ontological vagueness. In such a case three-valued logic will be no longer appropriate. Instead of three ontological possibilities, there will be many more of them (probably infinitely many).
On the other hand, in my opinion there is no *metaphysical* difference between the situation in which *a* and *b* are identical and the situation in which they are determinately identical. If there is a fact of the matter as to their identity then they are identical (or distinct) and moreover - determinately identical (or determinately distinct).

identical to b, then the facts which obtain must leave the matter unsettled; i.e. they can determine neither that a and b are identical, nor that a and b are not identical. The world is in a sense incomplete: it is neither determinately the case that $a = b$ nor that $\neg(a = b)$. The indeterminacy in question is a state of suspension, so to speak, between the two determinate states. a and b cannot become determinately identical or determinately distinct unless the world changes - unless some new fact comes into existence.

It is hard to see how ontological indeterminacy could be construed otherwise. If we allow that the property of being such that x is F and the property of being such that it is indeterminate whether x is F are consistent and can be possessed by the same object x at the same time, then it becomes obscure why the indeterminacy involved is to be *ontic* indeterminacy at all. If the difference between indeterminacy-free and relevant indeterminacy-involving property is to be metaphysically grounded, there must be some ontological difference between the state of affairs in which an object possesses the former and the state of affairs in which that object possesses the latter. Hence, one object cannot have both such properties at the same time.

The apparent plausibility of the situation in which we are inclined to say that a is indeterminately identical to b although we do not exclude the possibility that a is in fact (determinately) identical to b, is due to our thinking that indeterminacy has epistemic sources. We think that it may well be the case that a and b are determinately identical or determinately non-identical, but we simply have no idea which is the case, and that prompts us to say that it is indeterminate whether they are identical or not.

If one is to adopt the above account, then it becomes clear that the logic of indeterminacy has to be a three-valued logic of some kind,[18] where the truth values are: (determinate) truth, (determinate) falsehood and indeterminacy.[19]

As Michael Dummett has noticed, such a view of ontic indeterminacy leads to a kind of anti-realism. Dummett writes that:

"The realist doctrine is that reality ... is determinately constituted, independently of our knowledge or means of knowledge, and serves to render our statements about it true or false. To say that it is determinately constituted is to say that any well-defined question about it has a definite answer, known to God, whether knowable by us or not".[20]

Someone who accepts what has been said above about ontic indeterminacy, can adopt such a view of reality, provided however that the word "determinately" is crossed out from its characteristics. The ontic vagueness theorist can be realist in a sense that he may hold that the world is the way it is "independently of our knowledge or means of knowledge", but he does not believe that it is determinately constituted.

---

[18] One may object to treating indeterminacy as a truth value on a par with truth and falsity. It does seem that indeterminacy is not of the same 'kind' as both determinate truth values. Indeterminacy is just the lack of determinacy: a matter of things having been left undetermined. and not another determinate truth value. However, it seems that if one is to think about indeterminacy as an ontic phenomenon, one has no option but to agree that it is a third ontological possibility. We may not call it the third 'truth-value', but it certainly indicates the third ontological 'status'. One might read "'*p*' is indeterminate" as "'*p*' is neither (determinately) true nor (determinately) false. but it seems to be that if "indeterminacy" is to be construed as ontic and not merely epistemic, bivalence has to be denied. On the other hand, it appears to me that ontic vagueness theorist may nevertheless maintain that indeterminacy consists in there being 'no fact of the matter': "*p*" is indeterminate, if there is no fact of the matter whether it is true and no fact of the matter whether it is false. He does not have to claim that since indeterminacy is the third ontological possibility there must be 'a fact of the matter' that '*p*' is indeterminate.

[19] For semantic theorists the problem with two-valued approach is that it introduces a sharp boundary between the two truth-values, whereas the existence of borderline cases seems to imply that there is no such boundary. One may argue that adding the third truth value does not solve the problem, for now we apparently have two sharp boundaries: between truth and indeterminacy and between indeterminacy and falsity. However, it seems clear that vagueness excludes the existence of *any* sharp boundaries (cf. Edgington (1993), p. 192). One three-valued approach which overcomes that problem has been proposed by M. Tye (1990). The boundaries between his three truth values are not sharp, for the truth value predicates are vaguely vague. This makes it possible for a proponent of such a conception to claim, for instance, that in the sorites series there is no last man who is (determinately) bald and the first who is non-determinately bald.

[20] Dummett (1995), p. 210.

On the contrary, he "must envisage reality as having ... patches of indeterminacy"[21] and reject bivalence, and therefore he may be called an "anti-realist" at least to a certain extent.

5. In what follows I will try to argue that there are in the world objects that deserve to be called "vague". Roughly speaking all objects with fuzzy - spatial and temporal - boundaries should count as vague objects. The most common example are clouds, but mountains, cats and watches are also vague. In most cases that vagueness goes unnoticed, or - in any case - it does not matter to us. We know the rough boundaries of the objects we are dealing with and usually such knowledge is sufficient for our purposes. In some cases, however, it may be crucial that we point to the precise boundaries of a given object and then we realise all of the sudden that we cannot do that, for that object has no such boundaries. Any attempt at delimiting precise boundaries of a cloud or a cat is deemed to failure: it is completely arbitrary, and moreover it is just one of the many similar possible attempts. The differences between such tentative delimitations are very minute and there seem to be no principled reason why one should chose one rather than any other. This phenomenon gives rise to the so called problem of the many.

The fact that objects are vague becomes most apparent in cases in which identity comes into question. And it is mainly in those cases that vagueness of objects starts bothering us.

Think of Jimmy the cat, for instance. Now, as the summer is approaching, Jimmy loses his hairs. Some of those hairs have already fallen out, some of them are

[21] ibid.

still in the process of falling out. The former are not parts of Jimmy anymore, but the status of the latter is not so clear. It seems indeterminate whether we should count them among Jimmy's parts, or not. Since Jimmy has quite a few such questionable parts, his spatial boundaries become fuzzy. Moreover, one may argue that even if Jimmy were not shedding, his boundaries would also be vague to some extent. At the tip of each of his many hairs there are molecules that neither clearly are parts of the given hair nor clearly are parts of the air surrounding Jimmy. The existence of such molecules means that the intuitive thought that cats have precise boundaries is a sheer illusion.

Moreover, it is not only Jimmy's spatial boundaries that are vague, his temporal boundaries may be vague as well. Admittedly, in most cases, temporal boundaries of cats are quite precise (one may only debate over the precise moment of a cat's coming into and out of existence). However, there are many so called thought experiments that show that it need not be so. We can imagine, for instance, that the original parts of Jimmy are exchanged with bionic replacements. It is pretty clear that although Jimmy would survive a few of such replacements (he might not like his new bionic tail, but it would not endanger his life), he would not survive the replacement of all his parts. Jimmy the bionic entity may look exactly like Jimmy the cat, but it would not *be* Jimmy the cat. What is the precise moment at which Jimmy's life has been disrupted and the 'life' of the new bionic entity began? It seems obvious that there is no such moment (if this sound unconvincing, we may add the provision that the parts that are replaced are tiny). And if this is so, then Jimmy's temporal boundaries are not precisely defined.

Temporal vagueness may lead to vagueness in identity. One may ask whether Jimmy the cat is identical to the cat that has such-and-such parts replaced with their bionic counterparts, and if the parts are sufficiently many (or sufficiently vital) neither of the answers "Yes" and "No" may seem suitable. In such cases the answer one may be tempted to give is that it is *indeterminate* whether they are identical. It should be noticed that it is not identity itself which is vague in such cases but rather it is indeterminate whether (sharp) identity holds between the given objects.

It should be clear that the fact that Jimmy is a cat has no special bearing on the issues under consideration. Analogous remarks apply to tables, stereos, trees, canaries and other artefacts and living creatures. The particular cases will only differ as to which type of vagueness - spatial or temporal - is more robust. For instance, watches and stereos are quite precise as far as their spatial boundaries are concerned, but their temporal boundaries are pretty vague. On the other hand, mountains are spatially vague to a considerable extent, but their temporal vagueness may be negligible. In the case of trees and rivers both kinds of vagueness may be prominent (e.g. rivers not only have undetermined origins, but they also temporally dry out or change their bed).

Vagueness in spatial boundaries (so called compositional vagueness) may also result in indeterminacy of identity. Had Marco Polo correctly understood the intentions of the natives, he would have probably given the name "Madagascar" to a part of Africa's mainland and not to the African island.[22] If this had been the case, the question would have issued: Is Marco Polo's Madagascar identical to the natives' Madagascar? Probably neither the former nor the latter would have bothered with a precise demarcation of the boundaries of the objects they wanted to name. In such a case the answer concerning the identity of the object named by Marco Polo and the object named by the natives could have no determinate answer.

[22] See Evans (1973). He cites Isaac Tylor's 1898 book *Names and Their History: A Handbook of Historical Geography and Topographical Nomenclature* (Detroit, MI: Gale Research Co., 1969).

6. Gareth Evans famously argued that the notion of indeterminately identical objects is incoherent. If he is right, then any project of locating vagueness in objects seems very dubious. As we have seen it is ontic vagueness that may lead to indeterminacy in identity and the proof of the incoherence of the latter throws serious doubt upon the coherency of the former. Therefore I will start my considerations with a discussion of Evans's argument. In the first chapter I will try to argue that this argument is invalid and does not reduce the idea of vague objects to absurdity. In the second chapter the general issues concerning indeterminate identity and its relation to vague objects will be discussed. The third chapter will be devoted to indeterminate identity over time and diachronic identity puzzles, while the fourth will deal with indeterminate identity at a time and the problem of the many. In the fifth - final - chapter some particular issues concerning indeterminate identity in the quantum domain will be addressed. Seven years ago E. J. Lowe argued that electrons were obvious candidates for being vague objects and even offered an example of apparently indeterminately identical electrons. I will try to evaluate that example, but before doing this we will have to spend some time on general questions concerning the identity of quantum particles.

Chapter I

GARETH EVANS'S ARGUMENT

1. GARETH EVANS'S ARGUMENT

1.1. Introduction

Anyone who wishes to investigate the question of vague identity and vague objects has to face G. Evans's argument. His one-page article entitled "Can There Be Vague Objects?" is usually regarded as a *reductio ad absurdum* of the claim that identity between objects may be a vague matter. If what the argument proves is indeed that vague identity is an inconsistent notion, then there is not much point in undertaking the study of it. Therefore, any investigation devoted to vague identity has to start with the exploration of the meaning and consequences of Evans's argument. Before exposing oneself to the dangers of 'the quicksand' (as M. Tye calls the intricacies of the issue of vagueness) one ought to make sure that one is not embarking on a venture that is *bound* to end in a contradiction.

The above mentioned article is no doubt one of the most discussed papers to have been published within the last 30 years.[1] It has been criticised both for leaving too many things unspoken and for saying too much.[2] In the first place there is no common agreement as to whether Evans's argument is valid. Moreover, those critics who accept its validity cannot agree as to whether or not it proves what Evans

---

[1] *Analysis* 38 (1978), p. 208.
[2] Cf. Lewis (1988), p. 129.

intended it to prove. According to some theorists, the argument does not prove anything interesting, according to others it proves too much.[3]

After presenting Evans's argument, the main problems surrounding this argument and its interpretations will be discussed. The aim of this chapter is to investigate how vague objects and vague identity fare after Evans's argument and the arguments of his critics. In particular, we will try to examine the connection between the existence of vague objects and indeterminate identity statements in the light of Evans's proof.

Evans's argument goes as follows:

Let "a" and "b" be singular terms such that the sentence "$a = b$" is of indeterminate truth value, and let us allow for the expression of the idea of indeterminacy by the sentential operator "∇".

Then we have:

(1)∇ $(a = b)$

(1) reports a fact about b which we may express by ascribing it the property "λx [∇ $(x = a)$]":

(2) λx [∇ $(x = a)$]b,

But we have:

(3) $\neg\nabla$ $(a = a)$

and hence:

(4) $\neg\lambda x$ [∇ $(x = a)$]a.

But by Leibniz's Law, we may derive from (2) and (4):

(5) $\neg(a = b)$

contradicting the assumption, with which we began, that the identity statement "a = b" is of indeterminate truth value.

---

[3] Cf. Rasmussen (1985), p. 82. Some commentators have gone so far as to invoke their personal acquaintance with Evans in order to support their (*NB* contradictory) interpretations of the argument. See Lewis (1988), p. 130; Burgess (1984), p. 116.

If "Indefinitely" and its dual, "Definitely" ("Δ") generate a modal logic as strong as S5, (1) - (4) and, presumably, Leibniz's Law, may each be strengthened with a "Definitely" prefix, enabling us to derive:

(5') $\Delta \neg(a = b)$

which is straightforwardly inconsistent with (1).

Two different interpretations of what Evans took this argument to prove have been offered. According to the first one, and this is apparently the one that Evans really intended,[4] the argument shows that the vague-objects view is untenable.[5] It allegedly demonstrates that the assumption that there are vague identity statements leads to contradiction. It is obvious, however, that there *are* such statements. Take, for instance, the identity statement "Princeton = Princeton Borough".[6] Most theorists will agree that it is indeterminate in truth value, for no determinate answer to the question of whether Princeton is identical to Princeton Borough is acceptable. Therefore, the only conclusion one can draw is that Evans's argument, which is a *reductio* of the existence of such statements, must be fallacious. At least one step of the proof must be illegitimate. The idea is that Evans *intended* his argument to fail in order to demonstrate something. Namely, he wanted to show that only those theorists who take vagueness to be a semantic phenomenon are able to spot the fallacy. The view according to which vagueness is linguistic can diagnose the fallacy in the proof: the step from (1) to (2) is invalid, because it commits a scope fallacy. One cannot infer:

(2) $\lambda x\, [\nabla(x = a)]b$

---

[4] See Lewis (1988), p. 129.

[5] Where by "vague objects" we mean objects which are indeterminately identical to something. If one maintains that vague objects need not be indeterminately identical objects, then Evans's argument has no bearing on vague objects whatsoever. For the possible standpoints concerning the relations between vague and indeterminately identical objects see chapter II.

[6] Lewis (1988), p. 128.

from

(1)$\nabla(a = b)$,

unless "b" is a precise designator.[7] If "b" is vague, it does not single out a unique object determinately. In this case, contrary to what Evans has argued (or rather has pretended to argue), (1) - in which such a vague designator "b" features - does not report any facts about b. Moreover the statement (1) can be true, even if (2) is false. Since "$\nabla(a = b)$" does not entail "$\lambda x\, [\nabla(x = a)]b$", the argument is invalid.

In contrast, the view according to which vagueness is in the world, and not in language, cannot explain why the proof is fallacious. According to this theory "a" and "b" are precise designators denoting vague objects. So, on this view one cannot block the step from (1) to (2). If "b" is precise, the inference (1) - (2) is valid. Moreover, it has been argued that the vague-objects theorist has no reason to object to the other steps of Evans's argument, either. From his point of view all the other steps seem valid. In consequence, vague-objects theorists are forced to accept the evidently false conclusion that there cannot be vague identity statements. As D. Lewis puts it

"In fact, the vague-objects view does not afford *any* diagnosis of the fallacy, so it is stuck with the unwelcome proof of an absurd conclusion".[8]

Thus, the vague-objects view, within the framework of which one is not able to refute a clearly absurd claim to the effect that vague identity statements do not exist, should better be rejected. The claim is that the vagueness-in-language view is the only view which can deal with Evans's argument and therefore it should be accepted as the correct theory of vagueness.

---

[7] See below, section 1.3.
[8] Lewis (1988), p. 129.

This is the interpretation proposed by D. Lewis, which has been endorsed by Evans as a correct explanation of what he was trying to do in his paper.[9] B Garrett points out, however, that the conclusion that the vague-objects view cannot offer any explanation of the fallacy is unwarranted. The vague-objects theorists do not claim that *all* vagueness is in the world and none in the language. And they do not support an implausible claim that all vague identity statements are vague as a result of the vagueness in the world. On the contrary, they argue that both the world and language are vague, and identity sentences can be indeterminate in truth value because of the vagueness of the designators as well as because of the vagueness of the objects. In particular, they do not hold that all designators have to be precise. Hence, the scope fallacy diagnosis is as available for them as it is for the vagueness-in-language theorists.[10]

So, if the above interpretation of Evans's argument is correct, then the argument is of little significance. It is intended to prove that the vague-objects view is untenable, but it wrongly characterises the view it is supposed to refute. Although it does indeed show that the view that all vagueness is in the world is committed to the absurd claim that there are no indeterminate-identity statements, such a view is in general (i.e. independently of Evans's argument) quite implausible. The vague-objects theorists are people who think that vagueness afflicts not only language but the world as well. By no means do they want to attribute all vagueness to the world. That our language is vague is a fact accepted probably by any philosopher whatsoever, whether he is an ontic-vagueness or a linguistic-vagueness theorist. In particular, saddling the

[9] Lewis (1988), p. 130. Lewis quotes Evans's letter in which Evans replies to Lewis's attempts to clarify the intentions behind his argument: "Exactly! Just so! Yes, Yes, Yes! I am covered with relief that you see so clearly what I was doing".
[10] Cf. Garrett (1988), p. 131.

vague-objects theorists with the claim that singular terms such as "Princeton" and "Princeton Borough" are precise is simply unfair.

According to the other interpretation Evans's argument is not concerned with all vague-identity statements but only with those vague-identity statements whose vagueness is a result of vagueness in the world. It is obvious that ontic vagueness is not the only possible source of indeterminacy. The statement "$a = b$" may not have any determinate truth value as a result of one or both singular terms, "a" and "b", being imprecise designators. The fact that the statement "Princeton = Princeton Borough" is indeterminate does not indicate that Princeton is a vague object, for its indeterminacy is caused by the name "Princeton" not having a precise designation. Thus, the assumption that a given identity statement lacks determinate truth value does not entitle one to the claim that there are vague objects in the world responsible for the indeterminacy of that statement. In order to interpret the argument as an argument which purports to say something about ontic vagueness, the assumption to the effect that singular terms flanking the identity sign are precise designators must be added. Only by claiming that the statement "$a = b$" is indeterminate and that "a" and "b" are precise designators can one hope to capture the idea of ontic vagueness.[11] On this interpretation, Evans's argument seeks to prove that there cannot be vague identity statements whose vagueness is due solely to the existence of vague objects; i.e. it is supposed to establish that there cannot be indeterminate-identity statements "$a = b$" that contain only precise designators "a" and "b" and the identity sign.[12] If

[11] Garrett points out that precise designators need not be rigid designators. Although rigid designators are precise, not all precise designators are rigid. "The tallest man in the room" may be both precise and non-rigid. See (1991), p. 342.
[12] Cf. Garrett (1988), p. 130.

such a statement composed entirely of precise terms existed and nevertheless were vague, its vagueness would have to be a result of the vagueness in the world.

Thus, the argument has it that if there are indeterminate-identity statements "$a = b$", where "a" and "b" are precise, then there is ontic vagueness. The argument assumes for *reductio* that there is such a sentence and arrives at a contradiction. Hence, the conclusion is that the statement consisting of two precise designators and the identity sign cannot be indeterminate in truth value.[13] By proving that there cannot be such a statement, the argument allegedly proves that there is no vagueness in the world - i.e. that all vagueness is linguistic. Whether or not the argument with a tacit assumption that "a" and "b" are precise designators is valid is a contentious matter, the main reason being that it is not clear which logic Evans assumes for his argument.

The differences between the two interpretations can be summarised in the following way. On both interpretations the argument attempts to prove that there cannot be true vague identity-statements "$\nabla(a = b)$". Each interpretation assumes that Evans has left an important assumption unspoken - an assumption without which the proof cannot properly be understood. On the first interpretation the tacit assumption is that it is obvious that indeterminate identity-statements statements do exist, so the proof as a whole is in fact a *reductio* of an obvious truth - i.e. a *reductio* that is obviously fallacious. People who believe in the existence of vague objects and think in addition that every such object is designated by a precise term, cannot diagnose the fallacy and are forced to endorse the proof as a *bona fide reductio*. They have to argue - contrary to facts - that there are no indeterminate identity-statements. On this

[13] For the relation between vague identity statements and vague objects see chapter II, section 3.1.

interpretation Evans succeeds in showing that a vague-objects view combined with the claim that all singular terms naming vague objects (and all non-vague objects too) are precise is untenable.

On the second interpretation the tacit assumption is that the singular terms "a" and "b" are precise designators. This interpretation does not saddle the vague-objects theorists with an implausible claim that all vague objects are precisely designated. The proof is a *bona fide reductio* of the claim that "∇ ($a = b$)", where terms "a" and "b" are precise, can be true. Whether or not it succeeds is an open matter; in any case it is not *intended* as a clearly fallacious proof. If it works, then also on this interpretation Evans succeeds in showing that a vague-objects view combined with the claim that singular terms naming vague objects are precise is untenable. Thus, if the proof is valid on the second interpretation, on each interpretation one of the aims of the argument is to show that vague objects cannot be precisely designated, but the means of achieving that aim are interpreted differently. While on the first interpretation Evans succeeds by means of an obviously fallacious proof, on the second interpretation, if he succeeds, it is in virtue of using a valid proof. The additional difference is that the first interpretation requires that we take the vague-objects theorists to be the people who put all the vagueness in the world and none in language. Such a characterisation seems unfaithful to the facts.

Evans precedes his argument by the following introduction.

"It is sometimes said that the world itself can *be* vague. Rather than vagueness being a deficiency in our mode of describing the world, it would then be a necessary feature of any true description of it. It is also said that amongst the statements which may not have a determinate truth value as a result of their vagueness are identity statements. Combining these two views we would arrive at the idea that the world might contain certain objects about which it is a *fact* that they have fuzzy boundaries. But is this idea coherent?"

This introduction is followed by the proof quoted above, in which Evans from the assumption that it is indeterminate whether *a* is identical to *b* derives a contradiction. It is then hard to resist the temptation to treat that proof as a negative answer to the question he asked in the last sentence of the introduction - i.e. as a proof that the idea that there are vague objects is in fact incoherent. Although we know from Lewis that this is not the reading Evans had in mind,[14] it certainly is the interpretation that suggest itself most vividly to the reader of Evans's paper. In other words, it is at least a justified interpretation. Moreover, it is not without significance, that it is the interpretation that does justice to the vague-objects theorists.

If the first interpretation is the one that is correct, then it is obvious that the proof fails as intended (because of the obvious fallacy in the step (1) - (2)) and the aim of the paper is achieved. There is not much point in investigating other steps of the proof. If it is the second interpretation which is adequate, however, then all the steps are important. Recall that on this interpretation someone who wants to show that the vague-objects view is untenable has to show that the proof is correct. The step (1) - (2) is no longer obviously fallacious on that interpretation, because of the assumption that "*a*" and "*b*" are precise. Other steps of the proof are interesting in their own right and are certainly worth investigating. In what follows we will adopt the second interpretation with the aim of examining the possible fallacies of the argument.

In general, it is far from clear how the argument is supposed to work. First of all, although Evans introduces "∇" as an operator which expresses the

[14] That it is not Evans's intended reading is also suggested by the already quoted sentence "Let "*a*" and "*b*" be singular terms such that the sentence "$a = b$" is of indeterminate truth value...". It does not say anything about objects: it says let us choose such singular terms that the identity statement will be indeterminate.

indeterminacy of truth value, he also assumes that it generates a modal logic So, the question arises what the correct interpretation of delta operators, "∇" and "Δ", is. Are they truth value indicating operators or modal operators? Moreover, doubt has been cast upon the "Definitely" prefix. It is not clear whether it can be treated as a dual of "∇" and it seems that even if it can, together they cannot generate so strong a logic as Evans wanted. Secondly, since the steps from (1) to (2) and from (3) to (4) involve property abstraction in contexts governed by delta operators their validity can be questioned. Thirdly, step (3), which is assumed as trivial, in the presence of vague objects becomes controversial. Fourthly, it is doubtful whether Leibniz's Law (LL) can be used in order to derive (5) from (4). Fifthly, it is by no means obvious that (5) contradicts (1). And finally the proposed strengthening of (1) - (4) and LL with "Δ" is a very contentious operation.

These difficulties will be examined in detail in what follows.

1.2. The interpretations of "Indefinitely" and "Definitely" operators

It is not entirely clear how Evans meant his delta operators to work. On the one hand, as we have seen, he begins his proof in the following way: "Let "*a*" and "*b*" be singular terms such that the sentence "$a = b$" is of indeterminate truth value, and *let us allow for the expression of the idea of indeterminacy by the sentential operator* "∇"" (my emphasis). This quote suggests that "Indefinitely" and "Definitely" should be regarded as operators that indicate the truth value of the statement to which they are attached.[15] On the other hand, Evans's later tentative claim that ""Indefinitely" and

[15] Cf. Pelletier (1989), p. 482.

its dual, "Definitely" ("Δ") generate a modal logic as strong as S5" suggests a reading according to which "Indefinitely" and "Definitely" are modal operators.

According to the "truth-value indicators" reading "Δp" says that "p" has one of the determinate truth values, whereas "∇p" says that the truth value of "p" is indeterminate. On this reading "∇p" is true iff p is neither true nor false. Hence, on this interpretation "the sentence "$a = b$" is of indeterminate truth value" means that "$a = b$" is neither true nor false, but has some third truth value; the operator "∇" expresses that fact. The sentence "$\nabla(a = b)$" is taken to be a description of the actual world, which expresses the fact that the statement "$a = b$" has no determinate truth value in this world.

Two contrary opinions can be found in the literature. On the one hand, it is often argued[16] that in order to express indeterminacy at least three truth values are needed: one needs some kind of 'status' which would reflect the fact that there is no fact of the matter as to whether a given statement is (definitely) true, or (definitely) false (no matter whether it will be another value, truth-value glut or truth-value gap). This third "status" is marked by "∇". On the other hand, it has also been claimed that indeterminacy should not be expressed by a sentential operator like "∇". E. J. Lowe argues that if 'indeterminacy' is regarded as 'there being no fact of the matter' then it is wrong to treat *the lack of any objective fact* of the matter determining the truth value of a sentence "$a = b$" as itself being *an objective fact* of the matter which can be reported by a true sentence, "$\nabla(a = b)$".[17]

[16] Cf. e.g. Tyc (1994).
[17] Lowe (1994), p. 112.

It seems, however, that if indeterminacy is to be a 'genuine' ontological possibility, then one needs some means of expressing it. If there is no fact of the matter as to whether a and b are identical, then it is clearly neither (determinately) true nor (determinately) false that they are identical. It is then tempting to ascribe some third 'status' to the statement "$a = b$". A person who agrees with Lowe that "∇" should not be used as a means of expressing the lack of any objective fact of the matter, deprives himself of the possibility of talking about worldly indeterminacy.

The "truth value indicators" reading takes only the first of the above-quoted Evans's claims into account. If one takes the operator "∇" to be the operator that indicates the third truth value that sentences can have and the logic in which Evans's argument operates to be a 'common' (i.e. non-modal) three-valued logic, then one is forced to ignore the claim concerning the generation of modal logic and regard it as a slip on Evans's part.

According to the alternative reading "∇" and "Δ" are **modal operators**. J. F. Pelletier interprets them as operators attached to statements that already possess determinate truth value.[18] The statement "p" is either true or false at any given world and the statement "Δp" says that it possesses the same truth value in all possible worlds. The statement "∇p" orders one to look at some related worlds to check whether "p" is true or false there, before ascribing "∇p" a truth value at our world. On such an interpretation "p" does not follow from "Δp", for "Δp" may be true in virtue of "p" being false in all worlds.

This interpretation is not an adequate interpretation for the aim that Evans wanted to achieve, however. Evans's argument is supposed to deal with statements

[18] Cf. Pelletier (1989), p. 482.

which may not have a determinate truth value as a result of their vagueness. The starting point of his reasoning is the assumption that the sentence "$a = b$" is indeterminate in truth value and "∇" is introduced as a device expressing this indeterminacy. In contrast, on the modal interpretation presented above each statement already has a determinate truth value before a modal operator is attached to it. Although one may not know what the truth values of the statements "Δp" and "∇p" are, one does know that "p" has a determinate truth value at each world. And of course modal operators, interpreted in this way, do not express any indeterminacy. Moreover, it seems that that modal interpretation does not capture the intuitions connected with ontic vagueness. As we have seen, Evans's argument can be taken to prove that "the idea that the world might contain certain objects about which it is a *fact* that they have fuzzy boundaries" is incoherent. If we take the "Indefinitely" operator to be a modal operator in the above sense, then it may say nothing in particular about the real world. The actual world being vague or not being vague makes no difference to the truth value of the sentence "∇p". Hence, in particular the truth or falsity of the sentence "$\nabla(a = b)$" has nothing to do with vague objects at our world and the argument to the effect that that sentence cannot be true, has no bearing whatsoever on the answer to the question whether there can be vague objects in our world.[19]

Thus, the modal reading presented above is a non-starter for the indeterminate identity theorist. There is however another modal interpretation of "Δ" and "∇": according to it they are modal operators, but instead of ranging over possible worlds they range over admissible precisifications. Thus, "Δp" will be true if "p" is either true

[19] Nevertheless, such modal logic might be useful in the analysis of vague cross-world identity.

on all admissible precisifications or false on all admissible precisifications, whereas "∇p" will be true if "p" is true on some, and false on some admissible precisifications.[20] Such a reading is reminiscent of the method used by the supervaluationists and is much more compatible with intuitions concerning indeterminacy.[21] Evans's assumption that the sentence "$a = b$" is of indeterminate truth value should, on this reading, be interpreted as saying that "$a = b$" has opposite truth values on different admissible precisifications, and that fact we express by the "∇" operator. Since indeterminacy is to be a worldly phenomenon, the relevant precisifications must be precisifications of the (vague) state of affairs corresponding to "$a = b$", and not of the statement "$a = b$".[22] The objects a and b are vague objects, which can be precisified, and the truth value of the precise statement "$a = b$" changes depending on the objects-precisification in which it is currently evaluated.[23]

It is worth noticing that the supervaluationists' reading of "Δ" and "∇" seems to be compatible with both remarks concerning delta operators made by Evans. As we have just seen on this reading "Δ" and "∇" are modal operators ranging over admissible precisifications. However, it is also true that they indicate a truth value of the sentence to which they are attached. Moreover, K. Fine, the 'father' of supervaluationism, claimed that the set of valid formulas in a language with a definitely operator was given by the modal system S5. A model for a language with

---

[20] Compare Lewis (1988), p. 128. So, also on this interpretation "Δp" may be true, while "p" is not.
[21] Cf. *Introduction*.
[22] Of course, on the first interpretation of Evans's argument - according to which the argument is fallacious - the names "a" and "b" may be imprecise. It is exactly because "a" and "b" have different precisifications, that neither (2) follows from (1) nor (4) follows from (3), and the argument is invalid.
[23] Originally precisifications are always sharpenings of meanings of vague *expressions*. Cf. *Introduction*. Here the assumption is that one may precisify vague objects (e.g. by precisifying their boundaries) and properties, too.

"Δ" and "∇" might be thus considered analogous to that for S5,[24] which seems to correspond to Evans's intentions.

However, as T. Williamson has pointed out, a model for S5 is inconsistent with the possibility of *higher-order vagueness*. In such a model T schema $[\Delta p \rightarrow p]$, S4 schema $[\Delta p \rightarrow \Delta\Delta\, p]$ and S5 schema $[\nabla p \rightarrow \Delta\nabla p]$ are all valid. In order to take higher-order vagueness into account one should introduce the relation of the admissibility between precisifications, allowing for the possibility that it might be indeterminate whether something is determinate. Supervaluationists have recognized this and introduced the relevant relation into their framework. However, now the analogy with S5 system is inadequate, for neither schema S4 nor schema S5 are valid. It seems that S5 and even S4 are both too strong to hold in a logic which is to take into account higher-order indeterminacy.

So far we have ignored Evans's claim that delta operators are **duals**. Interpreting "∇" and "Δ" as duals seems to commit one to the following definition:[25]

(Def ∇) $\nabla A \leftrightarrow \neg\, \Delta \neg A$.

But this definition is equivalent to "$\neg\nabla A \leftrightarrow \Delta\, \neg A$" and this cannot be a valid law of indeterminacy.[26] It works for the right-to-left reading of biconditional, but the left-to-right reading amounts to the claim that if it is not the case that $\nabla(a = b)$, then it is determinate that $\neg(a = b)$. This cannot be true, since in the case in which it is determinately the case that $a = b$, the antecedent is true and the consequent is false. From the fact that a given statement is not indeterminate it does not follow that its negation is determinate. Thus, it seems that delta operators cannot be duals after all.

---

[24] Cf. Fine (1975), p. 290; Williamson (1994), p. 149. See also my *M. Litt.* dissertation.
[25] See Pelletier (1984), pp. 416nn.
[26] Cf. Garrett (1991a), p. 346.

There is also another argument against the duality of delta operators.[27] If delta operators are duals and $\nabla A =_{df} \neg \Delta \neg A$, then Evans's step

(3) $\neg\nabla (a = a)$

becomes

(3') $\neg\neg \Delta \neg(a = a)$,

which is equivalent to the absurd

(3") $\Delta \neg(a = a)$.[28]

Clearly, on the supervaluationist reading "∇" and "Δ" are not duals. "∇A" cannot be defined as "$\neg\Delta\neg A$", for although in the supervaluationistic logic, if it is indeterminate whether p (i.e. "p" has different truth values on different precisifications), then it is not the case that determinately $\neg p$, but not *vice versa*. Determinately $\neg p$ may be false, because determinately p is true. We seem to have the following relations between "∇" and "Δ" in this logic: $\nabla A \leftrightarrow \nabla\neg A$; $\nabla A \rightarrow \neg\Delta A$; $\nabla A \rightarrow \neg\Delta\neg A$.

Therefore, it seems that although the supervaluationist logic seems to conform to some of the Evans's claims (namely the claim that delta operators indicate truth value of sentences to which they are attached and the claim that they generate a modal logic), it does not satisfy all Evans's requirements. The logic that "∇" and "Δ" generate is not as strong as S5 (and moreover it appears that it *should not* be so strong, because if it were, it would not be an adequate logic for the phenomenon of vagueness) and they are not duals.

---

[27] Over (1989), p. 97.

[28] Over notices that if one wants to hold on to the duality of delta operators, but does not want to be committed to the absurd claim that a is determinately not identical with a, then one is forced to a very strange reading of "Δ" operator. For, if "∇" is read as "it is indefinite whether", then "Δ" has to be read as "it is not indefinite whether not", i.e. "it is definite whether not". Cf. ibid.

1.3. Property Abstraction

The steps (1) - (2) and (3) - (4) involve property abstraction. From the fact that it is indeterminate whether $a = b$ we infer that b is such that it is indeterminate whether it is identical with a (i.e. b has the property of being such that it is indeterminate whether it is identical with a). And from the fact that it is not the case that it is indeterminate whether a is identical with a we infer that a is such that it is not indeterminate whether it is identical with a.

One can object to the validity of both steps by appealing to the modal analogy. If delta operators are taken to behave like modal operators then property abstraction becomes questionable.[29] First of all, modal operators introduce contexts which are notoriously opaque. Quantification into such contexts is not always allowed, for it is often fallacious. Lewis compares the inference from step (1) to step (2) with the following fallacious modal inference:[30]

From the true statement

(A) It is contingent whether the number of planets is 9,

one infers

(B) The number of planets is such that it is contingent whether *it* is 9,

which is obviously false.

The inference is not valid because the description "the number of planets" is a non-rigid designator in the statement (A). One cannot infer contingency *de re* from a statement which expresses contingency *de dicto* and which features a non-rigid

[29] Cf. Pelletier (1989), p. 485.
[30] Lewis (1988), pp. 128-9.

designator. From the fact that it is contingent what the number of planets is, it does not follow that for a particular number of planets it is contingent that it is that number.

By the same token one might argue that

(2) $\lambda x\ [\nabla\ (x = a)]b$,

could not be inferred from

(1)$\nabla\ (a = b)$,

if at least one of "a" and "b" were an imprecise designator. Hence, the additional assumption that "a" and "b" are precise designators is crucial if one wants to run the argument. The distinction between "$\nabla[\lambda x[(x = a)]b]$" and "$\lambda x[\nabla(x = a)]b]$" (i.e. between the statement "it is indeterminate whether b is such that it is identical with a" on the one hand and "b is such that it is indeterminate whether it is identical with a" on the other) makes a difference just in case either "a" or "b" is imprecise. In the case where both "a" and "b" are precise designators, the statements "$\nabla[\lambda x[(x = a)]b]$" and "$\lambda x[\nabla(x = a)]b]$" are equivalent.[31] Therefore the property abstraction in the inferences (1) - (2) and (3) - (4) is not valid unless we assume that "a" and "b" are precise designators.

Following the analogy between delta operators and modal operators further it can be argued that not every lambda abstract designates a 'genuine' property.[32] It is claimed that not all modalised formulas designate 'genuine' properties. For instance, the property of Paul that he might have been a little bit taller, is usually not considered as his 'genuine' property on a par with his actual property of being 1,90 m tall. So, if delta operators are regarded as modal operators then they also need not

---

[31] Cf. Rasmussen (1985), p. 84.
[32] Cf. Pelletier (1989). p. 485.

designate 'genuine' properties. It is argued that one cannot assume without further argument, for instance, that there is a 'genuine' property which the predicate "being such that it is indeterminate whether it is identical to a" designates. There are two options available now. One option is to claim that lambda abstracts formed with "∇" are ill-formed, in which case both "$\lambda x[\nabla(x = a)]b$" and "$\neg\lambda x\ [\nabla(x = a)]a$" will be flawed, and claims (2) and (4) should be rejected. Alternatively one can treat such lambda abstracts as well-formed but excluded from the range of Leibniz's Law,[33] and therefore regard step (5) as invalid. If a's property of being such that it *is not* indeterminately identical to a, and b's property of being such that it *is* indeterminately identical to a, cannot be used in the substitution of Leibniz's Law, then one has no grounds to derive the conclusion that a is not identical to b.

The above objections arise from treating delta operators as modal operators. As we have already seen, this is not the only possible interpretation of these operators. One can argue that provided the operators are interpreted as truth value indicators, the above objections lose their force. One could maintain that if the contexts governed by delta operators are not modal, there is no reason why they should not refer to 'genuine' properties. However it might be responded that even if we interpret "∇" as a truth value indicator, there is no such thing as the property of *being such that it is indeterminate whether it is identical to a*.[34] One can hold that it should not be assumed that the expression of the fact that it is indeterminate whether an object has a certain property constitutes itself a (definite!) ascription of another property. The fact that it is indeterminate whether a is identical to b amounts to there

[33] Exactly in the same way in which modal properties are excluded. LL is usually taken to quantify only over 'genuine' properties.
[34] See e.g. Keefe (1995), p. 188. See also Chapter II, section 3.3.

being *no fact of the matter* as to whether those objects are identical or not. And it itself does not - or so the argument goes - involve another indeterminacy-involving property. In general the vague identity theorist should not allow such indeterminacy-involving 'properties' into his ontology at all. If the phrase "it is indeterminate whether Fa" expresses the claim that there is no fact of the matter as to whether a has the property F, then we should not treat it as ascribing another property to a (and cannot use it in the contraposition of Leibniz's law).

There is also another line of attack possible. T. Parsons and P Woodruff claim that even if delta operators are interpreted as truth value indicators one still cannot assume without argument that lambda abstracts in contexts governed by delta operators automatically stand for properties and also fully satisfy property abstraction.[35] Property abstraction is a principle that "$\Phi(a)$" is interchangeable with the lambda abstract "$\lambda x[\Phi(x)]a$" in all extensional contexts. As is well-known, such a principle in sufficiently rich languages leads to paradoxes (in particular the Russell paradox). So, in order to avoid the paradoxes one should restrict either the abstraction principle or the quantification over properties.[36] According to Parsons and Woodruff, there is also another ("less-familiar") constraint according to which "one *cannot* take for granted that lambda abstracts that bind variables in contexts governed by the indeterminacy operator "∇" stand for properties *and also* fully satisfy [property] abstraction."[37] Jointly assuming these two claims simply begs the question against the ontic vagueness theorist. In order not to beg the question, one should give up one of the claims. One option (call it the *conceptual* option) is to argue that

---

[35] See Parsons, Woodruff (1995), p. 175n.
[36] Parsons, Woodruff (1997), p. 329.
[37] Parsons, Woodruff (1997), p. 325, their emphasis.

although the abstraction principle always holds, there is no guarantee that the predicates featuring in that principle stand for properties.[38] The option is called *conceptual*, because abstracts "are guaranteed to reproduce the conceptual content of the formulas from which they are generated".[39] So, although we can always substitute "$\Phi(a)$" with "$\lambda x[\Phi(x)]a$", it may be the case that there is no property corresponding to "$\lambda x[\Phi(x)]a$". Hence, even though claims (2) and (4) are justified, (5) cannot be derived from them. For although (2) $\lambda x[\nabla(x = a)]b$ and (4) $\neg\lambda x[\nabla(x = a)]a$ are both true, there is no guarantee that there are corresponding properties that could be ascribed to a and b. Therefore there might be no properties that could be used in proving that a and b are not identical. Since it is usually taken that Leibniz's Law operates on properties, not on predicates,[40] (5) $\neg(a = b)$ does not follow.

The other option (call it the *ontological* option) is to

"take for granted that abstracts stand for properties, but reject the principle of abstraction as always providing the conditions under which such properties holds of objects".[41]

This option is called ontological, because abstracts are guaranteed to stand for something. Thus, one assumes that the predicate "being such that it is indeterminate whether it is identical to a" refers to a property, but denies that the principle of abstraction gives its application-conditions. Now, the steps (2) and (4) are in need of justification. Although we know that there are properties corresponding to the abstracts "$\lambda x[\nabla(x = a)]$" and "$\neg\lambda x\ [\nabla(x = a)]$", we are not entitled to ascribe the corresponding properties to a and b.

---

[38] ibid.
[39] Parsons, Woodruff (1997), p. 331.
[40] Compare however Noonan's view (Noonan (1984)). He argues that identity should be defined in terms of predicates rather than properties. See also chapter II, section 3.3.
[41] Parsons, Woodruff (1995), p. 177.

So to sum up this line of attack: There are two ways in which Evans's argument may fail. Either it assumes full abstraction principles, but then there is no guarantee that predicates stand for properties, or else it assumes that predicates always stand for properties, but then the use of full abstraction principles may be illegitimate. In the former case the argument fails because step (5) is unjustified, in the latter - it fails because the inference (3) - (4), which uses the contrapositive of abstract elimination,[42] is not valid.

This whole reasoning rests upon the claim that one cannot assume without argument that lambda abstracts in contexts governed by delta operators stand for properties and also fully satisfy property abstraction. However, it is not clear what is the status of this claim. It seems to be in need of justification itself. It is true that some lambda abstracts are 'suspect' especially when they appear in opaque, such as e.g. modal, contexts. But there is no obvious reason to be suspicious about abstracts containing delta operators as long as they are interpreted as truth value indicators. As we have seen, Parsons and Woodruff argue that the "joint assumption" that lambda abstracts containing the indeterminacy operator always stand for properties and that these abstracts fully satisfy property abstraction is unjustified, because it begs the question against the proponents of indeterminate identity. The question is however where the burden of proof lies. Is it the opponents or the proponents of vague identity who have to prove their case? Is it the opponents who have to demonstrate that the joint assumption is justified, or the proponents who have to show why the joint assumption fails? The assumption that lambda abstracts in contexts governed by delta operators stand for properties and also fully satisfy property abstraction is indeed

[42] See ibid, p. 183.

assumed without argumentation, but it might be argued that since there is no reason to suppose otherwise, the burden of proof rests upon theorists who claim that this assumption is unmotivated.

1.4. Step (3), i.e. definite self identity

Probably no reasonable theorist would claim that there are objects that are not identical to themselves. The reflexivity of identity, the claim that everything is identical with itself, is usually considered as a part of the definition of what identity is. One could argue, however, that there is a difference between, for instance, a being identical with itself and a being identical to a.

Thus, one can claim, for instance, that (3) $\neg\nabla$ $(a = a)$ is not true in virtue of a being a vague object. It may seem that if a is a vague object then it may also be vague whether it is identical with a. So, although it is determinately true that a is self-identical, it is indeterminate whether a is identical to a. To this it could be responded that even if a is vague, then one still can obtain precise identity by matching a with a. a corresponds precisely to a, for "[a]ll their vagueness matches exactly".[43] Moreover, this reasoning clearly multiplies properties: each object x will possess two (distinct) properties: one of being self-identical and another of being identical to x.

This last claim is contested by Copeland. He argues against distinguishing those two properties and claims moreover that the fact that such properties are not distinct makes Evans's argument invalid. Copeland argues that "[i]t is not as though there are two different properties that a has, the property of being determinately self

[43] Wiggins (1986), p. 175; see also Garrett (1988), pp. 132-3.

identical and the property of being determinately identical to a".[44] He considers two formulas:

$$(2') \neg\lambda x[\Delta (x = a)]b$$

and

$$(4') \lambda x[\Delta (x = a)]a,$$

and argues that because in the case of a, the property of being determinately identical to a is the same as the property of being identical to itself, (4') says in fact that a has the property of being self-identical. Since b is also self-identical, (4') does not ascribe to a any property that b does not have. Thus, one may claim that (2') and (4') are both true, without maintaining that a has a property which b lacks. Analogous reasoning can be repeated for Evans's steps:

$$(2) \lambda x[\nabla (x = a)]b$$

and

$$(4) \neg\lambda x[\nabla (x = a)]a.$$

In this case (4) says that a does not have the property of being indeterminately self-identical. However, (2) does not say that b has that property (i.e. the property of being indeterminately self-identical). It says instead that b has the property of being indeterminately identical to a. Again, one can claim that both (2) and (4), which says that a does not have the property of being indeterminately self-identical, are true, without holding that b has a property that a lacks. The appearance that it is otherwise, arises, according to Copeland, because of an illegitimate substitution into lambda abstracts containing unbound singular terms. In his words:

[44] Copeland (1994), p. 88.

"The substitution of a for y and the substitution of b for y in the open sentence $\neg\lambda x$ $[\Delta (x = a)]y$ are not of the same feather. The first substitution produces a statement equivalent in meaning to

$\neg\lambda x\ [\Delta\ (x = x)]a$

but the second does not".[45]

Copeland concludes that (2) and (4) cannot be used to derive (5). To say that $\lambda x\ [\nabla(x = a)]b$ and $\neg\lambda x[\nabla(x = a)]a$ does not amount to saying that there is a property F such that b has it and a lacks it. Therefore, (2) and (4) cannot be used in the contraposition of Leibniz's Law to prove that a and b are distinct.[46]

Thus, Copeland concentrates on the relation between a's property of being self-identical and a's property of being identical to a and argues that there is nothing for "$\neg\lambda x[\nabla(x = a)]a$" to mean other than "$\neg\lambda x[\nabla(x = x)]a$", for there is only one property at issue, namely the property of being indeterminately self-identical.[47] Since b also does not have that property, one cannot conclude that b and a are determinately dissimilar. The fact that "$\neg\lambda x[\nabla(x = a)]a$" expresses a's property of not being indeterminately self-identical explains why (4) does not deny that a has the property that (2) attributes to b. For although (2) ascribes to b the property of being indeterminately identical to a, this latter property is not the property that (4) is about.

In Evans's proof one tries to derive the conclusion that $\neg(a = b)$, from the premises which say that a is not indeterminately self-identical, while b is indeterminately identical to a. Copeland's argument has it however, that these two premises together cannot be used as the premise for the contrapositive of Leibniz's Law (i.e. $\exists F\ (Fb\ \&\ \neg\ Fa)$), which would entitle the derivation of "$\neg(a = b)$". Since,

---

[45] Copeland (1994), p. 89.
[46] Copeland (1994), p. 90. Copeland (ibid.) writes moreover that "[t]o hold that $a = b$ does not determinately imply $\lambda x\ [\nabla\ (x = a)]a \leftrightarrow \lambda x\ [\nabla\ (x = a)]b$ is not to question the determinate truth of the proposition that if $a = b$ then a and b have all their properties and relationships in common".
[47] Cf. Copeland (1994), p. 89.

in the case of a, "$\neg\lambda x[\nabla(x = a)]$" and "$\neg\lambda x[\nabla(x = x)]$" express one and the same property, there is only one property to be attributed to a, namely the property of being determinately self-identical. Although one can express that property in two ways, it should not mislead one into thinking that there are two properties corresponding to these ways.

An objection similar to Copeland's has been raised by Lowe. His claim is that the inference from (3) to (4) is invalid.[48] Lowe concentrates on two properties: "$\lambda x[\nabla(x = a)]$" and "$\lambda x[\nabla(x = b)]$". Let us agree that "$\lambda x[\nabla(x = a)]$" expresses a 'genuine' property, which b possesses. Then, since our assumption was that a is indeterminately identical to b, a must possess the symmetrical property $\lambda x[\nabla(x = b)]$. If, however, there is no objective fact of the matter as to whether or not a is identical with b, then the property "$\lambda x[\nabla(x = a)]$" is not determinately different from the property "$\lambda x[\nabla(x = b)]$", because these properties differ only by permutation of "a" and "b". In other words, since a is indeterminately identical to b, the property of being indeterminately identical to a is indeterminately identical to the property of being indeterminately identical to b. Thus, the possession by b of the property λx $[\nabla(x = a)]$ cannot determinately differentiate b from a, since that property itself is not determinately different from the property λx $[\nabla(x = b)]$ possessed by a. Since $\lambda x[\nabla(x = b)]$ and $\lambda x[\nabla(x = a)]$ are not determinately different, one cannot (determinately) deny that a possesses the property λx $[\nabla(x = a)]$.[49]

This argument is quite compelling. It seems intuitive that if b is indeterminately identical to a, then the property of being indeterminately identical to a

48 Compare Parsons' and Woodruff's considerations concerning that step (section 1.3. above).
49 Lowe (1994), p. 114.

possessed by b cannot be determinately different from the property of being indeterminately identical to b possessed by a, and therefore if one agrees that a possesses the latter property, one cannot determinately claim that it does not possess the former. Anyway, using any of these properties in an argument to the effect that a and b are determinately different seems unfair.

Lowe argues further that to claim that (3) entails (4) is to make a formal error. It is true that a is determinately identical to itself, but since it is also indeterminately identical to b, which is in turn indeterminately identical to a, one cannot conclude that a does not possess the property of being indeterminately identical to a. Therefore, a formal restriction must be placed on the property abstraction so that from "$\neg\nabla(a = a)$" only "$\neg\lambda x[\nabla(x = x)]a$" could be derived.[50]

To sum up, Lowe argues that even though one can determinately deny that a possesses the property of being indeterminately identical to itself, one cannot determinately deny that a possesses the property of being indeterminately identical to a. Since there is no fact of the matter as to whether a is identical to b, there is also no fact of the matter as to whether the property of being indeterminately identical to a is different from the property of being indeterminately identical to b. Thus, although "$\neg\lambda x[\nabla(x = x)]a$" is determinately true, "$\neg\lambda x[\nabla(x = a)]a$" is not.

[50] Compare also Copeland, (1994), p. 88.

1.5. Leibniz's Law

Evans appeals to Leibniz's Law (hereafter: LL) in order to derive (5) from (2) and (4). He does not indicate which form of this law he uses. Clearly the Principle of Indiscernibility of Identicals in its traditional form

(LL) $\forall x \forall y\, [(x = y) \rightarrow \forall F\, (Fx \leftrightarrow Fy)]$,

where x and y are variables ranging over individuals, and F is a variable ranging over properties,[51] is of no use to him, since we are not assuming that a is identical to b. Moreover, although LL is taken to be a valid law in (second-order) classical logic with identity, no matter which interpretation of delta operators we choose we will not get classical logic. Regarding "∇", "Δ" as modal operators leads to some kind of modal logic (which at best could be an extension of classical logic) and regarding them as truth value indicating operators leads to a logic with at least three values. As we remember, one might argue that on the modal interpretation LL will not apply to properties involving one of delta operators, for modal properties are excluded from the range of F.[52] For instance, the property $\lambda x\, [\nabla\, (x = a)]b$ will be a modal property and as such will not belong to the range of the quantifier featuring in LL. Hence, the argument will have it that on the modal interpretation of "∇" and "Δ" LL cannot be used in deriving (5) from (2) and (4).

On the truth value-indicators interpretation, LL in the form given above is of no help, either. What is needed to derive (5) is its contrapositive[53], namely:

---

[51] The Principle is sometimes formulated in terms of predicates, not properties. Compare Noonan (1984), p. 118.

[52] Cf. Pelletier (1989), p. 485. See above, section 1.3.

[53] This contrapositive is sometimes called "the law of the diversity of dissimilar".

$$(\mathrm{LL1})\ \forall x \forall y\, [\neg \forall F\, (Fx \leftrightarrow Fy) \rightarrow \neg(x = y)]$$

In our case, the relevant substitution will take the form:

$$(\mathrm{LL}\lambda)\ \neg\{\lambda x[\nabla(x = a)]b \leftrightarrow \lambda x[\nabla(x = a)]a\} \rightarrow \neg(a = b).$$

In classical logic both LL and its contrapositive LL1 are valid in the classical sense of validity, in which an argument is valid iff it is truth-preserving. The notion of validity can be extended so as to apply also to three-valued systems. We say that an inference is valid if it leads from true premises to a true conclusion or from indeterminate premises to a true or indeterminate conclusion (i.e. if it is truth- and indeterminacy-preserving). And it is by no means obvious that in a three-valued logic LL and LL1 will be valid in the sense.

One logic in which LL is not valid is given by Johnsen. He adopts the Kleene strong tables,[54] out of which the following are relevant for the present purpose:

p	$\neg p$
T	F
F	T
I	I

p	q	$p \rightarrow q$	$p \leftrightarrow q$
T	T	T	T
T	I	I	I
T	F	F	F
I	T	T	I
I	I	I	I
I	F	I	I

[54] Kleene's strong tables are commonly considered as the most suitable for three-valued logics in which the third value is "indeterminate". See e.g. Körner, *Experience and Theory*, Routledge and Kegan Paul, London 1966. On the other hand, it might be argued that no logic whose connectives are truth functional can be adequate for vagueness. For instance, using Kleene's strong tables we end up having to ascribe sentences such as "A & $\neg A$" and "$A \vee \neg A$"; where A is a borderline sentence, the value I. To some theorists it appears inadmissible. Cf. e.g. Williamson (1994). See also below.

where "T" stands for "true", "F" stands for "false" and "I" stands for "indeterminate". He introduces the following truth tables for "∇" and "Δ":

p	∇p	Δp
T	F	T
F	F	T
I	T	F

and proposes the following counterexample to LL: Assume that a has a vague property, namely it is indeterminate in colour: it is neither determinately green nor determinately blue. Hence, the statement "$\lambda x(Gx)(a)$", where "G" stands for green, is indeterminate in truth value. Now, we have got an instance of LL:

(LLa) $(a = a) \rightarrow (\lambda x(Gx)(a) \leftrightarrow \lambda x\ (Gx)(a))$

which is not true but merely indeterminate according to the truth tables given above. The antecedent "$a = a$" is necessarily true, the consequent is indeterminate (since it is indeterminate whether a is such that it is green, and the equivalence of two indeterminate statements is also indeterminate). Since we start with a true premise and arrive at an indeterminate conclusion, the whole conditional must be indeterminate.

Thus, LL is not a valid law of the three-valued logic which adopts Kleene's strong truth tables. If LL is to be a law of three-valued logic it must be reformulated. Johnsen goes on to suggest some such reformulations and claims that LL should become:

(LLv) $[\Delta(a = b)\ \&\ \Delta\lambda x(\phi x)(a)\ \&\ \Delta\lambda x(\phi x)(b)] \rightarrow [(a = b) \rightarrow (\lambda x(\phi x)(a) \leftrightarrow \lambda x\ (\phi x)(b))]$.

The other reformulations are:

(LLi) $[\Delta\lambda x(\phi x)(a) \vee \Delta\lambda x(\phi x)(b)] \rightarrow [(a = b) \rightarrow (\lambda x(\phi x)(a) \leftrightarrow \lambda x(\phi x)(b))]$

(LLnv) $[\Delta\lambda x(\phi x)(a) \,\&\, \Delta\lambda x(\phi x)(b)] \rightarrow [(a = b) \rightarrow (\lambda x(\phi x)(a) \leftrightarrow \lambda x(\phi x)(b)]$

LLnv could be used to prove the incoherence of vague identity but neither it nor LLi can be assumed without argument to be a valid law of a three-valued logic. LLv seems to be the only version guaranteed by the law of two-valued logic, LL.[55] LLv is obviously of no use for the opponents of indeterminate identity, because one of the conjuncts in the antecedent is the claim "$\Delta(a = b)$", which one cannot accept without begging the question against indeterminate identity. So, although LLv is a valid law, it cannot be used in Evans's argument. And the status of the law that could be used - namely LLnv - is unclear. It is stronger than LLv and therefore needs to be argued for. It is doubtful that any proponent of vague identity would be willing to accept it.

Thus, Johnsen concludes that

"Evans's [...] attempted proof ha[s] at best established that vague identity is incoherent iff something stronger than LLv is a law of three-valued logic. It is not evident, though, that anything stronger than LLv *is* a law of three-valued logic; and a vague identity theorist should be quite prepared to reject any such contention."[56]

It seems however that Johnsen's counterexample to LL may prompt one to draw another conclusion than the one envisioned by him. Consider

(LLa) $(a = a) \rightarrow (\lambda x(Gx)(a) \leftrightarrow \lambda x\,(Gx)(a))$

again. What one is claiming here is that although it is (determinately) true that a is identical to itself,[57] it is nevertheless indeterminate whether a's being such that it

[55] See Johnsen (1989), p. 109.

[56] Johnsen (1989), p. 112.

[57] I ignore here the issues discussed in section 1.4.

is indeterminate whether it is green is equivalent with a's being such that it is indeterminate whether it is green. This does not seem right. What else could a's self-identity consist in, if not in its sharing all, i.e. precise and vague, properties with itself? As has been mentioned above, all vagueness of a should match exactly that of a. It seems that a's being (determinately or indeterminately) green should be determinately equivalent to a's being (determinately or indeterminately) green. Moreover, saying that the biconditional "$\lambda x(\phi x)(a) \leftrightarrow \lambda x(\phi x)(a)$" is indeterminate in truth value amounts to the claim that a's possessing the property of being vaguely green is only indeterminately equivalent to a's possessing this very same property. This in turn is tantamount to the claim that indeterminate sentences are not (determinately) equivalent to themselves. If sentence "p" is vague then sentence "$p \leftrightarrow p$" is equally vague. This may be considered hard to swallow. One might argue that although "$\lambda x(\phi x)(a)$" is indeterminate, the biconditional "$\lambda x(\phi x)(a) \leftrightarrow \lambda x(\phi x)(a)$" should be ascribed truth rather than indeterminacy. The statement "p" of indeterminate truth value seems to be determinately equivalent with itself. In general, there is no reason why the biconditional whose two sides are identical indeterminate statements should be treated differently from an analogous biconditional having two true (or false) identical statements as its sides.

According to Kleene's strong tables not only does "$p \leftrightarrow p$" become indeterminate, if "p" is indeterminate, but all classical tautologies share that fate. The three-valued logic with Kleene's strong truth tables has no tautologies at all: all classical tautologies come out as indeterminate on some substitutions. This might suggest that Kleene's strong logic is not an adequate logic for ontic vagueness. The tables for indeterminacy do not square with our intuitions concerning vagueness.

There is nothing in the theory of ontic vagueness that would suggest that the indeterminacy of the statement "p" should result, for instance, in the indeterminacy of the conditional "$p \rightarrow p$" or the biconditional "$p \leftrightarrow p$".

The above remarks might suggest that no truth-functional logic will be suitable to capture the phenomenon of vagueness. Any such logic would have to take into account the so-called *penumbral connections*,[58] i.e. the internal and external connections existing, for instance, between vague properties.[59] It might seem that in the case of vagueness, the truth value of complex sentences concerning borderline cases should depend not only on the truth value of the component clauses but also on their content. For instance, a disjunction whose both disjuncts are indeterminate may be either true or indeterminate depending on the content of the disjuncts: "either a is green or a is not green" might be considered true, but "either a is green or a is green" is indeterminate. The situation with the biconditional seems analogous. Although "$\lambda x(\mathrm{G}x)(a) \leftrightarrow \lambda x\,(\mathrm{G}x)(a)$" appears to be true, "$\lambda x(\mathrm{G}x)(a) \leftrightarrow \lambda x(\mathrm{B}x)(a)$" seems false. Clearly, in order to capture these intuitions the connectives cannot be truth-functional.[60]

However, even if one decides to hold on to truth-functional logic and adopts different truth tables which would assign LLa the value "truth" and preserve Leibniz's Law, it does not mean yet that the contrapositive of LL, LL1, would also be valid according to those tables. And as has been noted above, Evans's argument uses LL1,

---

[58] See Fine (1975), p. 276 and Williamson (1994), p. 142. Fine defines penumbral connections as semantic constraints built into the meaning of a word..

[59] Internal connections may be regarded as connections between different borderline cases of the same property: if a is not determinately blue, then b, which is less blue than a, cannot be determinately blue. External connections concern common borderline cases of different properties: if a is neither determinately green nor determinately blue, then b, which is bluer in colour than a, cannot be determinately green.

[60] An example of such logic applied to linguistic vagueness is supervaluationism. See *Introduction*.

not LL. LL and LL1 are equivalent in classical logic, but they need not be equivalent in three-valued logic. For instance, provided that we assume that "∇A" is true iff "A" is neither true nor false,[61] the following inference is valid inference for "∇":[62]

$$\frac{A}{\therefore \neg\nabla A}$$

but its contrapositive is not valid:

$$\frac{\nabla A}{\therefore \neg A}$$

because when "∇A" is true, "$\neg A$" is not. Therefore, in particular it cannot be taken for granted that the inference "$\neg[\lambda x(\phi x)(a) \leftrightarrow \lambda x(\phi x)(b)] \rightarrow \neg(a = b)]$" is valid. In a three-valued logic there are examples of valid inferences (such as the one given above) which have invalid contrapositives. LL1 cannot be assumed - its validity has to be argued for.[63]

1.6. Step (5)

The problem with the step:

(5) $\neg(a = b)$

is that it becomes ambiguous once we assume that the underlying logic is a three-valued logic.[64] In three-valued logics there can be two kinds of negation. On the strong interpretation of negation "$\neg A$" is true iff "A" is false and "$\neg A$" is indeterminate iff "A" is indeterminate. On the weak interpretation "$\neg A$" is true iff "A" is either false or indeterminate. So, on the strong interpretation (1) and (5) do in fact

---

[61] See below the beginning of the next section.
[62] Parsons, Woodruff (1995), p. 178.
[63] Compare also Broome (1984), p. 8-9.
[64] Garrett (1991a), pp. 345-6.

contradict each other. If it is true that $\nabla(a = b)$ then "$\neg(a = b)$" must be false, and if "$\neg(a = b)$" is true, then "$\nabla(a = b)$" has to be false. But it remains yet to be proved that (5) with a strong negation in it follows from (2) and (4). Simply assuming that it does, begs the question against indeterminate identity. One can insist that it is a weak negation that should be used throughout the argument. And if one interprets (5) as containing a weak negation, then we do not arrive at a contradiction - contrary to what Evans claimed. On this interpretation, the statement "$\nabla(a = b)$" is perfectly consistent with the claim "$\neg(a = b)$". The latter can be true, even if the former is true (i.e. even if "$a = b$" is indeterminate).

However, it should be noted that the weak reading is not very plausible for indeterminacy.[65] On this reading "$\neg A$" is true if "A" is indeterminate, so all negations of borderline statements, which are themselves borderline statements, are true. Since borderline statements are *ex definitione* statements with indeterminate truth value, it would follow that negative borderline statements have two true values: indeterminacy and truth.

If we regard "∇" and "Δ" as modal operators, then it seems that (5) does not contradict (1). (1) says that "$a = b$" is true on some precisifications of a and b and false on some. Clearly, (5) does not say that "$\neg (a = b)$" is true on all precisifications. Thus, it seems that (1) $\nabla(a = b)$ and (5) $\neg(a = b)$ can be true together.

If we agree that there is no inconsistency between (1) and (5), then the argument - if valid - proves:[66]

(P)$\nabla(a = b) \rightarrow \neg(a = b)$.

---

[65] Garrett notices this but derives a different conclusion, see (1991a), p. 346.
[66] Pelletier (1989), p. 483n.

The problem is that from that by contraposition we can get

(P') $(a = b) \rightarrow \neg\nabla\,(a = b)$

and by duality of delta operators (P') is equivalent to

(P") $(a = b) \rightarrow \Delta\neg\,(a = b)$

which is absurd, for it says that if a and b are identical then they are determinately distinct.

F. J. Pelletier assumes that Evans's argument proves (P). According to him, since (P) is equivalent to the absurd (P"), there must be something wrong with Evans's proof. However, two things are worth noticing.

First of all, the argument in order to derive (P") from (P) essentially uses contraposition. As we have seen several times already, the use of contraposition becomes dubious in a logic with three truth values. Also if "∇" is interpreted as a modal operator one would have to object to contraposition. For although (P) seems a valid inference in a modal logic of indeterminacy, (P') cannot hold in this logic.

Moreover, the equivalence between (P') and (P") depends on the assumption that delta operators are duals and - as we have already seen - one might argue that this assumption is flawed (see section 1.2.1. "Duality of delta operators").

1.7. Step (5')

Evans proposes to strengthen (5) so as to obtain

(5') $\Delta\neg(a = b)$

which - as he says - "is straightforwardly inconsistent with (1)". Whether it really is inconsistent depends again on the reading of "∇" and "Δ".

If three-valued-logic reading is presupposed, then (5') is either ineffective or unnecessary, depending on the reading of the negation used in (5).[67] As has been claimed in the preceding section, if the negation in (5) is a strong negation, then (5) already contradicts (1) and transition to (5') is unnecessary. If, on the other hand, the negation in (5) is weak, then moving to (5') does not improve the situation. (5') still does not contradict (1): if $\nabla(a = b)$ is compatible with $\neg(a = b)$, then there is no reason why it should not be compatible with $\Delta\neg(a = b)$.

On the modal reading, (5') evidently contradicts (1), for while (1) says that a and b are indeterminately identical, (5') says that they are determinately not identical. However the problem is that we are not entitled to strengthen (5) in this way. Recall that Evans writes as follows: "If "Indefinitely" and its dual, "Definitely" [...] generate a modal logic as strong as S5, (1) - (4) and, presumably, Leibniz's Law,[68] may each be strengthened with a "Definitely" prefix, enabling us to derive [(5')]". This claim indicates a modal interpretation, assumes explicitly that delta operators are duals, and argues that (5') can be inferred, provided that "∇" and "Δ" generate a logic which is as strong as logic S5. As we have already seen however (Cf. section 1.2), even if one adopts a modal reading, it is by no means obvious that delta operators are duals and moreover they generate a logic as strong as S5. Surely, if one accepts the supervaluationists logic, such a 'strengthening' of (5) is out of the question.

[67] Garrett (1991a), p. 347.

[68] It has already been argued that it cannot be the usual form of LL that Evans's wanted to use. Johnsen argues that Evans had in mind the following law:
(LLΔ) $\Delta\forall y\forall z\ ((y = z) \rightarrow [\lambda x(\phi x)(y) \leftrightarrow \lambda x(\phi x)(z)])$, which is not a law of three-valued logic just as LL is not. See Johnsen (1989), p. 109.

Before summing up the results of our investigations into the validity of Evans's argument, let us look briefly at the two other arguments against vague objects: N. Salmon's and D. Wiggins's, both of which are in the same spirit as the argument of Evans.

2. NATHAN SALMON'S AND DAVID WIGGINS'S ARGUMENTS

2.1. Nathan Salmon's argument

Nathan Salmon's argument is similar to Evans's. It is constructed in the metalanguage.[69] The argument starts with the assumption that it is vague whether x is identical with y. But then the pair $<x, y>$ will be definitely not the same pair as $<x, x>$, since it is determinately true that x is identical to itself. Hence, it follows that x and y must be distinct, which contradicts the initial assumption.[70]

Johnsen argues that Salmon's argument is valid, but is not sufficient to prove that vague identity is incoherent.[71] Salmon assumes that metalanguage is two-valued (it is always determinate whether an object possesses the property of being an object x such that the predicate expressing the property of being identical to x is determinately true of x) and assumes that LL is valid in the appropriate metalogic. Johnsen objects that one cannot simply assume that LL is valid in metalogic; such a claim has to be justified. One might argue that if the metalanguage is to say anything

[69] The argument is metalinguistic, because it uses a metalinguistic property of being an object x such that a certain predicate (namely the predicate expressing the property of being identical to x) is determinately true of x. See Johnsen (1989), p. 110.
[70] See Salmon (1982), p. 243.
[71] Johnsen (1989), p. 111.

about vagueness, its object language should be three-valued and that brings us back to the question of validity of LL in the object language.[72] If one holds that three truth values are needed to express indeterminacy in the object language, then the arguments formulated by Johnsen against Evans's argument (see section 1.5), can be applied here as well. LL will be valid in the metalanguage, only if

(LLnv) $[\Delta\lambda x(\phi x)(a) \ \& \ \Delta\lambda x(\phi x)(b)] \rightarrow [(a = b) \rightarrow (\lambda x(\phi x)(a) \leftrightarrow \lambda x(\phi x)(b)]$

is valid in the object language. If it is

(LLv) $[\Delta(a = b) \ \& \ \Delta\lambda x(\phi x)(a) \ \& \ \Delta\lambda x(\phi x)(b)] \rightarrow [(a = b) \rightarrow (\lambda x(\phi x)(a) \leftrightarrow \lambda x (\phi x)(b))]$,

which is the only form of LL valid for the object language, then LL is not valid. Hence, Salmon's proof establishes that the indeterminate identity is incoherent, *provided* that something stronger than LLv is a law of three-valued logic. And as has been argued this is far from obvious and must be backed up by arguments.

Contrary to Johnsen, T. Parsons takes Salmon's argument to be invalid.[73] He argues that Salmon's argument can be simplified and reformulated as follows:

1. $\nabla (x = y)$	assumption
2. $\neg\nabla (x = x)$	logical truth
3. $x \neq y$	1, 2 Logic of iden.

The crucial move here is, of course, the derivation of (3) from (1) and (2). The inference rule called "Logic of identity" clearly appeals to a version of Leibniz's Law. The problem is that it does not appeal to LL itself (for it does not proceed from the claim that $x = y$ and x has a certain property, to the claim that y must have that property as well), but to its contraposition. From the claim that y is indefinitely identical to x, and x is not indefinitely identical to x, it derives the conclusion that x

[72] ibid.
[73] Parsons (1987). pp. 8-11.

and y must be distinct. Although Parsons has no objections to LL, he does object to its contrapositive. According to him, the contrapositive of LL is simply not valid in the presence of indeterminacy.[74]

The above formulation of Salmon's argument is very important, because it can be regarded as a formulation (and simplification) of Evans's argument as well. By using variables, it avoids the problems connected with the possibility of indeterminate reference of terms flanking the identity sign. It also skips the uses of property abstraction, avoiding the questions concerning the validity of property abstraction. So, one cannot argue that the argument is invalid because the terms used in it are imprecise designators. Neither can one maintain that it is the use of property abstraction which is fallacious and invalidates the whole reasoning. The present argument is extremely simple and uses only one rule of inference: the contrapositive of LL. We have seen many times now (and most recently in the preceding paragraph) that that rule can be questioned in a logic with indeterminacy. The problem is however, that quite independently of the general doubts concerning the validity of the contrapositive of LL, there seem to be nothing wrong with that particular application of that law which features in the above argument. The paradox here is that that argument just *seems* right. It appears that if y is indeterminately identical to x and x is not indeterminately identical to x, then x and y have to be different objects.

One could reply to this by appealing to Lowe's considerations concerning the properties "$\lambda x\ [\nabla(x = a)]$" and "$\lambda x\ [\nabla(x = b)]$" (see above, section 1.3). Here we

[74] Parsons (1987), pp. 9-10. Parsons accepts a different truth-table for the conditional then the one given above. He takes "$A \rightarrow B$" to be true, if "A" is false or "B" is true or both are indeterminate, false if "A" is true and "B" is false, and otherwise indeterminate. As an example he gives the following valid inference pattern: From: $A \rightarrow B$; and: $B \rightarrow C$; infer: $\neg\nabla\ (A \rightarrow C)$, whose contraposition is invalid: From: $\nabla\ (A \rightarrow C)$; and: $B \rightarrow C$ one cannot infer: $\neg\ (A \rightarrow B)$, because the inference fails, when A is true and B and C are indeterminate.

have two objects x and y of which we assume that they are indeterminately identical. One can argue that if x and y are indeterminately identical then the property of being indeterminately identical to x is not determinately different from the property of being indeterminately identical to y. Thus, it can be maintained that even though y has the property of being indeterminately identical to x and x does not have that property, x has the property of being indeterminately identical to y, which is not determinately different from y's property. Thus, such properties cannot be used to determinately distinguish x from y. In this case, the argument is even more plausible, since we do not have names that feature in the predicates which express the relevant properties.

Alternatively, following Copeland (see section 1.4), one could insist that the only admissible reading of "$\neg\nabla(x = x)$" is "x is not indeterminately identical to itself". Arguably, this reading does not allow to derive the conclusion (3).

2.2. David Wiggins's Argument

There is one more argument which deals with indeterminate identity. It does not use indeterminate identity at all, but aims nevertheless at ruling it out altogether. D. Wiggins has offered the following proof:[75]

1. $x = y$	assumption
2. $\Delta\ (x = x)$	truism
3. $\Delta\ (x = y)$	1, 2, LL
4. $x = y \rightarrow \Delta\ (x = y)$	cond. proof[76]

This argument does not use the contrapositive of Leibniz's Law at all. It applies Leibniz's Law itself. Thus, it seems that there is no denying that (3) follows

[75] See Wiggins (1986), p. 173. I use variables "x" and "y" instead of "a" and "b", in order to side-step the possible issue of the vagueness of "a" and "b".
[76] Zemach (1991), p. 335.

from (1) and (2). What the argument (1) - (3) proves is that if two objects are identical they must be determinately identical. In other words, if we assume that x and y are identical, we are forced to conclude that it is determinate that they are identical. This argument does not rule out the possibility of indeterminate identity, yet. The vague identity theorists would agree that, if "$x = y$" is true, then "$\Delta(x = y)$" is true too. Thus if we take LL to be the law of inference which says that if it is true that x is y, whatever is true of x is true of y, and *vice versa*, then the ontic vagueness theorists can accept it. The problem arises at step (4). This step says that "$\Delta(x = y)$" follows from "$x = y$", and it appears that the theorists who believe in vague identity have to deny the validity of that inference; i.e. they have to reject conditional proof. The vague-objects supporter has to deny that (4) is always true, since it can be the case that its antecedent may be indeterminate, thus making its consequent false. And if the antecedent is indeterminate and the consequent false, the whole conditional will be indeterminate.[77]

3. CONCLUSION

There is one interpretation according to which Evans's argument is almost unproblematic. It is a sort of 'didactic' argument: it purposely fails in order to check who will notice and diagnose the fallacy. It pretends to prove an absurd claim that there are no indeterminate identity statements, but one of its steps is fallacious. The fallacy lies in the imprecision of the singular terms used in the proof. Thus, only theorists who allow the possibility that such singular terms may be imprecise can

[77] Garrett (1988), p. 133.

diagnose the fallacy. If there were theorists who maintained that indeterminately identical objects have to be denoted by precise terms, they would not be able to refute Evans's absurd conclusion.

However, there is also another possible interpretation of Evans's argument. According to this interpretations the aim of the argument is twofold: it attempts to prove that a certain sort of indeterminate identity statements is incoherent - namely statements which contain only precise designators - and by doing this, it allegedly shows that the world cannot be vague. In this chapter we focused mainly on the former aim. Whether or not the argument achieves this aim is an open question. Every single step of this argument has been challenged in many ways. While some of these attacks are clearly misguided, some pose a genuine threat to the validity of the argument. Anyway, it appears that the vague objects theorists have some room for manoeuvre. The crucial thing is the correct interpretation of delta operators. If one decides to regard them as modal operators, then one may i.a.:

(i) question the 'genuineness' of the properties described in (2) and (4);

(ii) question the applicability of LL to properties involving "∇";

(iii) argue that (5) does not contradict (1) (as a matter of fact, it is hard to understand how it could contradict (1) on this reading of delta operators);

(iv) claim that delta operators cannot be duals and (5) cannot be strengthened to (5').

On the other hand, if one chooses the truth-value-indicators interpretation, then one can i.a.:

(i) question the full applicability of abstraction principles to abstracts containing "∇";

(ii) question the validity of the step (3) - (4) on the grounds that from (3) only "$\neg\lambda x[\nabla(x = x)]a$" can be derived;

(iii) question the validity of the contrapositive of LL in a three-valued logic;

(iv) argue that (5) does not contradict (1), because it contains a weak negation;

(v) maintain that the strengthening of (5) to (5') is ineffective.

It seems, however, that even if one agrees that Evans's argument is valid (i.e. it does show the incoherence of the statement "$\nabla(a = b)$"), one may still wonder whether it achieves its second aim. In the next chapter we will try to assess whether the argument gives the answer to the title question "Can there be vague objects?".

Chapter II

INDETERMINATE IDENTITY AND VAGUE OBJECTS

1. INTRODUCTION

The title of Evans's article "Can There Be Vague Objects?" - discussed in the first chapter - clearly suggests that the argument is to have some bearing on the existence of vague objects. The problem however is that the relation between vague identity statements (with which Evans's argument is concerned) and vague objects is not clear. In introducing his argument, Evans hints that the idea of fuzzy objects is incoherent, but fuzzy objects are not mentioned explicitly in the argument itself. The proof concerns vague identity statements. As Parsons puts it, the argument as it stands "is not just an argument against 'vague objects'; it is an argument against vagueness (indeterminacy) itself."[1] It derives a contradiction from the assumption that a certain vague identity statement is true. Thus, if the argument were valid, it would refute the existence of any indeterminacy in truth value of identity statements.[2] Without the assumption that designators within the identity statement are precise, it is an argument against all indeterminate identity statements (and no wonder that it is not valid).

On the other hand, the property abstraction used in steps:

(2) $\lambda x\,[\nabla\,(x = a)]b$

---

[1] Parsons (1987), p. 14.
[2] Cf. Parsons (1987), p. 13.

and

(4) $\neg\lambda x\,[\nabla\,(x = a)]a$

suggests that the argument attempts to say something about objects, not about statements concerning those objects. In order to make the argument relevant to the discussion concerning the existence of vague objects, the assumption that the singular terms used in the argument are precise has to be added. If all the components of the identity statement are precise; if the singular terms determinately single out unique objects, but the statement is itself indeterminate, the only possible source of this indeterminacy seems to be vagueness in the world.

It might be argued, however, that it does not follow that if there cannot be such statements, there are no vague objects either. It is by no means obvious that the argument which shows that the indeterminate identity statements containing only precise designators do not exist, shows in this way that vague objects cannot exist. For the sake of simplicity, so far we have used the expression "vague objects" as a synonym of "indeterminately identical objects", i.e. "objects that are indeterminately identical to something". However, the claim that vague objects are objects that are indeterminately identical is not at all obvious. Indeed it appears that all indeterminately identical objects are vague objects, but it is by no means evident that the converse holds: i.e. that all vague objects are indeterminately identical objects.[3]

In the following section we will look at issues pertaining to the connections between indeterminate identity, indeterminately identical objects, and precise designation, whereas the rest of the chapter will be devoted to the question of what

[3] See e.g. Burgess (1984), p. 113.

indeterminate identity may consist in and in particular to the relation between vague identity and vague objects.

2. INDETERMINATE IDENTITY AND PRECISE DESIGNATION

One could argue that Evans's argument has no bearing on the issue of the existence of vague objects, for vague objects cannot be precisely designated.[4] In order to construct an identity statement "$a = b$" which would be 'guaranteed' to be ontically indeterminate one has to name vague objects first, and then use these names to say that the objects designated by those names are indeterminately identical. If precise reference is unattainable in the case of vague objects, no such statement may be constructed. In other words, unless vague objects can be precisely designated, no statement containing precise designators says anything about these objects. Thus, it seems that even if one takes Evans's argument to be valid, this argument does not give one the answer to the title question. It does not prove that vague objects cannot exist.

Besides, Evans's argument can have any bearing on the existence of vague objects only if such objects can be indeterminately identical. If vague objects are never indeterminately identical, then it seems that Evans's argument does not pertain to them at all. For what the argument shows, if it is valid, is that indeterminately identical objects cannot be precisely designated. In order to show that it is *vague* objects that cannot be precisely designated, one would have to show that all vague objects are objects that are indeterminately identical to something. Besides, as we have seen, it is rather doubtful whether the argument *is* valid. However, independently of Evans's

---

[4] This is the view of e.g. Over (1989), p. 98; Cowles (1994), p. 153. Compare also Sainsbury (1989), p. 99n.

proof it can be shown that objects which are indeterminately identical cannot be precisely designated. Let us assume that "*a*" and "*b*" are precise and each of them denotes exactly one object: "*a*" denotes *a* and "*b*" denotes *b*. Imagine now that *a* and *b* are vague objects such that it is indeterminate whether *a* and *b* are in fact one and the same object - i.e. it is indeterminate whether they are identical. To put it differently, it will be indeterminate whether the object denoted by "*a*" is identical to the object denoted by "*b*". However, it appears that if the objects denoted by "*a*" and "*b*" are indeterminately identical, "*a*" and "*b*" *cannot be precise*. For one may ask whether "*a*" denotes *b*. If the answer were "No", then *a* and *b* would have to be (determinately) distinct. Since "*a*" denotes *a* and does not denote *b*, *a* has - and *b* lacks - the property of being denoted by "*a*". Therefore, they must be distinct. On the other hand, if the answer were "Yes", then since "*a*" denotes both *a* and *b*, and our assumption was that "*a*" is precise and singles out a unique object, *a* and *b* would have to be (determinately) identical. So, if one does not want to contradict the assumption that *a* and *b* are indeterminately identical, one has to maintain that it is indeterminate whether "*a*" denotes *b* (and *vice versa*: in order not to contradict the assumption that "*a*" and "*b*" are precise designators, one has to give up the claim that *a* and *b* are indeterminately identical). And if it is indeterminate whether "*a*" denotes *b*, "*a*" must be an imprecise designator. If it is indeterminate whether *a* and *b* are identical, one cannot claim that "*a*" refers to exactly one object. For if it is indeterminate whether *a* and *b* are identical, then it is indeterminate whether they are one object or two objects.[5]

---

[5] It is a rather unpalatable consequence of treating indeterminacy as a third option that in such a case the number of objects involved will neither (determinately) be 1 nor 2, and yet it will be indeterminately 1 or 2.

Thus, once *a* and *b* become indeterminately identical, "*a*" and "*b*" cease to be (determinately) precise designators. For if it becomes indeterminate whether *a* is identical to *b*, then it becomes indeterminate whether "*a*" picks out a unique entity. If *a* is indeterminately identical to *b*, it is indeterminate whether *b counts* as *a* or not. Hence, it must be indeterminate whether "*a*" refers to *b*. Thus, the assumption that *a* and *b* are indeterminately identical is incompatible with the assumption that "*a*" and "*b*" are determinately precise designators.

One might reply to this that it is enough for a designator to be precise that there is an object to which it refers determinately. If this were so, then "*a*" would remain precise, even though *a* and *b* were indeterminately identical, because "*a*" does refer determinately to *a*.

It should be noticed that if there are vague objects which can be indeterminately identical, then we are dealing with a peculiar kind of designator. The standard view seems to have it that a designator "*a*" is precise iff it singles out a unique object *a*. The very same thought is sometimes expressed thus: a designator "*a*" is precise iff it refers determinately to *a*. However, in the presence of vague objects and indeterminate identity these formulations are not equivalent. It might be claimed that in the case envisaged above although it is indeterminate whether "*a*" singles out a unique object (since it is indeterminate whether *a* is identical to *b*), "*a*" does nevertheless refer determinately to *a*. After all it is neither false nor indeterminate that "*a*" refers to *a*. So, "*a*" determinately refers to a vague object *a and also* indeterminately refers to a vague object *b*. Since "*a*" refers determinately to *a* and indeterminately to *b*, it is indeterminate whether it refers to one object or two objects. Thus, it is indeterminate whether it singles out a unique object. Hence, although "*a*" satisfies one criterion of being a precise designator, namely it refers determinately to *a*, it does not satisfy the other criterion, namely it does not determinately single out a unique object.

The question arises whether such a term should be considered vague or precise. Is the designator "*a*" which determinately designates *a* and indeterminately designates *b* precise? Let us call the view which answers in the negative to this question the *standard* (or semantic) view and the view which answers in the positive - *non-standard* (or ontico-semantic). Since $\nabla(a = b)$, it is indeterminate whether "*a*" singles out a unique object. It is not determinately the case that it does and it is not determinately the case that it does not. Roughly, the standard view says that a designator is precise iff it is determinate that it singles out a unique object, whereas the non-standard view claims that it may be indeterminate whether a precise designator picks out a unique object or not, provided that it refers to that object determinately. On the non-standard view one has to insist that since it is not determinately the case that there are two objects to which the term purports to refer, one is not entitled to conclude that that term is imprecise.

The two senses are different only if indeterminately identical objects exist. If there are no indeterminately identical objects then in each case in which a designator refers determinately to an object, it determinately singles out that object, and *vice versa*. This is why I dubbed the non-standard view *ontico-semantic*. The view is distinguishable from the standard view only if there is ontic indeterminacy of identity.

Now, the question arises whether the non-standard interpretation would allow one to run Evans's argument on terms naming vague objects. If one accepts the novel understanding of precise designators one may argue that the designators "*a*" and "*b*" in "$\nabla(a = b)$" are precise. However it seems to me that "a" and "b" are just *not precise enough* to be used in the proof. Even if we agree that they refer determinately to a and b respectively, neither of them determinately singles out a unique object. It is indeterminate whether "a" singles out b and it is indeterminate whether "b" singles out a. And if we want to attribute any properties to objects designated by "a" and "b" - especially the properties concerning the identity of the objects that has been singled out - the 'singling out' must be determinate one way or the other.

Moreover, it seems to me that the non-standard version seems to be a rather strange interpretation of what being a precise designator consists in. For according to this definition, a designator could be precise even if it referred (both determinately and indeterminately) to an indeterminate number of objects. Thus, it might be argued that calling such a designator "precise" is stretching the meaning of "precise" too far. In fact it is more plausible to regard the above definition as a non-standard interpretation of what being an *imprecise designator* consists in and consider designators that refer both determinately and indeterminately as *im*precise in a non-standard sense.

On the other hand, if one accepts the standard understanding and maintains that a precise designator must refer determinately to some object *and* not refer indeterminately to any object, then ontic indeterminacy in identity precludes precise designation: there are *no* indeterminate identity statements containing only precise designators.

If precision is understood in the standard way, then it is hard to see how Evans's argument relates to the issue of the existence of vague objects. As has already been mentioned if "a" and "b" in "$\nabla(a = b)$" are imprecise, the vagueness of "$a = b$" may be due to the semantic indeterminacy of "a" and "b". In order to make sure that the vagueness arises because of the ontic indeterminacy, one has to rule out the possibility that "a" and "b" are imprecise, and assume that they are precise. As we have just seen however, the assumption that "a" and "b" are precise (in the standard sense) cannot be made consistent with a and b being indeterminately identical. Thus, it seems that if we do not assume that "a" and "b" are precise, we have no guarantee that it is indeterminately identical objects we are talking about, whereas if we do assume that "a" and "b" are precise, then a and b cannot be indeterminately identical. Hence, in neither case does Evans's argument succeed in saying anything about vague objects.

3. THE NOTION OF INDETERMINATE IDENTITY

We keep talking about indeterminately identical objects, but so far nothing has been said that would explain in virtue of what objects a and b may be indeterminately identical. The ontic vagueness theorist argues that some facts concerning identity are left unsettled - there is no fact of the matter as to whether certain objects are identical or not. But, what would it take for objects a and b to be ontically indeterminately identical?

Commonly it is assumed that identity is reflexive [for each object a, $a = a$] and satisfies Leibniz's Law [$a = b \rightarrow \forall F(Fa \equiv Fb)$]. Therefore, there seem to be the following possible reasons for the indeterminacy of identity:

(i) a and/or b may be vague objects, in which case it presumably may be indeterminate whether they are identical or not;

(ii) properties may be vague; i.e. it may be indeterminate whether the property F' possessed by a is the same as the property F'' possessed by b, in which case it will be indeterminate whether $\forall F(Fa \equiv Fb)$;

(iii) having of the properties may be indeterminate; i.e. it may be indeterminate whether or not a has F, in which case the right hand side of Leibniz's Law will be indeterminate;

(iv) the range of the variable F may not be determined; i.e. it may be undetermined what counts as a property or what counts as a property that is relevant for the identity claim (for it is widely accepted that F does not range over all properties, for instance intensional properties are excluded).

It appears that if any of these possibilities, (i) - (iv) is realised, one might maintain that the identity statement "$a = b$" will be of indeterminate truth value. Each proponent of any of these options has to say something about Evans's argument. As we have seen this argument can be understood as an argument about objects which are indeterminately identical. In order to understand it in this way one has to make the additional assumption that the designators "a" and "b" in the sentence "$\nabla(a = b)$" are precise. The argument allegedly demonstrates that there cannot be such statements. Thus, anyone who wants to maintain that it is otherwise, has to disarm that argument somehow. One way to do it is to appeal to the arguments discussed in the first chapter which show that the Evans's proof does not work, because it contains some errors. Another way is to argue that independently of whether Evans's argument with the additional assumption in place works, or not, that assumption is not satisfied, since indeterminately identical objects cannot be precisely designated (see the preceding section).

Presently the possibilities (i), (iii) and (iv) will be discussed in greater detail.[6] The main stress will be put on the first possibility according to which objects may be indeterminately identical, if they are vague objects.

3.1. Indeterminate identity and vague objects

First of all, what does it mean to say that *a* and/or *b* are vague objects? M. Sainsbury devotes the main part of his paper "Why the world cannot be vague" to searching for the answer to that question. He tries to find a substantive thesis of ontic vagueness and starts this search for vagueness in the world as a search for vague objects. According to him a thesis of ontic vagueness counts as substantive, if it does more than assert that borderline cases exist. Let us assume that Mark is a borderline case of "tall". Although it is vague whether Mark is tall or not, we do not want him to count as a vague object for this reason alone. Sainsbury calls borderline cases of vague expressions - such as Mark - "anodyne vague objects". Clearly, a thesis that there are anodyne vague objects is not a substantive thesis of ontic vagueness. In short, a substantive thesis of ontic vagueness should enable us to separate anodyne vague objects from 'genuine' vague objects. To be a 'genuine' vague object, an object has to satisfy some more demanding condition - i.e. a condition which would not be satisfied by common borderline cases. The problem is to define that condition.

Sainsbury does not succeed in finding such a condition and confesses that he has "drawn a blank in [his] attempts to find an intelligible and controversial thesis of

---

[6] The option (ii) is only mentioned here and will not be analysed. As I said in the introduction, in this thesis I am concerned with the identity of concrete objects only.

ontic vagueness".[7] It seems to me however that maybe the goal he set for himself (on behalf of the ontic theorists) was unrealistic. He argues that the vague objects theorist is a person who tries to explain vagueness in language by vagueness in the world; who thinks that language is vague because the world contains vague objects and our concepts are fashioned to match that vagueness. Sainsbury claims that such a picture is unintelligible:

> "We cannot think of our world except through our concepts, so there is no intelligible notion of our world independently of our concepts. [...] There is thus [...] no sense to the idea that, preconceptually, our world contains vague objects".[8]

One may agree with this, but claim nevertheless that the ontic theorist need not think in such terms - that such theorists do not have to be able to think of objects independently of language. Even the endorsement of the claim that we can think of the world only through our language still leaves some space for the ontic theorists. It seems very likely that if someone wants to find a thesis which would be satisfied solely by objects which are *genuine* vague objects and not anodyne vague objects then one's attempts are bound to fail. I will try to argue, however, that not all anodyne vague objects are equally anodyne. On the contrary, there are kinds of allegedly anodyne vagueness which are much more 'ontic' than the others.

The first candidate for a substantive ontic-vagueness thesis that Sainsbury considers is roughly the following:

(1) There exists a vague object; where x is a vague object iff, for some φ, x satisfies the predicate: $\lambda z\ (\nabla\varphi z)\ x$.

---

[7] Sainsbury (1994), p. 79.
[8] Sainsbury (1994), p. 79

However, it is evident that (1) cannot count as a substantive thesis of ontic vagueness, for it entails that every borderline case is a vague object.[9] For instance, for a given tomato t to be regarded as a vague object, it suffices that it satisfies the predicate "is such that it is vague whether it is red". And if one agrees that it is vague whether tomato t is red, there seem to be no reason why one should withhold from saying that tomato t is such that it is vague whether it is red. There is no principled reason why one should not derive "λz (∇red z) t" from "∇red t" in this case. The same goes for other borderline cases of vague expressions.

The second thesis that Sainsbury considers and immediately rejects is the compositional vagueness thesis:

(2) There exists a (compositionally) vague object; where x is a (compositionally) vague object iff it satisfies the predicate: $\exists y \lambda z$ (∇(y is a part of z))x.

This thesis is no better than the previous one. Since "part of" is vague semantically, the person who thinks that vagueness is a mere linguistic phenomenon can believe in the existence of vague objects in this sense.

According to Sainsbury, the only way to make the ontic vagueness thesis inconsistent with the view which takes vagueness to be a mere linguistic phenomenon is to require that the predicate used in this thesis be sharp. If the predicate φ is sharp, an object cannot satisfy the abstract "λz ($\nabla\varphi z$) x" without itself being vague. There are some problems with this formulation connected with the worry whether someone who believes in ontic vagueness may avail himself of the notion of a predicate's being sharp. It appears that he might not be able to determine what it is for a predicate to be

---

[9] Sainsbury (1994), p. 66.

sharp.[10] However, instead of defining what is needed for a predicate to count as sharp, we may focus on a token sharp predicate: identity. Intuitively at least identity is as sharp as any predicate could be; if there are any sharp predicates at all, identity will be one of them. So the next attempt at a thesis of ontic vagueness is:

(3) There exist a vague object; where x and y are vague objects if they satisfy: $\lambda w \lambda z\ (\nabla(w \text{ is identical to } z))x, y$.[11]

Thus, (3) is a substantive thesis of ontic vagueness provided that identity is a sharp relation.[12] Do we have any arguments justifying the claim that identity is sharp, apart from our intuitions? Sainsbury claims that one can prove the sharpness of identity by using Evans's argument. The problem is that he takes that argument to be both a proof that identity is sharp and a proof that there are no vague objects. More exactly, his claim seems to be that Evans has proved that there cannot be vague objects by proving that identity is sharp. So, although we are able to formulate a substantive thesis of ontic vagueness - namely (3), there is not much use for such a thesis, since at the same time we are able to prove that it is false. Although (3) is an intelligible thesis, there are no objects that satisfy it.

---

[10] According to Sainsbury, one of the reasons why it may be impossible for the believer in ontic vagueness to specify which predicate counts as vague is that we can have vague statements featuring sharp predicates and vague singular terms. Hence, we cannot stipulate that a predicate is vague iff when attached to a singular term it gives rise to an indeterminate statement. Not only vague predicates, but some sharp predicates as well would satisfy this definition. The example he gives is "Snowdon has an area of 1500 acres". The predicate "has an area of 1500 acres" presumably is sharp (though compare (1994), pp. 70-71), but the statement is indeterminate nevertheless. It seems to me however that we can deny that "Snowdon has an area of 1500 acres" is indeterminate. This statement can either read "Snowdon has an area of just (exactly) 1500 acres" or "Snowdon has an area of roughly 1500 acres". In the former case it is simply false (Snowdon has fuzzy boundaries not precise ones). In the latter case it is indeterminate, but the predicate "has an area of roughly 1500 acres" is no longer sharp.

[11] Recall that our aim was to find out when object a and b can be indeterminately identical. One option was that they may be indeterminately identical if they are vague objects. Now we say that objects are vague, if they are indeterminately identical. This is not a vicious circle however, because vague objects are not *defined* as indeterminately identical objects. This view does not explain what vagueness of objects consists in, but merely tells us how we could detect it.

[12]Sainsbury (1994), p. 74.

Sainsbury admits that "Evans's proof is contentious in a number of ways"[13], and that he has taken some of the contentious issues for granted, but claims that he has done so on behalf of the believers in ontic vagueness. The vague-objects theorists need Evans's argument to prove that identity is sharp - so, if Evans's proof does not work, their situation is not good. Thus, according to Sainsbury, the upshot is the following. If Evans's argument does not work, we do not have a proof that identity is sharp and (3) cannot count as a substantive thesis of ontic vagueness. If, on the other hand, Evans's argument does work, than we have a proof that identity is sharp, but no objects whatsoever satisfy (3).

One could object that vague identity thesis - such as "$\lambda w \lambda z$ (∇(w is identical to z))x, y" - is independent of the thesis of ontic vagueness, i.e. that the existence of a vague object need not result in a vague identity statement. Even if a is a vague object, then one still can obtain definite identity by matching a with a. a corresponds precisely to a, for "[a]ll their vagueness matches exactly".[14] Thus, it can be argued that even if a is a vague object, the statement "∇ ($a = a$)" is false. And if there is nothing else with which a is indeterminately identical, then there will be no true indeterminate identity statements concerning a.

This argument - if it is accepted[15] - merely points out that thesis (3) gives a sufficient, but not a necessary condition for objects to count as vague objects. If we find for a an object b such that together they satisfy (3), we may be sure that a and b are vague objects. If we do not find such b, we are not entitled to conclude that a is not vague.

---

[13]Sainsbury (1994), p. 74.

[14] Wiggins (1986), p. 175. Cf. chapter I. See also Garrett (1988), pp. 132-3.

[15] For the assumption that there is nothing with which a is indeterminately identical, might be contended. See the following section.

Another objection might appeal to the prevailing interpretation according to which Evans's argument is an attempt at proving that there cannot be vague identity statements whose vagueness is due solely to the existence of vague objects. As we remember one of the important points to notice is that this argument seems to rely on a tacit assumption that "*a*" and "*b*" are precise designators. Hence, if vague objects cannot be precisely designated, no statement containing precise designators says anything about those objects.[16]

Moreover, one could argue - contrary to Sainsbury - that Evans's argument does not *prove* that identity is sharp. Rather it assumes the sharpness of identity in order to prove that identity between objects cannot be indeterminate. If this is so, then Evans's proof cannot be used as a justification of the claim that "identity" is a sharp predicate. Again, such argument weakens the chances of (3) to count as a substantial thesis of ontic vagueness in Sainsbury's sense. The ontic-vagueness theorists need identity to be sharp, hence they would have to find some other arguments for its sharpness.

It appears that as far as Evans's argument is concerned, the ontic vagueness theorist can insist both that identity is sharp and that vague objects exist, but cannot be precisely designated. He can even take Evans's argument to be the proof that identity is sharp and yet believe that this result has no bearing on the existence of vague objects. It is clear however, that such a theorist will still owe us an explanation of how we are to determine which objects are vague and which are not. It should be remembered that Sainsbury's thesis (3) is meant as a definition of what it takes for an object to be vague. If someone claims that vague objects cannot be precisely

[16] See section 2 in this chapter.

designated, he says in fact that theses such as (3) cannot tell us anything about such objects. The claim that Evans's proof has no bearing on the existence of vague objects is tantamount to the claim that thesis (3) has nothing to do with vague objects, either. If vague objects cannot be precisely designated and if the property abstraction can be applied only in cases in which we have a unique singlement, then (3) cannot be a substantive thesis of ontic vagueness.[17] Therefore, Sainsbury's condition imposed on a substantive thesis which would state in what being a vague object consists, has not been satisfied. If one wanted nevertheless to be able to predicate *of* vague objects, then the requirements for the correct application of property abstraction would have to be loosened. One would have to argue that it is enough that we *roughly* know to which object we are referring.[18]

So, what are the options for the ontic theorist? Clearly an option which involves acknowledging that Evans's argument proves both that identity is sharp and that there are no vague objects is a non-starter for him. So, he can either argue that (3) is a substantive thesis of ontic vagueness, in which case he will have to find arguments that identity is sharp (i.e. arguments other than Evans's argument); or alternatively he may claim that (3) is no good as a thesis of ontic vagueness, in which case he will have to tell us which thesis is adequate.[19] However, as far as the former option is concerned, it should be noticed that there are some independent doubts concerning the suitability of (3) as an ontic vagueness thesis. It is instructive, for

[17] Nevertheless, one might object to this by pointing out that (3) is formulated with the help of individual variables and not names, such as "*a*" and "*b*". The problems concerning precise designation do not arise for variables. However, although individual variables do not designate objects, they stand in for them. Therefore one might doubt whether vague (not entirely individuated) objects can be substituted for such variables, in particular in cases where variables feature in lambda abstracts. So, it might be argued that the problems with imprecise designation of vague objects are in a way analogous to the problems with the substitution of vague objects for individual variables.

[18] See below and compare also chapter III.

[19] See chapter IV, section 4.4, for an attempt at such a thesis.

instance, to compare Sainsbury's 1995 paper, with which we have been concerned thus far, with his 1989 *Analysis* article. There he gives the following definitions.

(i) x is compositionally vague iff x is such that for some y it is indeterminate whether y is a part of x (this definition is equivalent to the thesis (2) above).

(ii) x is temporally vague iff x is such that for some time y it is indeterminate whether x exists at y.[20]

Moreover, Sainsbury has argued that temporal vagueness may lead to individuative vagueness: x is *individuatively vague* iff x is such that for some y it is indeterminate whether x is identical to y. This latter definition is equivalent to our (3).

First of all it seems to me that compositional vagueness as well as temporal vagueness can lead to individuative vagueness. If for some y it is indeterminate whether y is a part of x, then x is such that for some z (namely z which consists of all of x - y) it is indeterminate whether x is identical to z. To this one may object, however, that the assumption that there is a z which is equal to x - y, is unjustified.[21] On the other hand, one may argue that if y is indeterminately a part of x and determinately not a part of z, then x is determinately not identical to z. There is also another argument showing that compositional vagueness may lead to individuative

[20] Sainsbury distinguishes also modal vagueness, which he defines as follows:
(iii) x is modally vague iff x is such that for some world y it is vague whether x exists at y.
I'm not sure whether (iii) should be distinguished (or rather I'm not sure what the relation between (ii) and (iii) is).Compare e.g. the following definitions of essence:
1. essence is the intersection of its essential attributes, i.e. the attributes it shares with all and only its counterparts (Lewis (1968), p. 35);
2. an essential property is a property which that individual could not have lacked, or which it possesses in all possible worlds in which it exists (Lowe (1989), p.106);
3. an essential property is a property which that individual cannot lose without thereby ceasing to be (Lowe, ibid.).
If we define essence as in 3. then we're back with vague persistence conditions and (ii). In what follows I ignore modal vagueness as a separate kind of ontic vagueness.
[21] For instance, van Inwagen who rejects the doctrine of arbitrary undetached parts, would not recognise the existence of such a z. See (1990), p. 217. Compare also the Everest/Gaurisanker example below.

vagueness, however. Consider, for instance, Professor Schrödinger's example of Everest and Gaurisanker.[22] A certain mountain can be seen both from Nepal and from Tibet. When seen from one direction it was called "Gaurisanker", when seen from another direction, it was called "Everest". It can be argued that both Everest and Gaurisanker are compositionally vague objects,[23] because there are objects (namely bits of ground) such that it is indeterminate whether they are parts of Everest and it is indeterminate whether they are parts of Gaurisanker. One could also argue that Everest and Gaurisanker are merely anodyne vague objects, because the sole reason for their being compositionally vague is the fact that "is a part of" is a vague expression. However, it is clear that it is indeterminate whether Everest is the same object as Gaurisanker. Since they have vague spatial boundaries (in Sainsbury's anodyne sense), determining decisively whether they are identical or not is impossible. So, we can conclude that individuative vagueness is a consequence of each of temporal and compositional vagueness.

In his 1995 paper Sainsbury argues effectively that compositional vagueness is anodyne and dismisses it as a 'genuine' kind of ontic vagueness right at the start. As regards temporal vagueness, he mentions that there is a chance that the life history of an object which has vague persistence conditions may not fit exactly into any precise stretch of time, but does not count such objects as candidates for 'genuine' vague objects. On the other hand, he takes individuative vagueness definition (i.e. thesis (3)) to be the most serious candidate for the ontic-vagueness thesis. It appears to me however that - by Sainsbury's own lights - the individuative-vagueness definition has

---

[22] Kripke quotes this example in "Identity and Necessity". There it is used for entirely different purposes.
[23] Alternatively one could claim that "Everest" and "Gaurisanker" are vague terms which refer indirectly to many precise objects.

no future as the substantive thesis. It is doomed from the beginning just as the definitions of compositional and temporal vagueness are. Recall that the idea behind the introduction of a sharp predicate into the ontic-vagueness thesis was to separate genuine vague objects from anodyne vague objects. If a vague predicate is used instead, then a sharp object may satisfy that thesis merely in virtue of being a borderline case of that predicate. However, if each of compositional and temporal vagueness (i.e. anodyne kinds of vagueness) leads to individuative vagueness, then it is clear that there will be anodyne vague objects satisfying the individuative-vagueness definition, for such objects can be borderline cases of sharp predicates. Hence, if compositional and temporal vagueness are anodyne, individuative vagueness must be anodyne as well.

To sum up: according to Sainsbury at least some compositionally vague objects are anodyne vague objects (i.e. they count as vague according to the compositional vagueness definition, but the sole reason for this is semantic vagueness of the predicate "is a part of"); since compositional vagueness can lead to individuative vagueness, it is probable that some of those anodyne objects will satisfy the individuative vagueness definition (and hence thesis (3)). Therefore thesis (3) cannot count as a substantive thesis of ontic vagueness. Even if we find a pair of objects that satisfy that thesis, we will not have the guarantee that those objects are 'genuine' vague objects, and not mere anodyne vague objects, which happen to satisfy that thesis in virtue of being borderline cases of the predicate "is a part of", as was the case with Everest and Gaurisanker. Even though Everest and Gaurisanker are anodyne in Sainsbury's sense, they do satisfy:

(3) $\lambda w \lambda z\, (\nabla(w \text{ is identical to } z))x, y$.

Since there are anodyne vague objects satisfying (3), by Sainsbury's own lights (3) cannot be a substantive thesis of ontic vagueness.

J. Copeland makes a similar point. In his reply to Sainsbury he argues that (3) is no good as a substantive thesis of ontic vagueness, because there are anodyne vague objects which satisfy (3). He gives the following example: ∇ (New Devon = Nouvelle Provence), where "New Devon" is the name given by a seventeenth century British seafarer to a natural harbour and indeterminate amount of hinterland on the coastline of what is now Western Australia; and "Nouvelle Provence" is the name given a year earlier by a French mariner to roughly the same spot.[24]

By way of reply, in footnote 6 Sainsbury confesses that he is inclined to believe that Copeland is right and that it makes things even harder for ontic theorists, for (3) cannot be used as a substantive thesis of ontic vagueness.

So, if one insists that the substantive thesis of ontic vagueness should formulate a condition which is uniquely satisfied by 'genuine' vague objects, then the prospects for the believer in ontic vagueness are rather dim. All attempts at formulating such a condition are futile, since anodyne vague objects are bound to satisfy every such condition as well. Sainsbury has asked rhetorically "If the predicate [used in a thesis of ontic vagueness] is sharp, how could an object satisfy the [relevant] abstract without itself being [genuinely] vague?". Now we have found the answer to that question: an object can satisfy the relevant abstract (i.e. $\lambda w \lambda z$ (∇(w is identical to z))x, y) by being a compositionally or temporally vague object - in other words, by being an anodyne vague object.

[24] Copeland (1995), p. 83.

However, it seems to me that the class of so called "anodyne vague objects" is not homogenous. Not all "anodyne vague objects" are as 'anodyne' as it may appear. As we have just seen, "$\lambda w\lambda z$ (∇(w is identical to z))x, y" will not be true of any anodyne object whatsoever: it can be true only of compositionally and temporally vague objects. Some kinds of vagueness - namely the temporal, compositional[25] and individuative vagueness - seem to be more strictly connected with objecthood and individuation than others. Not all kinds of vagueness threaten the intelligibility of our notions of individuation, objecthood and identity to the same degree. The fact that a certain tomato is such that it is vague whether it is red does not preclude us from saying what its identity conditions are, what kind of object it is and how it can be individuated. Similarly the fact that Mark is a borderline case of "bald" does not threaten his personal identity. On the contrary, the temporal, compositional and individuative vagueness do jeopardise the notions of individuation and identity-

[25] Recall that Sainsbury counts compositional vagueness as anodyne, because the predicate "is a part of" is vague. It might be worth noticing that two notions of being a part may be distinguished. The first one, which seems to be the one Sainsbury has in mind, is (roughly) a notion of being sufficiently well attached. Sainsbury justifies his taking for granted that "part of" is vague by appealing to two facts. First, the mere possibility of borderline cases suffices for a predicate to count as vague. Second, the applicability of the predicate "part of" to material objects is based on matters of degree, such as the strength of cohesive forces. There are two kinds of borderline cases of "part of" in this sense. One kind will be objects which are in the process of falling out. So, for instance, there will be an instant in the process of breaking a table's leg at which it will be indeterminate whether the leg is still a part of the table. The other kind of borderline cases of "part of" in this sense will be molecules on the surface of our everyday objects. It is indeterminate whether the cohesive forces between these molecules and the object are strong enough to justify calling them parts of the object.
The second notion of "part of" is *geographical* part. Here whether something counts as a part of a given object is not a matter of how strong the attachment is. It usually depends on our stipulation. So, for instance, there are parts about which it is indeterminate whether they are parts of New Devon. The cause of this indeterminacy is not the insufficient strength of the attachment - for there is no physical attachment. The forces interacting between the object and the parts in question are unimportant. When we speak about parts in the second sense, we have to specify what they are parts of, because something may be a borderline case of "part of New Devon", but determinately be a part of Australia. Furthermore, "is a part of New Devon" is vague merely because New Devon is vague. So in this case it will be the relation "is a New-Devon-part" which is vague and not "is a part of" itself. Thus, the expression "is a part" in this sense is a syncategorematic expression. It does not make sense in itself. And "is a part of x" is not vague, unless x itself is vague.

conditions.[26] In order to individuate an object one does not have to determine its exact colour, but one has to distinguish it from its environment, its neighbouring objects, its predecessors and successors, etc. And vagueness in spatial or temporal boundaries may render it impossible. For instance, if such an object is compositionally vague, then there are objects such that they are neither determinately parts of the object one wants to individuate nor determinately parts of its environment. It is obvious that most objects are compositionally and temporally vague (in fact it seems that all composite objects are vague in this sense). So, precise individuation is usually impossible and we have either to acknowledge that we never succeed in individuating anything, or else accept that 'rough' individuation is enough - anodyne compositionally and temporally vague objects may be individuated without setting precise spatial and temporal boundaries. Obviously, how vague the boundaries can be in order for individuation to succeed, is itself indeterminate. The boundary between objects that can be individuated and those that cannot becomes blurred. And we lose our grip on what individuation itself consists in.[27]

The compositional, temporal and individuative vagueness seem to be kinds of **ontic** vagueness at least in a sense that they are intimately connected with the identity criteria of objects. So, these three kinds of vagueness seem to constitute a special kind of vagueness, and a more 'dangerous' one at that.

Besides, one could also argue that, if vagueness is so grave that it makes it indeterminate whether *a* and *b* are one and the same object, then it deserves to be called 'genuine'. According to such a view individuative vagueness is genuine

---

[26] E. g. if we agree that it is indeterminate whether Brown and Smith are the same person - i.e. that they are individuatively vague, then we are unable to answer the question "How many persons are there?". So, the criterion of personal identity becomes vague.

[27] I come back to the question of individuation later on in Chapter III, section 3.2.

vagueness. It is true that compositionally and temporally vague objects (i.e. anodyne vague objects) can satisfy the sentence "$\lambda w \lambda z$ (∇(w is identical to z))x, y", but if they do satisfy it, they cease to be anodyne vague. Indeterminacy of identity is a serious matter and if objects whose identity is indeterminate are not genuinely vague, then nothing is. In other words, (3) formulates a condition of being a genuine vague object. If an object satisfies it, it is genuinely vague, no matter whether it meets this condition in virtue of being merely anodyne vague. So, on this view, compositionally and temporally vague objects are anodyne vague as long as they do not satisfy "$\lambda w \lambda z$ (∇(w is identical to z))x, y". If they do, they count as genuinely vague.

The aim of this section was to develop the idea that the vagueness of objects a and/or b can make the statement "$a = b$" indeterminate. We were looking at Sainsbury's attempts to find out what the vagueness of a and b can consist in. His answer seems to be that the notion that a or b are genuinely vague objects is incomprehensible. The closest one can get to a substantive thesis of ontic vagueness is claim (3), namely the claim that a and b are vague objects if they are such that it is indeterminate whether they are identical or not. According to Sainsbury, the problem with such a thesis is that either no object satisfies it (if one accepts Evans's argument) or one has no guarantee that it is substantive (if one rejects Evans's argument). As we have seen there are also other alternatives that need considering. On the one hand, one may maintain that although Evans's argument works, it does not preclude the existence of objects that make the identity statement indeterminate, because Evans's proof can only be applied to precise designators and designators naming indeterminately identical objects are never precise. Then, in order to substantiate the claim that there are vague objects which are indeterminately identical, one would have to provide some other arguments for that claim. On the other hand, one may question Sainsbury's idea of what it takes for a thesis to be a substantive thesis of ontic vagueness. One could argue that a thesis which is satisfied only by compositionally or temporally vague objects deserves to be called substantive. Although compositionally and temporally vague objects are anodyne vague objects in the sense that they satisfy thesis (3) in virtue of being borderline cases of vague expressions, one might insist that they are 'genuine' vague objects in a sense that their temporal and spatial boundaries are vague and they cannot be precisely individuated. It is hard to imagine what more could be required from the ontic kind of vagueness. And it seems that objects which are vague in these sense can make identity statements indeterminate, although the identity predicate itself remains sharp.

3.1.1. Vague objects and indeterminately identical objects

In the preceding section [3.1.] we have investigated vague objects and in particular the relation between vague objects and indeterminately identical objects. It has been argued that vague objects - namely compositionally and temporally vague objects - can be indeterminately identical. They seem to be the only (concrete) objects that a true vague identity statement can be about. The question now is: Are *all* vague objects indeterminately identical objects? In other words: Could there be vague objects without vague identity? The answer to that question has a bearing on the impact and the range of application of Evans's argument. As it has turned out (Cf. section 2), vague objects which are indeterminately identical can be precisely designated only if we interpret "precise designation" in a rather awkward non-standard way. However, one may ask a more general question: Is this the fate of all vague objects? Is it the case that vague objects in general cannot be precisely designated in the standard sense? For if all vague objects are indeterminately identical objects, and if my reasoning concerning indeterminately identical objects and precise designation is correct, then we already know the answer. And if there are vague objects which are not indeterminately identical objects, then a separate argument concerning these objects is needed.

At first glance it might seem that the answer to the question whether all vague objects are indeterminately identical objects is "No". Although individuative vagueness is a plausible consequence of compositional and temporal vagueness, there is no reason to think that it is a necessary consequence of it. However, theorists are divided on this issue. This is not a place to present in detail all the different views on that matter, but let me just mention a few standpoints.

If all vague objects were to be objects that are indeterminately identical to something, then for each vague object there would have to exist an object indeterminately identical to it. This seems to be the view of Parsons and Woodruff, who seem to think that all vague objects are objects that are indeterminately identical to something. They argue that there exist vague objects and each such object has many precisifications to which it is indeterminately identical.[28]

On the other hand, P. van Inwagen claims that vague objects may - but do not have to - be indeterminately identical with each other. He does not believe in the

---

[28] Cf. Parsons, Woodruff (1995). See also chapter IV. It should be noticed that this view is incompatible with Sainsbury's claim (3). According to (3), objects which are indeterminately identical are vague, hence Parsons and Woodruff's precisifications would have to be vague. *NB* Parsons and Woodruff do not agree with the claim that indeterminately identical objects cannot be precisely designated (see pp. 186-190).

multitude of precisifications which are indeterminately identical to the vague object which they precisify, but argues that vague objects may be indeterminately identical one with another. The only macro-objects are living organisms and the life of those organisms may be suspended or disrupted. Sometimes an adventure may happen that neither determinately suspends the life nor determinately disrupts it. In such a case it will be indeterminate whether the life that exists after the disruption is the same as the life that went on before the disruption. He thinks that vagueness in identity is a consequence of any view which assumes that there exists some macro-objects (but denies that any collection whatsoever of simple objects composes a macro-object).[29]

M. Tye argues that there are vague objects, but there is no identity statement of indeterminate truth value. According to him an identity statement can be vague in a sense that it has a vague meaning, but it cannot be indeterminate in truth value. He claims that an identity statement can be vague in meaning if either of the singular terms flanking the identity sign is vague. He argues moreover that "the vagueness of "a" or "b" in "$a = b$" does not require that "$a = b$" might be indefinite in truth value".[30] Thus, it seems that his claim is that although there are vague objects, there are no indeterminately identical objects. Incidentally, Tye - for independent reasons - thinks that vague objects cannot be precisely designated.[31]

It seems to me that the following standpoint is also plausible. One might argue that in every case of a vague object there are bound to be more vague objects that will be indeterminately identical to it. Take the example of Everest and Gaurisanker,

---

[29] Cf. van Inwagen (1990). Ch. 18. See also my chapter IV.
[30] Tye (1990). p. 556.
[31] He writes (ibid.): "In my view, the statement "m = Everest" is vague, since "Everest" is vague (as also is "m" *unless it names an object that is completely precise*)" - my emphasis.

again.[32] As we have seen, it can be argued that both Everest and Gaurisanker are vague objects, because they have no determinate spatial boundaries. And it is clear that it is indeterminate whether Everest is the same object as Gaurisanker. Since they have vague spatial boundaries, determining decisively whether they are identical or not is impossible. Arguably such examples can be constructed for each object with no determinate spatial boundaries.

Roughly, if an object has fuzzy boundaries, one can always imagine another object which is very much like the previous one and whose boundaries overlap to some extent. It will then be indeterminate whether these two objects are identical or not. Since their boundaries are not determined one cannot establish their identity either way. One can repeat a similar reasoning for objects with fuzzy temporal boundaries. If this is so, then of course all vague objects are indeterminately identical objects. And if all vague objects are indeterminately identical objects, then no vague object can be precisely designated.

One of the possible ways of rejecting the last standpoint seems to be to insist that in every such case it is determinate that there is just one vague object there. It might be argued that we know for instance that at the place at which Everest is there is only one mountain. That mountain is vague but is unique. In this case every identity statement concerning Everest and another vague object will have a determinate truth value, truth or falsity, and every statement concerning Everest and a precise object will be false. It appears that on this view there cannot be any indeterminate-identity statements at all.

---

[32] See above, section 3.1.

Let us now look briefly at the other two reasons for the indeterminacy of identity: the indeterminate having of properties and the undetermined range of properties that count in the assessment of identity

3.2. The indeterminate having of properties

Instead of looking for vague objects, the ontic vagueness proponent can take the following standpoint.

"The world consists of some objects, and some properties and relations, with the objects possessing (or not possessing) properties and standing in (or not standing in) relations. Call these possessings and standings-in *states of affairs*. Then the world determines that certain of them hold, and that certain of them do not hold, but leaves the rest undetermined."[33]

In our case the claim will be that there are states of affairs concerning identity such that the world leaves it undetermined whether they hold or not. In other words, it is left undetermined whether two objects, *a* and *b*, stand in the identity relation to each other. On such a view it is neither the objects, *a* or *b*, nor the identity relation, which are vague. In general, it is argued that vagueness should not be ascribed to objects or properties and relations, but to states of affairs instead, for it is the relation of property instantiation and of standing-in a relation which are indeterminate.[34] The explanation of what exactly this indeterminacy consists in depends on the theory of properties and relations one takes to be true.

The reason why we should not ascribe indeterminacy either to objects or to properties and relations is that - contrary to appearance - there is no asymmetry between vague states of affairs such as:

---

[33] Parsons, Woodruff (1995), p. 173.

[34] One of the proponents of such a view is Katherine Hawley, typescript.

It is indeterminate whether Fred is bald.

It is indeterminate whether Snowdon has a surface area of exactly 1500 acres.

If we were to blame objects or properties for the vagueness of these states of affairs we would probably blame the property of being bald and the object Snowdon, the reason being that if we precisify being bald and Snowdon we get rid of indeterminacy. However, K. Hawley argues that there is no justification for such a choice. She claims that instead of precisifying baldness we could equally well precisify Fred. Just as we can precisify Snowdon with respect to its surface area, we may precisify Fred with respect to his baldness. So, there is no real difference between Snowdon and Fred.

It seems to me however, that the view described above is not right. There is an asymmetry between the above states of affairs after all.

First of all, precisification is not an arbitrary change of an object, we cannot precisify objects with respect to their precise properties. In particular, we cannot precisify Fred with respect to baldness by granting him more or less hair. Changing the number of hair on his head would be changing a precise property of his: having such-and-such a number of hairs on his head.

Besides, even if we allowed precisification of Fred, there still would be a difference between the Fred-precisifications and the Snowdon-precisifications. Any precisification of Snowdon will do, i.e. any Snowdon-precisification will remove indeterminacy from the state of affairs "Snowdon has a surface area of exactly 1500 acres". Whereas this may not be the case with the Fred-precisifications. We may need to add or remove a significant number of hair in order to make the state of affairs

"Fred is bald" determinate. Moreover, for certain Fred-precisifications we would still not know whether the resulting state of affairs is determinate or not.

There is also another asymmetry between the states described by sentences "It is indeterminate whether Fred is bald" and "It is indeterminate whether Snowdon has a surface area of exactly 1500 acres". Clearly there are ways of precisifying the property of *being bald*, but it seems to me that we cannot precisify the property of *having a surface area of exactly 1500 acres* (if indeed it is a precise property).

Thus, having vague states of affairs does not help much. At most it adds vague entities to our ontology. It is not able to explain asymmetries which show up in the above states of affairs, and we have to postulate further vague entities in the end - vague objects or/and vague properties and relations.

As far as indeterminate identity is concerned, it appears that the claim here would be that it is indeterminate whether or not *a* and *b* stand in the identity-relation to each other. In order to escape Evans's argument one would have to claim that from the fact that *a* definitely stands in the identity-relation to *a*, and *b* stands in this relation only indefinitely, it does not follow that *b* (definitely) stands in a different-from-relation to *a*.[35]

3.3. The range of '*F*'

The last option for the ontic vagueness theorist, who wants to maintain that there are identity statements which are indeterminate in truth value is to argue that the

---

[35] For instance, one could use a variant of Lowe's argument (see Chapter I, section 1.4.) and argue that the relation of being identical to *a* is not essentially different from the relation of being identical to *b*.

range of the variable F in "$a = b \rightarrow \forall F(Fa \leftrightarrow Fb)$" may not be determined. To put it differently, one can claim that it may be undetermined what counts as a property or what counts as a property that is relevant for the identity claim.

First of all, the question is whether to define identity in terms of properties or in terms of predicates. It has been argued that identity should be defined in terms of predicates rather than properties, for if there are predicates to which no property corresponds, any definition in terms of properties would result in "a kind of *relative identity*: a relation which ensures indiscernibility of its terms in some, but not all respects - in particular, not in respects only expressible by predicates containing "∇"".[36] The opposite view has it that since the test for identity is whether a and b share all properties and stand in all the same relations, "[t]ests for identity phrased in terms of language alone will not be conclusive for real identity in the world", for language may fail to contain vocabulary for the properties or relations in which a and b differ.[37] Hence, the latter worry is exactly opposite to the former. While the adherents of the former view argue that predicates may outnumber properties, the proponents of the latter account worry that there may be an insufficient number of predicates.

The importance of this issue will become apparent, when we investigate the proposed definitions of indeterminate identity. There are three standpoints to be found in the literature. I will phrase them using the notion of *property* rather than *predicate* and try to indicate what the consequences of such a presentation consist in.

According to **the radical standpoint**[38] a is indeterminately identical with b iff:

---

[36] See Noonan (1984), p. 118.

[37] See Parsons, Woodruff (1995), p. 174.

[38] Cf. Noonan (1984). It is worth noticing that this formulation avoids many problems, which Evans's argument faces, connected with the precision of designators.

(i) there is no property[39] which a (definitely) possesses and b (definitely) does not possess; and

(ii) there is a property which a (definitely) possesses, but it is indeterminate whether b possesses this property.

It might seem that this definition by itself rules out the possibility of a and b being indeterminately identical. The conditions (i) and (ii) are never jointly satisfied, for if "$a = b$" is indeterminate, there will be a property - namely *being such that it is indeterminate whether it is identical to a* - which b (definitely) possesses and a (definitely) does not possess.

As we have seen in the first chapter this is the very property that was used by Evans in an attempt to prove that the assumption that there are indeterminate identity statements leads to contradiction. From the assumption that the object a is indeterminately identical to the object b, it follows that b is such that it is indeterminate whether it is identical to a. Since a is not such that it is indeterminate whether it is identical to a, using the contraposition of Leibniz's Law [$\exists F\,(Fb \,\&\, \neg Fa) \rightarrow b \neq a$] one can derive the conclusion that a and b are not identical, which seems to contradict the original assumption.

However, there is a way out for the proponent of the above definition. In chapter 1 we saw some arguments against the existence of such properties as the property of *being such that it is indeterminate whether it is identical to a*. The argument has it that one cannot assume that the expression of the fact that it is indeterminate whether an object has a certain property constitutes itself a definite

[39] Since this definition is to specify sufficient as well as necessary conditions for indeterminate identity of a and b, spatio-temporal properties are included into the range of the quantifier. Otherwise, e.g., two distinct spheres which differ only in that one of them is determinately green, whereas the other is indeterminately green would count as indeterminately identical.

ascription of another property. The fact that it is indeterminate whether a is identical to b amounts to there being *no fact of the matter* as to whether those objects are identical or not. And it itself does not legitimate ascriptions of other indeterminacy-involving properties. The ontic vagueness theorist who claims that the phrase "it is indeterminate whether Fa" expresses the claim that there is no fact of the matter as to whether a has the property F, ought to protest against treating it as attributing another property to a. He should then argue that Evans's argument is invalid, since it essentially uses 'dubious' properties which have no ontological significance.

So, it seems that the ontic vagueness person can accept the above definition as the definition of indeterminate identity and still argue that there are objects which indeed satisfy that definition. The only price they have to pay is that they are forced to claim that the indeterminacy-involving expressions do not denote any properties. This is not necessarily a drawback, however, for such a claim seems to be consistent with the ontic vagueness theorists's views on indeterminacy.

Hence, as long as the definition is expressed in terms of properties it might be held to be satisfiable. The situation is different if we phrase it in terms of predicates. Then it would say that a is indeterminately identical with b iff: (i) it is not the case that there is any predicate which is (determinately) true of b and whose negation is (determinately) true of a, and (ii) there is a predicate which is (determinately) true of b, but it is indeterminate whether or not it is true of a. Now, it seems that the definition is never satisfied, for there is no reason why the predicate *is such that it is indeterminate whether it is identical to a* should not be constructed. Independently of whether such a predicate denotes a property, or not, if it is indeterminate whether a and b are identical [$\nabla(a = b)$] (and "a" and "b" are precise), then we are entitled to say that b satisfies the predicate *is such that it is indeterminate whether it is identical to a*. Therefore the adherent of indeterminate identity has no option but to insist that the definition be phrased in terms of properties and that the phrase "∇Fa" do not express a property. On the other hand, someone who maintains either that the definition should be expressed in terms of predicates or that the indeterminacy-involving expressions in question do denote properties has to admit that there are no indeterminately identical objects. So, according to the proponents of vague identity although a and b are not discernible in terms of properties, they are discernible in terms of predicates. Therefore, in order not to reduce identity to some sort of relative indiscernibility, they have to undermine the status of the indeterminacy-involving predicates and treat them as mere 'Cambridge predicates' akin, for instance, to the intensional ones.[40]

According to **the intermediate standpoint**[41] on indeterminate identity although there is the property of being such that it is indeterminate whether it is identical with a, it does not distinguish between a and b. If b possesses the property that it is such that it is indeterminate whether it is identical with a, i.e. $\lambda x\ [\nabla(x = a)]$, then a must possess an analogous property $\lambda x\ [\nabla(x = b)]$. However, if a and b are vague objects and there is no objective fact of the matter whether or not a is identical with b, then the property $\lambda x\ [\nabla(x = a)]$ is not determinately different from the property $\lambda x\ [\nabla(x = b)]$, for these properties differ only by the occurrence of "a" and "b" respectively. Thus, the possession by b of the property $\lambda x\ [\nabla(x = a)]$ cannot

[40] Cf. chapter I and Parsons & Woodruff arguments concerning property abstraction (section 1.3.).
[41] Cf. Lowe (1994), p. 114. This argument was examined in greater detail in chapter I.

differentiate b determinately from a, since that property is not determinately different from the property $\lambda x\ [\nabla(x = b)]$ possessed by a.

So in the alleged cases of indeterminate identity, the identity-involving properties cannot be used to definitely distinguish between indeterminately identical objects. Hence, the claim is that a is indeterminately identical with b iff:

(i) there is no identity-free property which a (definitely) possesses and b (definitely) does not possess; and

(ii) there is a property which a (definitely) possesses, but it is indeterminate whether b possesses it.

In such a case Evans's argument does not work, because it essentially uses an identity-involving property.[42] *A fortiori* that argument cannot be used against the next standpoint, for it dismisses all indeterminacy-involving properties from the definition of indeterminate identity.

According to **the liberal standpoint**[43] it can be indeterminate whether $a = b$ even though b determinately possesses a property which a determinately does not possess, provided this property is indeterminacy-involving. It is claimed that it would beg the question to use a property which merely reflects indeterminacy to show that $a = b$ cannot be indeterminate.

So on this account a is indeterminately identical with b iff:

(i) there is no indeterminacy-free property which a (definitely) possesses and b (definitely) does not possess; and

(ii) there is a property which a (definitely) possesses, but it is indeterminate whether b possesses it.

---

42 There are however Evans-type arguments based on identity-free properties. See chapters III and V.
43 Cf. Broome (1984), pp. 6-12.

It may be argued that holding the intermediate position is not going far enough. If one is ready to admit that some indeterminacy-involving properties do not count, there seem to be no reason why one should not go further and claim that no such properties count. In every case of the supposedly indeterminate identity the indeterminacy in the properties is a direct consequence of the indeterminacy in identity. If *a* and *b* undergo a change which results in their indeterminate identity, then everything *a* did and everything that happened to *a* before the relevant change will be indeterminately true of *b*, and everything *b* did and everything that happened to *b* after the change will be indeterminately true of *a*. If using identity-involving properties begs the question against the ontic vagueness theorist, then using properties which follow from the supposed indeterminate identity begs that question too.

Moreover, both the intermediate and the liberal standpoints claim that there is something 'fishy' about the properties essentially involving indeterminate identity (the intermediate proposal) or indeterminacy in general (the liberal proposal). There are of course indeterminacy- and indeterminate-identity-involving predicates in our language, but the properties they name are not fully-fledged properties that have to be taken into account when the claims concerning identity are assessed. It seems to me that the person who rejects such properties altogether, has an easier job than someone who believes in ontic vagueness and yet acknowledges the existence of those properties. While the former simply argues that there are no indeterminacy-involving properties and therefore - obviously - such properties need not be taken into account, the believer in the 'fishy' properties has to argue that although there are such properties, they are not important for the identity claims.

4. CONCLUSION

The upshot is that the ontic vagueness theorist who believes in indeterminate identity has some breathing space left. The claim that the identity of objects may be ontically indeterminate can be made plausible. Two options especially are worth pursuing: the 'vague-objects' option and the 'undetermined range of F' option. The former view distinguishes temporal and compositional vagueness and holds that these two kinds of vagueness can lead to individuative vagueness, which in turn results in the indeterminacy in truth-value of identity statements. The latter conception distinguishes three standpoints towards indeterminate identity which differ as to the kind of properties which are to be taken into account in the assessment of the truth-value of the identity statements. Arguably, each of these views has a way of disarming Evans's argument; i.e. on each conception the existence of indeterminately identical objects can be made coherent.

In general, leaving the question of the validity of Evans's argument aside, we may say that Evans's argument says something about vague objects only if (i) the identity between such objects can be indeterminate and (ii) the names of such objects are precise designators.

Re (i) The prevailing view between ontic vagueness theorists seems to be that there are vague objects that are indeterminately identical. The question remains whether all vague objects can be indeterminately identical to something. If it is only some vague objects that can be indeterminately identical, then Evans's argument - even if it succeeds in proving the inconsistency of indeterminate identity statements -

does not prove that vague objects in general cannot exist. There is no common agreement between theorists dealing with ontic vagueness on this issue. On the one side is Sainsbury: his best attempt at formulating a substantive thesis of ontic vagueness is the claim that objects are vague if they are indeterminately identical. Therefore, being indeterminately identical to something is a sufficient condition for being a vague object. On the other side is Tye, who argues that identity statements are never indeterminate in truth value. Hence, in particular the identity statements concerning vague objects are never indeterminate. Arguably, another standpoint is also plausible: One might maintain that for each vague object there will be objects to which it is indeterminately identical. In general, in the presence of a vague object one never knows the (determinate) number of objects that are present. On such a view, vagueness is a sufficient condition for indeterminacy in identity. On the first and the third views Evans's argument is an argument about vague objects (provided that it is interpreted as an argument about indeterminately identical objects - cf. chapter 1). For according to the first conception objects which are indeterminately identical are vague, whereas according to the third - objects that are vague are indeterminately identical.

Re (ii) A separate problem is that it seems that the names of indeterminately identical objects cannot be precise in the standard sense. And as we have seen the non-standard sense according to which the designator "a" which determinately designates a and indeterminately designates b, is precise, is a somewhat bizarre account of what it is like to be a precise designator. If that sense is rejected, then the indeterminately identical objects, a and b, cannot be precisely designated and Evans's argument does not succeed in making statements that would be *about* those objects.

Thus, to sum up the issue of the impact of Evans's argument on the second interpretation: Recall that according to this interpretation Evans's argument by proving that "$\nabla(a = b)$", where "a" and "b" are precise, is incoherent, intends to prove that vague objects cannot exist. I do agree with Evans that there can be no vague identity statements whose vagueness is due solely to the existence of vague objects, but not for the reasons he gave us. Moreover, I think that the fact that there cannot be such statements does not show by itself that the world is not vague.

Chapter III

PERSISTENCE AND VAGUENESS

I. INTRODUCTION

It may seem sometimes that philosophers try to surpass each other in inventing the most bizarre puzzle concerning identity. Such puzzles usually have to do with identity over time and a change of some kind. And the more puzzling and weird the example the better. The examples can roughly be divided into two groups. The first group consists of puzzles which involve change of the kind met in the sorites paradoxes. An object undergoes a series of small insignificant changes which finally add up to a significant modification. While it seems clear that an object which undergoes a few minute changes is still the same object it was before the changes, it is also obvious that an object which undergoes many such changes may not survive, in which case what emerges after the changes will be a different object. Moreover, how many changes count as many and how many count as few is left undetermined. What is puzzling in these examples is the fact that, while for any tiny insignificant change, we are tempted to say that an object that has undergone that change is the same object as the object before that change, it is not so clear whether we want to say the same about the object that has undergone 1000 such changes and the object that has undergone none. Moreover, the question concerning the object that has undergone no changes (or one change) and the object that has undergone 999 changes is exactly analogous. Similarly the question about the identity of the object that has undergone no changes and the object that has undergone 998 changes, and so on for the objects that have undergone 997, 996, ... changes. Again, how many numbers of changes are represented by "..." is not determined. Certainly the more changes the object has undergone, the less inclined we are to say that it is the same object as the object we have started with. As a result the transitivity of identity may be endangered: we seem to be holding both that $a_1 = a_2$ & $a_2 = a_3$ & ... $a_{999} = a_{1000}$ but we are undecided about the claim "a_1 (a_2, a_3, *etc.*) = a_{1000} (a_{999}, a_{998}, *etc.*)". Probably the most famous example of this kind is the puzzle of Theseus's ship repaired plank by plank. T. Parsons's pile of trash which you swerved around yesterday and which since then has been constantly interfered with by the wind may be another example.[1]

The second type of case involves a serious disruption of an object, or even its fission (or else a fusion of two objects which results in coming into existence of a new single object). Here the most popular examples are personal identity cases involving more or less complicated brain surgeries and transplants. Another well-known example is Hobbes' developed Theseus's ship puzzle in which not only is the original ship repaired, but also another ship is reconstructed from the old planks, and the question might arise whether the original ship is identical to the reconstructed one. The puzzles in this group are so designed that there is no apparent answer to the question of whether the object before the disruption is the same object as the object after the disruption (or respectively: whether any of the objects created by a fission is numerically identical to the object that underwent that fission; or whether the object which is the result of a fusion is identical to any of the fused objects).

[1] T. Parsons (1987), p. 5.

The two groups of puzzles are not essentially different.[2] Each of the above puzzles presents us with an apparently unanswerable identity question: Is the original Theseus's ship identical to the completely repaired ship? Is the pile of trash you swerved around yesterday identical to the pile of trash that is by the roadside today? Is Brown identical to Smith who underwent a serious brain operation which refigured half of his psychological characteristics? Is the original ship identical to the ship reconstructed from the old planks? Until recently the most common approach to those puzzles was to consider each case separately and try to find a solution peculiar to the given case. So, for instance, it has been argued that artefacts have two kinds of persistence conditions associated with them. According to one set of conditions (namely the continuity-under-a-sortal conditions) the original ship is the same ship as the repaired ship, while according to the other set (namely the identity-of-original-parts conditions) the original is the same ship as the reconstructed one. The additional assumption is that the former condition outweighs the latter where they conflict.[3] It is clear that this is a partial solution. First of all it concerns only artefacts. Moreover, it does not even solve all puzzles concerning the identity of ships, let alone artefacts. As we will see the puzzle can be so complicated as to make this solution useless.

However, another approach to the diachronic-identity puzzles has recently become popular. This is a general approach and it applies to all the puzzles of this

[2] There are some differences of course. In the first group of cases the additional complication is the existence of borderline cases and higher-order vagueness, which are not at issue in the fission/fusion cases. On the other hand, in most cases from the second group the proper assessment of the questions concerning identity are much more complicated: the number of objects that exist before fission/fusion seems to be different than the number of objects existing afterwards.
NB It seems that all these puzzles could be so re-formulated as to become puzzles of trans-world identity instead of diachronic identity. As I have already mentioned, it appears to me that in general the questions surrounding temporal vagueness and the problems concerning modal vagueness are very similar. See chapter II, fn. 20.

[3] Compare e.g. Garrett (1998), p. 66.

kind. It says simply that there is no determinate answer to any of the above identity questions. It is not the case that one of the answers "Yes" or "No" is the right one and we have to discover which one. On the contrary, neither of the polar answers is correct, for there is no fact of the matter as to whether the objects concerned are identical or not. In other words it is **indeterminate** whether they are identical. It is left undetermined whether certain identity relations hold or not.

At first glance this answer may seem attractive because it 'solves' all the puzzles at once. And the solution it offers is a 'master-key' solution - it fits all the riddles concerning dubious identity-over-time cases. In this chapter I will try to assess what such an answer really amounts to and whether it is indeed as attractive as it may seem at the outset.

It is worth noticing that most of the above examples have two common presuppositions. Namely, a tacit assumption that there are some changes which a given object is capable of surviving and also some changes which that object cannot survive. Whereas the latter claim seems uncontentious, the former one - although intuitively equally compelling - has been questioned. It has been argued that objects cannot undergo any intrinsic change whatsoever, because even the smallest change must result in the loss of numerical identity of the object undergoing it. The charge that intrinsic change is incompatible with persistence has given rise to two - entirely different - accounts of persistence: endurantism and perdurantism.

The structure of this chapter is as follows. First, we will examine briefly how endurantism and perdurantism can handle the charge that intrinsic change is incoherent. Of course, on any account that is unable to make change coherent there can be no identity over time puzzles, for each such puzzle essentially involves changes. Next, we will consider the diachronic-identity puzzles, and see what the claims about the lack of determinate answers to these puzzles boils down to. Finally, we will see how endurantists and perdurantists can accommodate indeterminacy in their responses to the puzzles of identity-over-time.

2. PERSISTENCE

2.1. Concrete particulars and intrinsic change

Persistence is a matter of existing through time: an object persists iff it continues to exist for a certain period of time. Here we will be concerned only with persisting concrete composite particulars; i.e. things like persons, cats, trees, mountains, statues and lumps of clay.[4]

Roughly speaking, a concrete particular is a spatio-temporally extended object capable of entering into causal relations. It may have many attributes such as, for instance, colour, shape, texture. At each time at which such a particular exists it has a location in space. If it is a composite object it has spatial parts, each of which also has its position in space. A particular has a temporally bounded career.[5] It comes into

[4] This is to say that in this chapter we will not be concerned with the problems of the persistence of simples (e.g. classical and quantum particles). Chapter V will be devoted to the identity of quantum particles. Since in this chapter we are dealing with familiar objects only, we also ignore the issues concerning alleged *discrete-continuants*; i.e. objects that persist through some period of time, then go out of existence and come into existence again at some later time, as well as objects that move discontinuously.
NB It is usually assumed that abstract objects and properties do not persist, because they do not exist in time. Abstract objects are eternal, timeless and unchangeable. For an opposite view see e.g. B. Hale, *Abstract Objects*, Basil Blackwell, Oxford 1987. According to Hale there are abstract objects which exist in time. What we say about properties depends on our metaphysical standpoint towards universals. Also events do not persist, because they do not continue to exist through time; they happen at a time.
[5] Loux (1998), p. 93. This is not to say that its spatial or temporal boundaries are determinate.

existence at a certain time and ceases to exist at a certain (later) time Existence through time often involves change, so persisting objects should be capable of surviving changes. Some of those changes are intrinsic changes; i.e. changes in some of the intrinsic attributes of the particulars.[6] Hence, it may happen that at different times at which a particular exists it has different and even incompatible attributes.

Were particulars not capable of intrinsic changes, ascertaining whether a certain particular still persists after a period of time would be easy. In order to check whether the particular *a* at a time t_1 and the particular *b* at some later time t_2 are in fact one persisting particular, it would suffice to check whether there is a spatio-temporal continuity between *a* and *b*. The re-identification of a particular *a* at a time t_1 with a particular *b* at a time t_2 would require the spatio-temporal continuity of the trajectory between the location of *a* at t_1 with that of *b* at t_2. However, since particulars *are* subject to change, tracing trajectories is not enough. The continuity of spatio-temporal trajectory between *a* and *b* is a necessary but not a sufficient condition for *a* and *b* being the same persisting particular. Assume that first a statue is made from clay, and next, the statue is destroyed and a vase is made instead. Clearly there is a spatio-temporal continuity between the statue and the vase, but we do not normally want to say that the statue is the same particular as the vase. The 'intuitive' view is that the statue does not persist after it was made into the vase. Similarly we can imagine certain person's parts being gradually exchanged with synthetic parts.

---

[6] There are notorious problems with defining what an intrinsic property is. See. e.g. Lewis and Langton (1998). Roughly, they suggest that a property is intrinsic iff it never can differ between duplicates. Duplicates in turn are defined as objects that have exactly the same basic intrinsic properties, where basic intrinsic properties are such properties of an object that are independent of the accompaniment or loneliness of the object and are neither disjunctive properties nor negations of disjunctive properties.
In what follows I assume that we have an intuitive understanding of this notion and that shape, mass, height all count as intrinsic.

Eventually we end up with a new - bionic - entity. Despite the continuous spatio-temporal trajectory between the person and the bionic entity we are inclined to say that they are different particulars. Intuitively, the person did not survive through the changes. On the other hand, there are changes which do not affect the persistence of a particular. A vase can continue to exist despite being chipped, a person usually survives putting on weight, having his hair cut, breaking his leg, etc. Mr Jones of today is the same particular as he was 10 years ago, even though he was a skinny child then and is an obese adult now. The claims which say that a particular existing at one time is the same particular as a particular existing at some other time are called claims of **diachronic sameness**.[7] Hence, a certain particular persists through period t_1 - t_2 iff the relation of diachronic sameness holds between *a* at t_1 and *b* at t_2. The questions about persistence can be rephrased as questions about diachronic sameness. What this relation consists in is precisely what is at issue here. There are two competing accounts of what it is for an object to persist: perdurance and endurance. Each of them offers a diametrically different account of diachronic sameness.

As has already been mentioned, a persisting object is capable of having incompatible attributes at different times at which it exists. How can it be then that one and the same object can have incompatible attributes? We reject such things as square circles from our ontology because we regard them as inconsistent. No genuine object can have any incompatible properties at the same time. We do allow into our ontology objects which have incompatible properties at different times, however. Lewis in his *On the Plurality of Worlds* famously asked: "How does having them at

---

[7] Loux (1998), p. 203. I use the term 'diachronic sameness' and not 'diachronic identity' or 'identity over time' in order not to prejudge the question of whether the relation denoted by that term is an identity relation or not.

different times help?". This is **the problem of intrinsic change**.[8] Perdurantists and endurantists offer entirely different solutions to that problem.

2.2. Endurantism, perdurantism and the problem of intrinsic change

In Johnston's terminology "something perdures iff it persists by having different temporal parts, or stages, at different times, though no one part of it is wholly present at more than one time; whereas it endures iff it persists by being wholly present at more than one time".[9] Endurance is supposed to be our common, intuitive view. It tries to make sense of our everyday talk of persisting objects without departing too far from pedestrian intuitions. It tries to describe and explain the world of objects as we see it. Thus, it assumes an ontology of familiar objects of everyday experience and does not postulate the existence of any unfamiliar entities. According to that view, objects of our everyday experience are three-dimensional objects lasting over time. They are wholly present at each time at which they persist. So, for instance, Mr Jones is a three-dimensional object which exists through time. He was wholly present 10 years ago when he was a skinny child, and he is wholly present now when he is a corpulent man. This whole talk about being "wholly present" can be

---

[8] This is Lewis's problem of **temporary intrinsics**. See Lewis (1986), p. 202. It has been argued that two separate problems should be distinguished: the semantic problem and the metaphysical problem. The former is "the problem of specifying the logical form of sentences ascribing temporary intrinsic properties to persisting objects, in such a way that we do not run into contradiction [...]." (Lowe (1998), p. 130). In other words one has to explain how the temporal modifiers work (e.g. what do they modify: properties, objects, having properties?). The latter is the problem of how there can be objects for the description of which the semantic problem even arises [...]" (Lowe (1998), p. 133). Although these two problems are separate problems they are not completely independent. One cannot answer one of them without thereby influencing the answer to the other. The answer to the semantic problem precludes some answers to the metaphysical problem. And the answer to the metaphysical problem dictates the answer to the semantic problem. Therefore I'll continue to refer to those problems as "the problem of intrinsic change".

[9] Lewis (1986), p. 202.

better understood if one compares it with its opposite: not being wholly present; i.e. being partially present. Perdurantists claim that objects of our everyday experience are never wholly present. At each time at which they exist they are only partially present; this is to say that at each time at which they exist there is only a part of them present - namely a temporal part. Perdurantists are revisionists as regards standard ontology. According to them objects are not three-dimensional things lasting over time. On the contrary, they are four-dimensional entities; they have three spatial dimensions and one additional - temporal - dimension. They are extended in time as they are in space. Every metaphysician, no matter whether perdurantist or endurantist, will agree that a spatially extended object is not wholly present at any spatial location. It has its parts and each of its parts has its location. Hence, only a part of it is present at each of these locations; it is only partially present at each of this places, so to speak. Perdurantists add to this uncontroversial claim a much more controversial one. They claim that time should be regarded on a par with space. It is just another dimension analogous to the three spatial ones. And just as an object can be partially present at a certain place in a sense of having one of its spatial parts at this place, it can be partially present at a certain time, in the sense of having one of its temporal parts at this time.

The **endurantist** view of persistence has it that a persisting particular at a time before a change has occurred is numerically the same object as the particular at some time after the change. On this view diachronic sameness consists in **numerical identity**. Endurantists claim, for instance, that skinny Mr Jones is numerically identical to fat Mr Jones. Thus, they have to explain how the three apparently incompatible claims:

(a) Mr Jones is skinny at t_1.

(b) Mr Jones is fat (i.e. not skinny) at t_2.

(c) Mr Jones at t_1 is identical to Mr Jones at t_2,

can be true together.

The obvious strategy is to make much of the difference between the time at which Mr Jones is skinny and the time at which Mr Jones fat. But endurantists do not want to relativise Mr Jones to time - it would not help solve the problem. It would merely force one to conclude - in accordance with Leibniz's law - that Mr Jones-at-t_1 is not numerically identical to Mr Jones-at-t_2, because they differ in their properties. And this is a result which straightforwardly contradicts the main endurantists' assumption and leads directly to the perdurantist view of persistence. Therefore, endurantists usually adopt the adverbialist view and claim that time modifies the way in which an object has a property.[10] Mr Jones is not skinny *simpliciter* and fat *simpliciter*, but he is skinny in the t_1 way (or is t_1-ly skinny[11]) and fat in the t_2 way. Alternatively (and equivalently) one can add time-indexes to the ascription of a property. Then, "Mr Jones is skinny" should read "Mr Jones is-at-t_1 skinny". Being skinny remains, on this account, a genuine intrinsic property, but the having of this property is relativised to (or modified by) time. Having a property is having-at-a-time that property,[12] or having it in a time-indexed way. Thus, the predicates are regarded as irreducibly tensed.

---

[10] See e.g. Haslanger (1989); Johnston (1987); Merricks (1994). The other popular endurantist theory takes properties to be relations to times. See e.g. van Inwagen, (1990), pp. 249-50. See also Merricks (1994). For a criticism of this view see Hawley (1998b).

[11] "*a* is t-ly such that it *F*s" is true-in-L just in case *a* satisfies$_L$-at-t the predicate "such that it *F*s". Johnston (1987), p. 128.

[12] Lewis ((1988), p. 66) claims that the adverbial theorists are committed to a three-place instantiation relation. Lowe (1998), pp. 131-132) and Haslanger (1989), pp. 120-122) argue against this claim. Lowe maintains that Lewis's mistake consists in that he takes the two-place relation of having a property to be a disguised three-place relation: between an object, a property and a time. In

The proposal has its drawbacks, however. "Skinny in the t_1 way" and "fat in the t_2 way" are compatible only as long as the time-modifiers are in place. Hence, it seems that they cannot be analysed in terms of simpler properties of being skinny and fat, respectively. For if we could analyse "being skinny in a *t* way" in terms of "being skinny *simpliciter*" and a time *t*, then it would follow that Mr Jones can be skinny *simpliciter* at one time and fat *simpliciter* at another time, and Lewis's question of how having the incompatible properties at different times helps, would still require an answer. Furthermore, it is a consequence of this proposal that no genuine change ever occurs.[13] If Mr Jones is fat in the t_1 way, then he will be fat in this way till his last days. Moreover, he was fat in this way since birth.[14]

These consequences can be avoided by adopting a view which ascribes a special status to the present time.[15] **Presentism** assumes that only one time is real; only one time 'counts' - namely, the present time.[16] The assumption that there is a real ontological difference between the present and both the past and the future allows us to analyse, e.g., being-at-t skinny in terms of being skinny *simpliciter* and yet avoid a

---

fact the holding of a two-place relation is related to a time: the two-place relation holds between a time and a two-place relation between an object and its property. Haslanger takes a different view. She sees the danger of the three-place relation proposed by Lewis in that it suggests that the relation between an object and its properties is just another relation on a par with relations in which objects stand to each other. And this is precisely what Haslanger opposes: she does not want to treat the instantiation of a property *F* by an object *a* as a relation.

[13] Merricks (1994), p. 169.

[14] The analogous objections apply to the "time-indexed" version.

[15] Cf. Loux (1998), p. 206. It is often claimed that relativity theory is at odds with endurantism. The physics of relativity theory treats time as another dimension on a par with spatial ones. Hence, "present" has no special ontological significance. Here are two responses to this objection:

1. If the interpretation of the Lorentz transformation that generates the block universe argument fails, this objection fails as well. If the block universe argument succeeds, endurance is ruled out. Merricks (1994), fn. 22, p. 180.

2. It is difficult to extract an ontological theory out of mathematical formalisms of physics. Loux (1998), p. 217.

[16] Merricks argues that there is a parallel between "existing at a time" and a time's being present and "existing in a world" and a world's being actual, where possible worlds are understood as maximal possible states of affairs. Merricks (1994), p. 177, fn. 15.

contradiction. Recall that Mr Jones existing at t_1 is numerically the same object as Mr Jones existing at t_2. Moreover, Mr Jones at t_1 is skinny, while Mr Jones at t_2 is fat. If t_1 and t_2 counted as equally real - equally present - Mr Jones would be both fat and skinny. It is only because t_1 is some time in the past which is not real any more, that no contradiction arises.

It has been argued that these two claims, the claim that only the present is real and the claim that tense should be treated seriously (i.e. that the predicates should be regarded as irreducibly tensed) are still insufficient to solve the problem of intrinsic change. The problem is solved - or rather it simply disappears - if we take tense seriously, but, as Merricks argues, "that taking tense seriously can adequately handle the problem only when coupled with a semantics for expressions like 'O at t'"[17]. Understanding such expressions is crucial for the understanding of the statements of diachronic sameness. Without the endurantist semantics of the expressions like "O at t" one is unable to explain (and in this way answer Lewis's provocative question quoted above) how having incompatible properties at different times helps.

Recall that we dismissed the relativisation of Mr Jones to a time as a non-starter for endurantists, because it seemed to lead straightaway to the perdurantist view of persistence. It is hard to resist the impression that "Mr Jones-at-t_1" is a name of a temporal part of Mr Jones, for there seems to be nothing else which it could name. However, it has been suggested that endurantists are able to provide a semantics for the expressions like "Mr Jones at t_1", a semantics which does not resort to temporal parts. The solution is to regard such expressions as definite descriptions, and not as proper names. "Mr Jones at t_1" is a definite description which refers to the

[17] Merricks (1994), p. 171.

object such that it is Mr Jones and exists at t_1. "Mr Jones at t_1" means something like "Existing-at-t_1 Mr Jones". So, in fact it is not Mr Jones himself but rather his existence which is relativised to time. The statement "Mr Jones at t_1 is identical with Mr Jones at t_2" should be read as "There is one object, Mr Jones, which exists at both t_1 and t_2". Thus, the claims of diachronic sameness express numerical identity.

Therefore the three claims (a) - (c) are not inconsistent after all. As we have just seen that statement "Mr Jones at t_1 is identical to Mr Jones at t_2" should be read as "There is one object such that it is Mr Jones and it exists at t_1 and it exists at t_2". What the sentence "Mr Jones was skinny at t_1" says is that Mr Jones is skinny when the time t_1 is present. It does not say that Mr Jones is skinny when t_2 is present. Analogously the sentence "Mr Jones is not skinny at t_2" says that Mr Jones is not skinny when the time t_2 is present. Since at any given time only one time is present - i.e. only one time is real - Mr Jones's being skinny when t_1 is present is consistent with his not being skinny when t_2 is present. Thus, no contradiction is involved.

The treatment of the problem of intrinsic change given by **perdurantists** is entirely different. Recall that according to perdurantists a concrete particular persists by having different temporal parts (i.e. different stages[18]) at different times. Our everyday objects are in fact "four-dimensional worms" extended in time as well as in space. A particular is actually an aggregate of temporal parts. Those parts are not abstract, set-theoretic constructions. On the contrary, they are as concrete as we take particulars to be. Take Mr Jones. At each time at which he exists there is a temporal part of him present. There are lots of parts of his, some of which overlap. A temporal

[18] Following Lewis, I take "temporal parts" and "stages" to be synonyms. See Lewis (1988), p. 66.

part "Mr Jones at noon yesterday" is a part of another temporal part "Mr Jones of yesterday" and of many other parts as well (e.g. Mr Jones of this week, *etc.*). Since a particular is spread out in time, it is not wholly present at any time. At each time there are only some temporal parts of it present. And it is these parts that really have properties; particulars have temporary properties only derivatively.[19] Mr Jones is fat at certain times only because at least some of his temporal parts are fat.

A temporal part is a material object which can be defined as the content of a spatio-temporal region filled with matter.[20] For any spatio-temporal region which is filled with matter, there is a material object consisting of that matter. Material parts that we take to constitute the objects of our common experience are not special in any sense. What is special about our familiar objects is the relations that hold between the material objects that constitute their stages. Our claims about identity between continuants existing at different times should be translated into statements concerning the relation between several stages of a single continuant. Let us call this relation the I-relation. So, questions about identity between particulars existing at different times are questions about I-relatedness among temporal parts of those particulars.[21] Diachronic sameness is in fact the I-relation on this account. It is identity over time between particulars of a certain kind that induces the I-relation[22] and therefore the I-relation is relativised to the kind of the particular in question. This is to say that what this relation amounts to depends on the kind of the particular it is the relation of. The I-relation for persons will be the relation which holds between the stages of one

---

[19] On the other hand, there are properties which can be possessed only by sufficiently big aggregates of temporal parts. Lewis notices that certain activities take too much time to be performed by stages (see below). Many of our predicates make sense only when applied to continuants: to objects that last for some time and have histories (cf. Lowe (1995), p. 181). For instance, Mr Jones could not be a person if he were an instantaneous time-slice. It is a consequence of perdurantism that being a person becomes an extrinsic feature of an object, because it depends on the relations in which that object stands to other objects. Moreover it seems that also being a person-stage is an extrinsic feature of a temporal stage. Whether the given temporal stage is a person-stage, depends on other temporal stages that surround it (in space and time). Only if the surrounding temporal parts are of the appropriate kind and moreover are appropriately interrelated, is the temporal part in question a part of a person.
[20] Loux (1998), p. 213.
[21] Lewis (1976), p. 59.
[22] ibid.

person. A person is a maximal aggregate of person-stages, each one I-related to all the rest.[23] But saying that a continuant object is an I-interrelated aggregate of stages is uninformative, and in fact circular. It boils down to the claim that, for instance, a person is an aggregate of stages related by the relation induced by identity between persons. However, the I-relation can be characterised differently. According to Lewis this relation is necessarily coextensive with the so called R-relation, which comprises relations of spatio-temporal continuity, similarity and causation. Perdurantists tell us that

> "the temporal parts of objects we prephilosophically recognise enter into distinctive spatio-temporal relations, distinctive relations of similarity, and distinctive causal relations".[24]

Familiar concrete particulars are in fact aggregates of temporal parts which are interrelated by appropriate relations of continuity, similarity and causation. We say that a concrete particular persists as long as it has temporal parts; i.e. as long as it is an aggregate of temporal parts related in these ways.[25]

Since the I-relation is necessarily coextensive with the R-relation and every stage is I-related to all and only those stages to which it is R-related, the I-relation is in fact the R-relation.[26] Hence, the R-relation as well as the I-relation is relativised to the kind of the relevant particular. If we are talking about persons, the relevant component relations of the R-relation will be mental continuity, similarity between the adjacent mental states, and the relevant causal relations. So, a person can be defined as a maximal R-interrelated aggregate of person-stages.[27]As we have seen, the R-relation is defined without direct reference to either the I-relation or continuant objects, hence a definition in terms of the R-relation is an informative definition. Thus,

---

[23] Lewis (1976). p. 59.
[24] Loux (1998). p. 215.
[25] ibid.
[26] Lewis (1976). p. 58.
[27] Lewis (1976). p. 60.

the claim is that in general the diachronic sameness relation can be defined in terms of the relations of spatio-temporal continuity, similarity and causation.

According to the present proposal, the claim "Mr Jones-at-t_1 is identical with Mr Jones at-t_2" taken at face value is simply false, for it says that two different temporal parts - namely Mr Jones-at-t_1 and Mr Jones-at-t_2 - are identical. According to perdurantism such claims should not be read literally, however. What they really say is that Mr Jones has two temporal parts - Mr Jones-at-t_1 and Mr Jones-at-t_2 - and these parts are related by the relevant R-relation. Thus, diachronic sameness is **not the numerical identity relation**, in fact it is not an identity relation at all. The temporal parts are numerically different and have different properties. On the other hand, the identity can hold between aggregates of temporal parts iff they have the same temporal parts. Of course, this is not diachronic identity: on this view objects wholly existing at different times are never identical.

The question arises how long temporal parts are. Lewis claims that he does not need instantaneous temporal parts.[28] For him,

> "a person-stage is a physical object, just as a person is. [...] It does many of the things that a person does: it talks and walks and thinks, it has beliefs and desires, it has a size and shape and location. It even has a temporal duration. But only a brief one [...]. Hence a stage cannot do everything that a person can do, for it cannot do those things that a person does over a longish interval."[29]

It is clear however that such a notion of temporal part will not solve the problem of intrinsic change. If a person-stage walks, it must change its shape and location. So, for instance, at one time of its temporal duration its leg is straight while at another it is bent. Hence, the argument against enduring things can be run against

---

[28] Lewis (1976), p. 76.
[29] Lewis (1976), p. 76.

such temporal parts as well. A short-lived temporal part is not good enough. A part can last at most as long as no changes occur. And since there seems to be no finite lower limit to the period of time required for a change to occur, the possibility of the existence of instantaneous parts has to be acknowledged.

So, it seems that if temporal parts are to be a solution to the problem of intrinsic change, the 'proper' or 'basic' temporal parts have to be momentary.[30] Longer temporal parts have to be constructed out of them and regarded as higher-order entities on a par really with our everyday objects. 'Mr Jones-yesterday' - as well as Mr Jones - is an aggregate of momentary temporal parts related by the appropriate relations.

Perdurantism clearly runs counter to common intuitions regarding the notion of changing objects. Actually, perdurantists do away with that notion altogether. On their view, there is nothing that is the subject of change; *nothing that changes*. The temporal stages themselves do not change (this is their *raison d'être*, so to speak), and neither do the aggregates of stages. The aggregates do not persist through change, they have instead different temporal parts at different times. The 'change' consist in the fact that some of the properties of the adjacent temporal stages are different properties.[31]

Perdurantists are **eternalists**; they accept the tenseless characterisation of time.[32] According to them there is nothing special about the present. The present time

---

[30] At least for some kinds of objects. If the duration of a temporal part is to be determined by the rate with which the intrinsic changes occur, then it is bound to be different for different kinds of objects.

[31] For a criticism of perdurantism see e.g.: Howard-Snyder (1997), pp. 291-2; M. C. Rea (1997), p. xxx; J. J. Thomson (1983), p. 210.

[32] Lowe (1998) argues that the tenseless theory of time is committed to a temporal-part ontology. On the other hand, in his characterisation of endurance, Lewis simply assumes that "[e]ndurance involves overlap: the content of two different times has the enduring thing as a common part" (Lewis (1986), p. 202). This claim presupposes already that time is the mereological sum of temporal individuals that exist at it, and hence that each time is equally real as all the others (hence there is

has no privileged ontological status. All times and all objects existing at those times are equally real. Mr Jones-at-t_1, Mr Jones-at-t_2 and Mr Jones-now are three different objects, each of which is just as real as the others. The ordinary verbs are in fact tenseless expressions. We say that Mr Jones-at-t_1 was skinny and Mr Jones-at-t_2 will be fat, but there is nothing significant in the fact that we use the past tense in one case and the future tense in the other. Equally well we could use the tenseless "is".

Eternalism is a natural choice for perdurantists. If perdurantists accepted presentism - as endurantists do - they would be forced to say that only one part of an object is real; that an object consists of one real part, parts which were real in the past and parts which will come into existence in the future. It would amount to the claim that an object can have parts which do not exist.[33] Moreover, perdurantists stress the analogy between time and space. The claim that there is no ontological distinction between different times and objects that exist at those times is prompted by a similar spatial claim; namely the uncontentious claim that there is no ontological difference between "here" and "there".[34]

So, to sum up the issue of diachronic sameness and intrinsic change: it seems that there is a stalemate between the endurantist and perdurantist views of

---

nothing special in the mereological sum of temporal individuals that exist at present). So, it begs the question against endurantism assuming that it is committed to eternalism. See Forbes (1987), p. 140.

[33]See Loux (1998), p. 209.

[34] It is worth noticing that notwithstanding the claim that temporal parts are to be analogous to spatial parts, they are not analogous to spatial parts as we usually conceive of them. When we talk about spatial parts of a familiar object what we usually have in mind is not any spatial region within the spatial boundaries of that object filled with matter. It is rather a component of that object, i.e. a chunk such that it is easily detachable and performs some function (Butterfield (1985), p. 35). Each spatial part in this sense constitutes an articulated whole, so to speak. If one were to construct temporal parts analogous to spatial parts in this sense, then the only temporal parts one would get would be such parts as "Mr Jones as a child", "Mr Jones as a student", "Mr Jones as an adult" and so on. As I have already argued, postulating the existence of such parts is not going to solve the problem of intrinsic change. One needs momentary parts if one is to solve that problem. So, the notion of a temporal part of an object has to be constructed as a theoretical entity analogous to the theoretical notion of spatial part (and not to the common one).

persistence. Perdurantists did not manage to prove that the endurantist conception is inconsistent, but they will no doubt continue to claim that their account is better, more sophisticated and not so implausible as it may seem. Endurantists on the other hand, will argue that since their account does not depart far from common intuitions, is consistent and provides answers to some troublesome questions, there is no need for any more foreign accounts.

Endurantists are able to provide a coherent account of change provided the tensed view of time is presupposed. And the tensed view has not been proved wrong yet.[35] The temporal-parts view is committed to eternalism - the tenseless view of time. This may be an advantage, because it seems to be a view supported by the theory of relativity, but on the other hand drawing ontological consequences from scientific theory need not always be the best thing to do.[36] The main problem for perdurantists, is to justify their far-from-common ontology; to show that their account squares with our common, prescientific beliefs about the world.[37] It is true that given this - admittedly elegant - ontology, we are able to solve the problems concerning persistence and identity, but one may ask whether the price is worth paying. After all, endurance is a much less revisionary view operating with objects familiar from our everyday experience, which also gives answers to the puzzles. As Johnston puts it:

"Russell said that we can properly do without the metaphysics of the stone age. Just so, but we can also properly do without the scientistic metaphysics of our own age. The ontology of the stone age is however another matter. It, fortunately, is still with us and well deserves its place."[38]

---

[35] See footnote 15.
[36] Compare Johnston's remarks on scientism. Johnston (1992). p. 104.
[37] Loux (1998), p. 217.
[38] ibid.

2.3. Persistence conditions and puzzles of identity over time

As has been argued, whether we are endurantists or perdurantists, we are able to provide an account of intrinsic change. Now we face another problem, however. We have to decide **which** changes are permissible; that is which changes a particular object is able to survive. What makes it the case, for instance, that the lump of clay but not the statue is able to survive being made into a ball? We want to say also that the lump of clay survived despite being made into the statue first, and into the vase next. We do not want to say that the statue survived being made into the vase, though. We take it that Mr Jones has survived putting on weight, but he did not survive having all his parts exchanged with bionic elements. What reason do we have for such claims? The question then is: What is it that decides which changes are relevant for a given particular's persistence and which are not?

A more or less standard answer to that question is that there are no "bare" particulars.[39] Particulars are of a kind; they are only recognisable as individuals of a kind. For any given kind of particulars there is a criterion of identity for particulars of that kind. A criterion of identity for a kind F tells us what conditions x has to satisfy in order to be an F. Different kinds often have different criteria of identity. A criterion of identity conveys semantic information which constitutes part of the meaning of the relevant sortal term; where sortal term is a term which names a kind of particulars.[40] It does not specify the whole meaning of a given sortal, though. This is why different sortals can have the same criterion of identity associated with them. Criteria of identity determine **persistence conditions**. Roughly speaking, persistence conditions

---

[39] Cf. Lowe (1989) and (1997).
[40] Lowe (1989), chapter 1.

tell us what it takes for a particular to continue to exist; in other words, what it takes for a particular to retain its sort.

The answer to the question whether a given particular still persists can be quite tricky and often leads to paradox. The paradoxes arise because the identity criteria that we intuitively associate with various kinds of particulars permit those particulars to change in certain respects while remaining numerically the same objects. However, for instance, a series of small and acceptable changes can add up to a large change which is intuitively incompatible with the retention of numerical identity.[41] A notorious example of this problem is the riddle of Theseus's ship. Assume one plank in Theseus's ship is exchanged every minute. Then, it seems that the original Theseus's ship at t_0 is the same ship as Theseus's ship at t_1, Theseus's ship at t_1 is the same ship as Theseus's ship at t_2, and so on. Of every two adjacent ships we would be inclined to say that they are the same ship. However, Theseus's ship at t_0 and the ship at t_{1000} (i.e. the completely repaired ship) do not strike us as the same ship. We would rather say that they are two different ships. However, the claims "$a_1 = a_2$ & $a_2 = a_3$ & ... $a_{999} = a_{1000}$" and "$a_1 \neq a_{1000}$" taken together amount to the denial of the transitivity of identity.

For those who are not convinced that there is a problem concerning the identity of Theseus's ship and who wanted to treat the completely repaired ship as identical with the original ship, the puzzle has been developed. Let us assume that the exchange of planks goes on as above, but now the replaced planks are put together so that they compose another ship. So, now we have the original ship, the repaired ship and the ship reconstructed from the old planks.

---

[41] Lowe (1997), p. 629.

the repaired ship $\neq$ the reconstructed ship

the original ship =? the reconstructed ship

the original ship =? the repaired ship

It is clear that the repaired and the reconstructed ships are different ships (they have different spatio-temporal location), but what about the original and the repaired ones? And what about the original and the reconstructed ones? Are they identical or not? Nothing has been changed as regards the repaired ship, so those who have been inclined to say that it is identical with the original, have no reasons to change their view. It seems that the fact that the reconstructed ship has been created has nothing to do with - and in particular should not influence - the truth value of the identity statement "the original ship = the repaired ship". However, what reason do we have to favour the repaired ship over the reconstructed one? How are those people to justify their claim against someone who holds that it is the reconstructed ship which is identical with the original one?

On the other hand, someone who decides to change his mind and claim that whereas in the old puzzle the original was identical to the repaired ship, in the new puzzle it is the reconstructed ship which is identical to the original, treads on dangerous ground. On his view, the repaired ship is just as it is in the previous example, and yet in this case it is not identical to the original ship. In fact what such a person argues can be put as follows. Had the reconstructed ship not existed, the original ship would have still been identical to the repaired one. Since it does exist, the original is identical with it, not with the repaired ship. This implies that the identity of a ship can be determined by extrinsic factors - it can depend on the existence of another candidate for identity with the original ship.[42] Whether the original ship and

[42] Garrett (1998), p. 64.

the repaired ship are identical depends not only on intrinsic features of the original ship and the repaired ship but also on certain extrinsic facts. Therefore, on that view one is committed to the extrinsicness of identity, which is hard to accept. Worse still, such extrinsic factors are undeniably contingent. Therefore identity would not only be extrinsically determined, but contingent as well.

Another problem concerning diachronic numerical identity is caused by big changes, such as disruptions of some kind, fissions and fusions. An example of this kind can be another version of the Theseus's ship riddle in which we only ponder the identity of the original ship and the ship reconstructed from the old planks 10 years after the original ceased to exist, say. The puzzle is always the same: Is an object which has undergone certain change (or even ceased to exist for a certain time) the same as the object before that change? The examples are so designed as to make each definitive answer - no matter whether positive or negative - look implausible. Here the most popular examples are the ones which involve personal identity.[43] Compare the following puzzle:

An alteration machine changes Brown physically and psychologically. His brain is refigured so that roughly half of his memories, beliefs, desires, and character traits are replaced with new and very different ones. Call the resulting person Smith. Apparently there is no unique decisive answer to the question whether Brown and Smith are identical (i.e. in this case: whether they are psychologically continuous).[44]

Another well-known example involves fission. Here is Garrett's version:

---

[43] For a collection of some weird thought-experiments performed on persons see Garrett (1998), pp. 16-17.

[44] Garrett (1998), p. 17. The example is due to S. Shoemaker (*Self-knowledge and self-identity*). A more general example has it simply that the machine mixes up precisely those conditions that are relevant for personal identity so that determining decisively the occurrence of identity or the lack of it becomes impossible.

"My body is riddled with cancer. The surgeons want to try out a new technique: hemisphere transplant. They have two brainless donor bodies available, cloned years ago from my body. Each of my two brain hemispheres is removed and placed in its own body. Two persons result. Since I am one of the few people whose brain hemispheres are functionally equivalent (...), both resulting persons will think that they are me, and they will both have my character, apparent memories, and all my other psychological features."[45]

2.4. Solutions to the puzzles

Notice that the puzzles as presented above are puzzles merely for endurantists. Perdurantists argue that there is no identity over time at all. Objects existing at different times are never identical. The original ship at t_1 is not identical with the repaired ship at t_{1000}, nor is it identical with the reconstructed ship. All three are not ships at all; they are mere temporal parts of a ship. And all three are different temporal parts - hence, different objects. They may be related by various relations, but certainly not by identity. The person before the alteration is a different temporal part than the person after the alteration - therefore they cannot be identical. Hence, all the puzzling identity over time questions should be answered in the negative. In fact *all* statements stating occurrence of identity over time are false.

However, the puzzles can be so reformulated as to present difficulty for perdurantists as well. Instead of asking about the identity of objects existing at different times, one should ask about the identity of aggregates of temporal parts.

---

[45] Garrett (1998), p. 17. Another well-known example is J. Broome's story concerning the club (which is not a material object, however). [See Broome (1984), pp. 6-7. Broome attributes this example to D. Parfit.] A club is constituted by its rules and society conventions, and these may not decide every question concerning the club. Imagine that the club has no meetings for twenty years and then some of the original members and a few new people start to meet under the same name. If the rules and conventions are silent on that matter, it will be unclear whether the reconstituted club is the same club as the original. One may know all the relevant facts and still not know whether the club existing later is the same as the club that existed twenty years ago.

There will be very many aggregates containing the temporal parts of the repaired ship, very many aggregates containing the temporal parts of the original ship, and very many aggregates containing both kinds of parts. So, the question arises which of all the very many aggregates should count as a ship. For instance the main question of the simple Theseus's ship puzzle can be reformulated as follows: Is the aggregate containing the temporal parts of both the repaired ship and the original ship a ship? To put it differently, the question here becomes whether the temporal parts of the repaired ship are appropriately related to the original ship's temporal parts, or not. And the answer to such a question is by no means obvious. In fact, it is just as troublesome as the answer to the original question is for endurantists. Just as endurantists have trouble deciding whether the original and the repaired ship are one and the same ship or two different ones, perdurantists will have problems in deciding whether there is an aggregate of ship-related parts such that it contains both the temporal parts of the original ship and the temporal parts of the repaired ship. So, although according to perdurantists strictly speaking there is no identity over time at all, the identity over time questions can be so rephrased as to constitute puzzles for perdurantists as well.

As I have already mentioned, until recently the most common strategy for solving the diachronic-identity puzzles has involved concentrating on each puzzle separately and investigating the persistence conditions for the kind of the particular involved. Probably the Theseus's ship puzzle is the one which has acquired the greatest number of solutions. So, for instance - as I have already mentioned in the introduction - it has been argued that the Theseus's ship puzzle can be solved by distinguishing two criteria of identity: the continuity-under-a-sortal criterion and the identity-of-original-parts criterion. According to the former criterion *a* at t_1 is the same ship as *b* at t_2 iff we can trace a continuous spatio-temporal path from *a* to *b*, under the sortal "ship".[46] According to the latter criterion *a* at t_1 is the same ship as *b* at t_2 iff they are made of the very same planks. Moreover, the assumption is that the former criterion outweighs the latter; i.a. in the case in which both criteria are applicable, the continuity-under-a-sortal criterion is dominant with respect to the identity-of-original-parts criterion. Thus, in the Theseus's ship puzzle the repaired ship has the better claim to be the ship of Theseus than the reconstructed ship.[47]

Another treatment of that puzzle has been offered (and straightaway dismissed) by C. Hughes. He has suggested that H. Field's account of scientific terms can be applied to general terms such as "ship". The idea is to treat such terms as expressions having indeterminate reference. Field has argued that before relativity theory was discovered, the word "mass" was referentially indeterminate. He did not mean by this that it did not have any reference. On the contrary, there are two physical quantities (namely relativistic mass and proper mass), each of which satisfies the criteria for being the denotation of the term "mass" and there is no fact of the matter as to which of these quantities that term denoted.[48] Field claims further that neither the claim

(HP) Newton's word "mass" denoted proper mass;

---

[46] Garrett (1998), p. 66. Garrett writes that we should require that "any exchange of planks (...) occur in the normal working life of the ship. (...) the new planks are of roughly the same size and material type as the originals." I find the expression "the continuity-under-a-sortal criterion" rather unilluminating. It does not say much, unless we know already what "under-a-sortal" means. It seems to me however that what Garrett had in mind was the preservation of the form of the ship. So, the identity-of-original-parts criterion gives us a "matter-constant ship" whereas the continuity-under-a-sortal criterion gives a "form-constant ship". The terminology "matter-constant ship" and "form-constant ship" is Hughes's (see (1997b), p. 56).

[47] ibid.

[48] Field (1973), pp. 466-467.

nor the claim

(HR) Newton's word "mass" denoted relativistic mass;

is correct. He introduces the notion of *partial reference* or *partial denotation* and claims that Newton's word "mass" partially denoted proper mass and partially denoted relativistic mass; it did not determinately denote any of them.

Hughes suggests that it is possible to apply the same interpretation to terms such as "ship". One may regard "ship" as a referentially indeterminate predicate, which partially denotes matter-constant and form-constant ships.[49] Neither of the claims

(HF) "Ship" denotes form-constant ship;

(HM) "Ship" denotes matter-constant ship;

is adequate, for that term refers to each of form-constant and matter-constant ships only indeterminately. In other words, it is indeterminate which of the above persistence conditions are the ones that should be associated with the term "ship". In order to determine the truth value of sentences this approach uses the supervaluation method. A statement about ships will be true (false) iff no matter how we resolve the indeterminacy about the extension of ship, it will come out true (false).[50] If this condition is not satisfied, the statement has no truth value. So, for instance, the statement "The original ship is identical with the repaired ship" has no truth value, since if we interpret "ship" so as it refers to form-constants ships, the statement will come out true, while if we interpret "ship" so that it means "matter-constant ship", the very same statement will be false. So it does not have the value true (false) because it

[49] See fn. 46.
[50] Hughes (1997b), p. 56.

is not the case that no matter how we resolve the indeterminacy in the reference it comes out true (false). The lack of truth value is often interpreted as indeterminacy.

Notice moreover that even if we stipulated that it is just one of the partial references which is the correct one, the Theseus's ship puzzle would not be completely resolved. For assume that the predicate "ship" 'really' denotes matter-constant ships (i.e. that the identity of original parts is the proper criterion of identity). If this criterion is to be realistic and apply to common ships, it cannot be a strict criterion forbidding any change whatsoever. Now we can assume that the exchange of planks has been interrupted in the middle and the ship has 50% of the original planks and 50% of the new ones. Is it identical to the original ship, or not? It is clear that the criterion of constancy of matter does not allow us to answer that question decisively. Here again indeterminacy sneaks into the picture. And this brings us to another solution to identity-over-time puzzles.

For some time now another method of solving such puzzles has been gaining popularity. This solution apparently solves all the puzzles at once and consists in the claim that the identity over time questions which are the centre of the puzzles have no determinate answers. For instance, it is neither the case that the original ship is (determinately) identical with the repaired one, nor is it the case that it is (determinately) identical with the reconstructed one. Rather, it is indeterminately identical to the former and indeterminately identical to the latter.

The problem of intrinsic change as such; i.e. the problem concerning the apparent impossibility of one and the same object having incompatible attributes at different times, has nothing to do with vagueness. Either intrinsic change involves contradiction, or it does not. There is no third option: it cannot be *indeterminate* whether it does. However, once we provide an account of intrinsic changes, then the issue becomes *which* intrinsic changes are possible, *which* criteria of identity and persistence are decisive, and indeterminacy may appear in the picture.

3. INDETERMINACY AND DIACHRONIC-IDENTITY PUZZLES

3.1. Indeterminate-identity answer to diachronic-identity puzzles

For endurantists the problem is to decide whether an object which has changed is still numerically the same object. Therefore, the question which becomes the crux of the whole matter is how one is to understand identity-over-time statements. As we have seen, solving each of the diachronic-identity puzzles involves answering a question of the form "Is a at t_1 identical with b at t_2?"; where t_1 is a time before the change (or the series of changes) and t_2 is the time after; while "a" and "b" are names, which may happen to name the same particular. Perdurantists, on the other hand, exclude at the outset the possibility that the object before the change is numerically identical to the object existing after the change. For them the 'genuine' question is whether there is an R-related aggregate of temporal parts which contains both parts of "a" and parts of "b". The puzzles illustrate the fact that sometimes neither of the definite answers seems plausible. Therefore one may feel tempted to claim that there is no definite answer to such questions. It is neither true nor false that a at t_1 is (determinately) identical with b at t_2. In fact the right answer is this: It is **indeterminate** whether a at t_1 is identical with b at t_2. All puzzles of identity over time are cases of indeterminate identity over time.

But is this really so? Can we be satisfied with the answer that in each case in which no definite answer seems right, the indeterminate answer is legitimate? Is it really the case that the lack of definite answer to the diachronic-identity questions which is caused by the silence of the relevant persistence conditions is tantamount to the indeterminate answer?

Moreover, it is not as if the appeal to indeterminacy solved everything. On the contrary, it may appear that it complicates the issue even further. Consider the following example of supposedly indeterminate identity:[51]

The watch I sent for repair = the watch I got back.

One may know every part of the watch one sent for repair and every part of the watch that one got back and still not know whether the watch sent is the same watch as the watch returned. The watches seem to be neither determinately identical nor determinately distinct. According to our intuitions, it is indeterminate whether the returned watch was worn last year, whereas it is determinate that the one sent was worn then. If they were determinately identical, it would not be indeterminate whether the returned watch was worn last year, for it would be determinate that it was. If - on the other hand - the watches were determinately distinct, again it would not be indeterminate whether the returned watch was worn last year, for it would be determinate that it was not. Hence, the conclusion seems to be that the watch sent and the watch returned are neither determinately identical, nor determinately distinct, but indeterminately identical instead.

On the other hand, one may equally well argue that the above mentioned facts concerning the watches support the conclusion that the watches are determinately

---

[51] Sainsbury (1994), p. 74.

distinct after all. The watch returned has the property of being such that it is indeterminate whether it was worn last year, whereas the watch sent lacks this property. So, we could run the following 'Evans-type'[52] argument:

(1) $\nabla\ \Phi b$ (it is indeterminate whether the watch returned was worn last year)	ass
(2) $\lambda x\ [\nabla\ \Phi(x)]b$	1, property abstraction
(3) $\neg\nabla\Phi a$	ass
(4) $\neg\lambda x\ [\nabla\ \Phi(x)]a$	3, property abstraction
(5) $\neg\ (a = b)$	2, 4, contrapositive of LL

So, after all, the watches are distinct. But it seems that we cannot just stop here and accept the conclusion that the watches are definitely distinct. For one can go on:

(6) Φa	ass
(7) $\exists y(\Phi y\ \&\ \forall z\ (\Phi z \rightarrow y = z))$	ass
(8) $\neg\Phi b$	5, 6, 7
(9) $\neg\nabla\ \Phi b$	8, characteristics of ∇
(10) $\perp$	1, 9 $\neg$ elimin.

Thus, the very assumption that it is indeterminate whether the watch returned was worn last year leads to a contradiction. Therefore we are forced to reject that assumption. However, if it is not indeterminate whether the watch returned was worn last year, then it must be either determinate that it was or determinate that it was not. And neither of these options is plausible.

Similar reasoning may be applied to each puzzle. For instance, it seems that the question whether Brown and Smith are one and the same person has no determinate answer. It appears to be indeterminate whether Brown survived the alteration. Now, if it is indeterminate whether Brown survived the alteration, Smith

---

[52] Recall that Evans's proof goes as follows.
Let "a" and "b" be singular terms. Then, Evans's proof runs as follows:

(1) $\nabla\ (a = b)$	Assumption
(2) $\lambda x\ [\nabla\ (x = a)]b$.	1, Property Abstraction
(3) $\neg\nabla\ (a = a)$	determinateness of self-identity
(4) $\neg\lambda x\ [\nabla\ (x = a)]a$	3, Property Abstraction
(5) $\neg(a = b)$	2, 4, Leibniz's Law

For further details see chapter I.

and Brown must be indeterminately identical. For if they were determinately identical Brown would definitely survive the alteration, and if they were determinately distinct, Brown would definitely not survive the alteration. On the other hand, the very same feature - i.e. the feature of it being indeterminate whether Brown survived the alteration - can be used in proving that Brown and Smith are determinately distinct.

It might thus seem that the indeterminate-identity answer is no answer at all. Instead of solving the identity over time puzzles it allows us to construct paradoxes. Recall, however, our considerations concerning indeterminate identity from the preceding chapter. In section 3.3. we distinguished three standpoints towards indeterminate identity: the radical, the intermediate and the liberal. The radical standpoint has it that *a* is indeterminately identical with *b* iff: (i) there is no property which *a* (definitely) possesses and *b* (definitely) does not possess; and (ii) there is a property which *a* (definitely) possesses, but it is indeterminate whether *b* possesses this property. The intermediate standpoint rules out identity-involving properties from consideration and claims that *a* is indeterminately identical with *b* iff: (i) there is no identity-free property which *a* (definitely) possesses and *b* (definitely) does not possess; and (ii) there is a property which *a* (definitely) possesses, but it is indeterminate whether *b* possesses it. Finally, the liberal view does not take any indeterminacy-involving properties into account and has it that *a* is indeterminately identical with *b* iff: (i) there is no indeterminacy-free property which *a* (definitely) possesses and *b* (definitely) does not possess; and (ii) there is a property which *a* (definitely) possesses, but it is indeterminate whether *b* possesses it.

All these standpoints are in a sense weakenings of the contrapositive of Leibniz's law. They say in fact that there are properties that do not count when one tries to decide the question of identity or difference of objects in question.

On the liberal standpoint the paradoxical reasoning concerning watches cannot be conducted. The property of being such that it was indeterminately worn last year cannot be used to distinguish the watch sent for repair from the watch returned because that property is indeterminacy-involving and therefore does not count in determining the identity of the watches. On the basis of (2) $\lambda x\ [\nabla\ \Phi(x)]b$ [i.e. b is such that it is indeterminate whether it was worn last year] and (4) $\neg\lambda x\ [\nabla\ \Phi(x)]a$ [i.e. a is not such that it is indeterminate whether it was worn last year] one cannot conclude that (5) $\neg\ (a = b)$, for both these properties are indeterminacy-involving, and as such are not taken into account.

On the intermediate standpoint the reasoning goes through, for although it uses an indeterminacy-involving property, it does not use an indeterminate-identity involving property and only the latter are banned by this standpoint. Since on the radical standpoint all properties 'count', the argument works there as well. Thus, on both latter accounts one ends up with an apparent contradiction. From (1) and (3) one can derive (5), which than can be used to derive $\neg(1)$. Notice however, that the conditions that objects have to satisfy in order to be indeterminately identical are formulated in terms of properties. This leaves open one possibility of disarming the above argument. The indeterminate identity theorist may insist that the indeterminacy-involving predicates do not designate properties. If there are no properties corresponding to ∇-involving predicates, one will be able to invalidate the paradoxical reasoning. On both the radical and the intermediate views the argument will be fallacious, since it uses property abstraction. Step (2) attributes to b the property of being such that it is indeterminate whether it was worn last year. If there is no such property, the argument is blocked.

However, if one insists that indeterminate identity be formulated in terms of predicates instead of properties, one does not need property abstraction at all. Instead of saying that e.g. b is such that it is indeterminate whether it was worn last year, one may say that while the predicate "is such that it is indeterminate whether it was worn last year" is true of b, its negation is true of a, which amounts to their being (determinately) not identical. In this case the only way to stop the argument is to object to the contrapositive of Leibniz's law in the presence of predicates containing ∇-operators.[53]

To sum up, the indeterminacy answer to diachronic identity puzzles does not lead to the paradoxical conclusion that the objects involved are both indeterminately identical and determinately non-identical simultaneously nor does it force one to accept two contradicting claims (1) $\nabla\ \Phi b$ and (9) $\neg\nabla\ \Phi b$, provided one either (i) accepts the liberal view of indeterminate identity, or else (ii) accepts either the radical or the intermediate view, but at the same time (iia) formulates the conditions for indeterminate identity in terms of properties and believes that indeterminacy-involving predicates featuring in the argument do not denote properties, or alternatively (iib) formulates the indeterminate-identity conditions in terms of predicates and rejects the contraposition of Leibniz's law as invalid for such predicates.

---

[53] Cf. chapter I. sections 1.3. and 1.5.

3.2. Individuation

It has been claimed that the identity over time puzzles do not constitute genuine cases of indeterminate identity after all. Take the watch-puzzle as an example. In order to have vagueness in identity we must have "the individuation of a watch, x, and individuation of a watch, y, and vagueness concerning whether x is y".[54] The argument has it that in this case we do not have such two individuations. It is not enough to point to a watch in order to determine which watch it is. For an individuation the origins must be somehow determined. Sainsbury argues as follows.

"We think that it is easy, by, for example, pointing to a watch, to determine which watch it is. Succeeding, however, requires that what we do somehow determines an origin, known or unknown, which is as definite as is required by the vague persistence conditions for things of that kind. [...] To the extent that there is genuine doubt about which origin what we have pointed to has, our pointing has not individuated a watch. We may say that it has individuated a watch stage; and we can represent the vagueness as bearing on which watch, if any, incorporates the watch stage".[55]

First of all what is the phrase "if any" supposed to mean? Does Sainsbury want to allow watch-stages which do not belong to any watch? Why are they *watch* stages then? As I have already argued, assuming perdurantism, whether the given temporal stage is a watch-stage, depends on other temporal stages that surround it (in space and time). Only if the surrounding temporal parts are of the appropriate kind and moreover are appropriately related, is the temporal part in question a part of a watch.

Secondly, Sainsbury argues that it follows from the above considerations that there are no objects in this situation which satisfy

---

[54] Sainsbury (1994), p. 75.
[55] Sainsbury (1994), p. 75.

(3) $\lambda w \lambda z\ (\nabla(w \text{ is identical to } z))x, y$.[56]

The claim is that "the watch sent" and "the watch returned" fail to individuate any temporally extended objects, while substituting the relevant watch stages for "x" and "y" in (3) results in a false statement. Thus, it is clear that although Sainsbury advocates the temporal stages solution, he - unlike the typical perdurantists - does not treat space and time on a par. On the one hand he confesses that he is inclined to believe that the anodyne vague objects like New Devon and Nouvelle Provence satisfy (3) and therefore make it uncontroversial, while on the other hand he argues that watches cannot even be substituted in (3). So, in the former case he allows "New Devon" and "Nouvelle Provence" to individuate objects even though the spatial boundaries of these objects are not determined, whereas in the latter he holds that watches cannot be individuated because their temporal boundaries are not determined.

As we have seen Sainsbury's treatment of watch-type puzzles consists mainly of two claims:

(a) The expressions "the watch sent" and "the watch returned" fail to individuate any watches; but

(b) These expressions individuate watch stages.

This solution has probably been most welcomed by perdurantists. If the indeterminate-identity puzzles can only be resolved by an appeal to temporal parts, then perdurantism gets a new argument in its favour. Sainsbury's solution may be regarded as a good solution only by someone who believes in temporal parts. What can endurantists do, then? Since they reject the very notion of a temporal part, the claim (b) is of no use for them. Therefore, for them, these two claims boil down to the

---

[56] See chapter II, section 3.1.

thesis that "the watch sent" and "the watch returned" do not individuate anything at all. That seems implausible. Let us first investigate whether a person who does not acknowledge the existence of temporal parts is really forced to accept that unattractive claim. Maybe there are better ways out of this rather uncomfortable situation that endurantists could adopt. The claim (b) will be dealt with in the section devoted to perdurantism and indeterminacy.

3.3. Endurance and indeterminacy

3.3.1. Semantic indeterminacy and imprecise designators

The justification for the claim:

(a) The expressions "the watch sent" and "the watch returned" fail to individuate any watches;

is that the origins of the watches has not been determined. However, the claim that in order to individuate something, e.g. a watch, what we do must somehow determine its origin, known or unknown, seems to be too strong a requirement.

Firstly, Sainsbury draws the analogy with a lion and its intrinsic features. He claims that intrinsic features are not enough for something to be a lion: an appropriate genesis is also required.[57] But this analogy is not a good one. We may agree that something can be a lion only if it has an appropriate origin, and still not agree that the same applies to watches. On the contrary, it seems that intrinsic features are enough for something to be a watch. It might be argued that as long as something shows

---

[57] Sainsbury (1994), p. 75.

times accurately it is a watch, no matter whether it has been made in a watch factory or created by God. Its origin seems irrelevant.

Moreover, in everyday life we do not bother about things' origins. Pointing at a watch or using a definite description "the watch I gave you last year" seems good enough for the purpose of individuation.[58] Moreover, it is unclear what this requirement really amounts to. What we do must determine an origin, but it may remain unknown. How do we know then whether it has been determined or not? How do we know whether or not we succeeded in individuating a watch?

Anyway, it is clear that in some cases this requirement is not fulfilled. Now, if we agree that in such cases we did not succeed in individuating a watch, did we individuate something else or nothing at all? Sainsbury seems to think that a person who does not believe in temporal parts has no option but to argue that in such cases we do not individuate anything. It appears to me that the claim that when we think we individuate a watch, we in fact individuate nothing at all amounts to the claim that terms such as "the watch sent for repair" are imprecise designators, in the sense that they fail to refer determinately to anything (in other words they fail to denote determinately anything). Since the claim that "the watch sent" does not individuate anything seems to be another way of saying that it fails to refer to an object determinately, "the watch sent" is an imprecise designator. Thus, when one utters "the watch sent" one does not speak *of* anything in particular. Moreover, since the imprecise designators do not succeed in singling out objects of which one could predicate something, the property abstraction becomes doubtful. This has a rather counterintuitive conclusion that I cannot even say that the watch which I sent for

[58] Provided of course that there is a watch at a place at which one points and that I gave you a watch last year respectively.

repair *is such that* I wore it last year. (*NB* The supervaluationist can argue here that the watch I sent for repair *is* the watch I wore last year, for on every precisification of "the watch I wore last year" and "the watch sent for repair", the identity statement "The watch I sent for repair is the watch I wore last year" comes out true. It seems to me however that even he cannot claim that the watch which I sent for repair *is such that* I wore it last year, because one cannot predicate anything of the watch I sent for repair, unless that object is singled out determinately.)

However, in order to argue that, e.g., "the watch returned" does not refer to a watch determinately, one has to argue that there are at least two objects, such that it is indeterminate which one is the referent of "the watch returned".

Usually one considers a designator *d* imprecise if there exist (at least) two objects, which are distinct and such that it is indeterminate to which of these objects *d* refers. In such a case there is nothing to which *d* refers determinately. Thus, for instance "the first black pen in the sorites series of black and grey pens" is an example of an imprecise designator in such a standard sense, since it fails to refer determinately to any pen. No single pen is determinately singled out by such a term, for there are several pens which are equally good candidates for the satisfier of the predicate "is the first black pen in the sorites series". Recall also that the reason why we have claimed that "is Harry's best friend" is a semantically indeterminate term was that it was indeterminate whether it was Sue or George who stand in this relation to Harry. The expression "Harry's best friend" does not refer determinately to a unique person.

Thus, if "the watch returned" is to be a semantically indeterminate term, there must be at least two distinct watches to which that term purports to refer. But it may be argued that such a view is absurd, for it leads to *spatio-temporal coincidence*. We know that only one object has been returned - one watch with a particular characteristics. We are absolutely sure that the watch-maker did not return two distinct, spatio-temporally separated watches. Therefore, if one is to argue that the expression "the watch returned" refers indeterminately to two watches, one has to commit oneself to the claim that the two watches are spatio-temporally coincident. Hence, coincidence is imminent. At the time of the utterance there must be at least two distinct, but nevertheless spatio-temporally coincident, returned watches.

One could argue that the spatio-temporally coincident objects are watch-precisifications. However, the precisifications of watches have to be watches, so this solution is not of much help.[59] Alternatively one could insist that for "the watch returned" to be a vague expression it suffices that there are two distinct objects - not necessarily watches - which are the candidates to be the watch returned. However, those objects, in order to be (indeterminate) referents of the expression "the watch returned" have to be at least very watch-like. Moreover, they have to be watch-like to the same degree, for if one of them were more watch-like than the other, it would be a better candidate for a watch, so the reference of "the watch returned" would be determined, contrary to our assumption.

So, the claim that expressions like "the watch returned" are imprecise designators which fail to refer determinately to anything[60] combined with the rejection

---

[59] See chapter IV.

[60] The problem is that such imprecision does not affect merely fictitious examples. On the contrary, it affects (almost) all natural-language singular terms (i.e. names, definite descriptions and demonstratives). We take the name "Bill Clinton" to be a precise designator. We are convinced that it individuates one (and only one) person determinately. However, were he to undergo fission, it would become unclear to which of the post-fission persons "Bill Clinton" applies. We cross the river and say subsequently "the river we just crossed is such-and-such". We think that when we say this, we refer determinately to a certain river. It may be the case however that the river divides somewhere up the stream. When we uttered the words "the river we just crossed" we did not specify which of the small divided rivers that description was to refer to. Call these small rivers "*a*" and "*b*". Since it is indeterminate whether "the river we just crossed" refers to *a* or to *b* (or to any of them for that matter), it is an imprecise designator. ("The river we just crossed" is imprecise as regards river's temporal boundaries as well. We can assume that 10 years ago there was a river in this place, which

of temporal stages leads to the acceptance of the spatio-temporal coincidence view, which many people think to be too high a price to pay.

3.3.2. Temporally vague objects

It seems to me that endurantists - if they want to avoid the spatio-temporal coincidence view - have to reject Sainsbury's claim (a), i.e. the claim that the expressions like "the watch sent" and "the watch returned" fail to individuate any watches. Endurantists should insist that, for instance, "the watch returned" does individuate a watch - namely the watch that has been returned by the watch-maker. Admittedly, the watch it individuates is a temporally vague object - for instance, it is indeterminate whether it satisfies the predicate "existed a year ago", but this does not mean that it is not individuated. On the contrary, it is clear that despite the fact that the origin of such a watch is not determined, it is sufficiently individuated for everyday purposes. As I have already mentioned Sainsbury himself has no qualms about individuating objects which do not have precise spatial boundaries, so I cannot see why one should not extend this view to temporal boundaries as well. "The watch sent" and "the watch returned" are designators that refer determinately to vague objects.

As it has been argued in chapter II, there are two senses in which a designator may be considered precise. In the standard sense a designator is precise if it singles out a unique object determinately. In the non-standard sense a designator is precise if

---

subsequently dried out completely. Later on the bed of a river filled up with water again. It is indeterminate whether "the river we just crossed" refers to the river which dried up.) And so on. One can construct a similar example for most singular terms (at least for terms referring to concrete, material objects existing in space and time).

it refers determinately to an object, but is such that it is indeterminate whether it singles out a unique object. However, this kind of 'precision' is rather bizarre and moreover it is possible only in the presence of indeterminately identical objects. As you may remember, in chapter II this kind of designator was called "precise" in a (desperate) attempt to get Evans's argument running. The idea then was to check what happens if someone insists on regarding such a kind of designator as precise. We wanted to examine whether a designator that refers both determinately and indeterminately can be used to prove the incoherence of indeterminate identity. As I have tried to argue, such non-standard and 'lax' understanding of precision does not help Evans's argument. Moreover, such a kind of designator is *imprecise* rather than precise. As I have pointed out the striking feature of such a designator is that it is indeterminate to how many objects it refers. It seems thus much more appropriate to call it "imprecise".

Thus, we see that in addition to the standard sense of imprecise designator discussed in the preceding section, there is also another sense of imprecision possible. An imprecise designator d may refer determinately to one object a and indeterminately to another object (more precisely not to another, but to an object which is indeterminately identical to a). If a is a vague object which is not determinately different from b, then it is indeterminate whether d refers to a only or to b as well. In this case imprecision is due to objects, not to expressions. We will call this sense the *non-standard sense*.

Therefore in the presence of indeterminately identical objects the claim that "the watch returned" and "the watch returned" refer determinately to certain objects does not mean that they are precise designators. According to the non-standard sense a designator that refers determinately to some object is still imprecise, provided it also refers indeterminately to some object. So, "the watch sent" as well as "the watch returned" are imprecise in this sense. "The watch sent" refers determinately to the watch sent, but it is indeterminate whether it refers to the watch returned. In general, it is indeterminate whether when we utter "the watch sent" and "the watch returned" we refer to one object or to two distinct objects.

So, the watch puzzle is a genuine puzzle after all. The term "the watch sent for repair" individuates a temporally vague watch, the term "the watch returned" also individuates a temporally vague watch and it is indeterminate whether the watches are one and the same watch or not. The puzzle remains a puzzle, for the identity of watches is indeterminate.

The same argument applies to all diachronic-identity puzzles of this kind. Consider, for instance the case of Brown and Smith. Recall that Brown is the man who has entered the alteration machine and Smith is the man who emerged from it. This case can be regarded either as a case involving ontic indeterminacy or as a case which involves merely semantic indeterminacy. Let us consider the latter option first. If there is no ontic indeterminacy involved in the Brown/Smith case, "Brown" and "Smith" can only be indeterminate in the standard sense. So, for instance, for "Brown" to be imprecise is for it to refer indeterminately to more than one object - i.e. there has to be at least two objects about which it is indeterminate whether "Brown" refers to them. Are there such objects, though?

It appears that only someone who believes in temporal parts can avail himself of that solution. The proponent of the temporal-parts view can claim that it is indeterminate to which of the collections of temporal parts "Brown" refers; for instance, it is indeterminate whether it refers to a collection which contains temporal parts of Brown-before-the-alteration only, or to a collection which contains in addition temporal parts of Smith. Noonan argues that if we suppose that Brown is the only man who enters the machine and Smith is the only man who leaves the machine, then if "Brown = Smith" is to be indeterminate in truth value, "the man who enters the machine = the man who leaves the machine" also has to be indeterminate.[61] Now, the definite description "the man who enters the machine" has a denotation only if the predicate "*x* is a man who enters the machine and anything which is a man who enters the machine is identical with *x*" is satisfied by just one object. The denotation of this description will be indeterminate if some object *x* satisfies that predicate under some sharpenings and some object *y* under other sharpenings, i.e. if there is more than one object which is a candidate for satisfying the predicate "*x* is the man who enters the machine". Noonan argues that someone who takes persons to be collections of temporal parts has no problem with finding the relevant candidates. For someone who does not believe in temporal parts the situation is different, however. According to Noonan, such a 'three-dimensionalist' is unable to account for the indeterminacy of the description in question. In order to explain the indeterminacy he would have to claim that there are candidates for satisfiers of "*x* is the man who enters the machine" which are distinct, located in exactly the same place before the operation, not related by part-whole relation and which satisfy the predicate under some sharpenings. Such spatio-temporal coincidence seems absurd. Thus, Noonan's conclusion is that endurantists must either deny the possibility of vague identity statements or reject the traditional analysis of definite descriptions.[62]

---

[61] See Noonan (1982), pp. 5-6. Noonan discusses a slightly different case of Brown and Brownson. See chapter V.

[62] Noonan (1982), pp. 5-6.

It seems to me that Noonan's conclusion applies only to those endurantists who do not believe in ontic vagueness. The situation is entirely different if we consider the Brown/Smith case as involving ontic vagueness. The endurantist theorist can claim, for instance, that there is one (vague) person who enters the machine and one (vague) person who leaves the machine. What is indeterminate is whether this is the same person or not. We do not know whether the change that Brown has undergone counts as a mere change or as the end of his existence and the beginning of the existence of another person. The predicate "is the man who leaves the machine" refers determinately to one person, i.e. Smith, but it is indeterminate when Smith 'has come into existence' - it is indeterminate whether it has been the birth of Brown or the brain-transplant. Brown and Smith are vague objects, whose temporal boundaries are fuzzy to a great extent. The description "the man who enters the machine" refers determinately to Brown *and indeterminately* to Smith and "the man who leaves the machine" refers determinately to Smith *and indeterminately* to Brown. The statement "The man who enters the machine = the man who leaves the machine" is indeterminate in truth value because it is indeterminate whether these descriptions refer to the same man or not. This view does not *commit* one to spatio-temporal coincidence, since it is indeterminate how many persons (i.e. one or two) there are.

Thus, one may conclude that it is not the case that the diachronic-identity puzzles have no determinate answers because the names and definite descriptions which we use in order to refer to objects undergoing changes fail to refer to unique things. In fact, it is indeterminate whether they succeed in referring to unique things, because those things are temporally vague.

Actually it seems that endurantists cannot do without vague indeterminately identical objects. If they do not allow such objects into their ontology, they are stuck with spatio-temporal coincidence of familiar objects. In almost every puzzle of diachronic identity a question is asked of whether a certain object *a* is identical with a certain object *b*. In most of those cases either of the determinate answers, "Yes" and "No", seems implausible and arbitrary. And if one wants to answer that it is indeterminate whether *a* is identical to *b*, then one has to explain the source of this indeterminacy somehow. The easiest explanation is to say that "*a*" and "*b*" are imprecise designators which do not refer determinately to anything. However, such an explanation leads endurantists directly to spatio-temporal coincidence. They must maintain that there is more than one object which deserves the name of "*a*" and more than one object which deserves the name of "*b*". Thus, in effect they have to argue that there are two objects of the same kind located in the same place at the same time.

Such a spatio-temporal coincidence can be avoided however, if one acknowledges the existence of vague objects. If *a* and *b* are vague objects, then it may be indeterminate whether they are identical. And it seems to me that endurantists have no problems with explaining how it may be indeterminate whether certain objects are one and the same object without having to (determinately) acknowledge spatio-temporal coincidence.

Recall that endurantism holds that objects existing at different times can be identical, in a sense that object *a* at t_1 can be the same object as object *a* at t_2. *a* can either be a proper name or a definite description. If it is a definite description, then it conveys in its meaning the kind of the object it refers to. For instance, "The watch I sent for repair" refers to an object of the watch-kind and which is such that I sent it for repair. "Theseus's ship" is an object of the kind "ship" and which belongs to Theseus. And so on. In such cases the question "Is *a* at t_1 identical with *a* at t_2" (e.g. "Is the watch I sent for repair the same as the watch returned?"; "Is the original ship identical with the repaired one?", etc.) boils down to the question "Is there a single object such that it is an *A* and it exists at t_1 and at t_2?" (so, e.g. "Is there a single watch such that it exists at t1 and at t2?"; "Is there a single ship such that it exists both at t1 and t2?", etc.) In some cases the question will be "Is *a* of the kind *A* at t_1 identical to *b* of the kind *B* at t_2?". Then, what one asks is whether there exists a single object such that it is an *A* *and* it is a *B* and it exists at t_1 and at t_2. Compare for instance "The statue is the same as the vase". What this statement really means is "There is one object such that it is a statue and a vase". For this statement to be true there has to be some higher-order kind which comprises both the statue- and the vase-kinds.

The case in which "*a*" is a proper name is not really different. Recall that the statement "Mr Jones at t_1 is identical with Mr Jones at t_2" has been interpreted as "There is one object, Mr Jones, which exists at t_1 and at t_2".[63] This latter expression does not only say that there is one object that exists at t_1 and at t_2, but it also says that that object is Mr Jones. In the case involving the description "the watch sent for repair" it is clear that we first predicate of an object that it is a watch and then that it was sent for repair. Analogously in the Mr Jones case we claim that there is one object which is called "Mr Jones" and which exists at t_1 and at t_2. Now, what does the name "Mr Jones" add to the diachronic-identity statement? The simplest solution seems to be to accept that names such as "Mr Jones" have some descriptive meaning determining the kind of the object named.[64] A minimal requirement is that their meaning consists of some indefinite description. In the case of "Mr Jones" it is the

---

[63] Cf. Merricks (1994), p. 176.
[64] Cf. Geach (1973).

indefinite description "a person". Hence, saying that an object existing at t_1 and t_2 is Mr Jones amounts to ascribing it the property of being a person called Mr Jones. Moreover, it might be argued that in some cases proper names can be replaced with definite descriptions. As we have seen, in the alteration case the name "Brown" can be replaced with "the person who entered the alteration machine", and "Smith" can be replaced with "the person who emerged from the alteration machine".

Hence, all those puzzles concern in fact meanings of sortal terms. In order for the answer to the question "Is x at t_1 identical to y at t_2?" to be "Yes", there has to be a single object existing at t_1 and t_2 and such that it falls under some sortal "X". We associate with each sortal term some persistence conditions, but these conditions are not sufficiently determined.[65] They suffice in most typical cases, but in some circumstances it may become indeterminate whether they are satisfied or not. In such cases a at t_1 and a at t_2 will be temporally vague and it will be indeterminate whether the former is identical with the latter. It is not however as if the vagueness of a at t_1 and a at t_2 were merely a semantic vagueness - namely the vagueness of the persistence conditions associated with a given sortal term, and the objects themselves were precise. Ontic vagueness is inseparable from semantic, but - as I have already argued - this does not make it less "ontic". One can think, for instance, that the issue of whether Mr Jones is still a person is a semantic issue, but in some cases it will become doubtful whether Mr Jones still exists, and such a problem is clearly not a mere semantic problem any more.[66]

---

[65] In some cases there are various and mutually inconsistent persistence conditions associated with a given term. In such cases an additional indeterminacy may come into the picture - namely it may be indeterminate whether a at $t1$ is identical with a at $t2$, because it is undetermined which persistence conditions are relevant (compare the developed Theseus's ship puzzle).

[66] See chapter IV, section 4.1.

Admittedly, the "indeterminacy" answer does not fit all diachronic-identity cases equally well. The most resistant are fusion and fission cases. Recall Garrett's example in which two brain hemispheres are removed from the body of a dying person and placed each in its own body. The bodies are identical clones cloned from the body of the patient years ago. As a result, after the transplant there are two identical persons, Lefty and Righty, who not only have the same sort of body as the deceased, but also are completely psychologically continuous with him. Let us call the poor patient Brian. The common view is that Lefty and Righty are different persons, since they occupy different spatio-temporal locations. The question is of course whether either of them is identical with Brian. The "indeterminacy" answer will have it that there are two statements of indeterminate truth value - namely "There is a unique person, Lefty, who existed before the transplant" and "There is a unique person, Righty, who existed before the transplant". Since both these sentences are indeterminate, it will also be indeterminate how many people existed before the transplant. This, according to Garrett, violates common intuitions according to which before the fission there is determinately one person who occupies the pre-fission body.[67]

To this one could reply that such cases violate common intuitions anyway. The "indeterminate" reply does not claim that determinately there is more than one person before the fission, it says 'merely' that it is indeterminate whether there is one. So, it is less counter-intuitive than some other solutions.[68]

---

[67] Garrett (1998), p. 64.

[68] Garrett has also other arguments against indeterminacy in the fission cases. See (1998), pp. 64-67. Some of those arguments stem from his conviction that indeterminacy comes into the picture when "something is missing or diminished" (p. 64). Firstly, this conviction can be challenged; secondly it seems to *back up* the indeterminacy answer to the Brian/Lefty/Righty case, contrary to Garrett's intentions.

Coming back to the watch case, the overall situation is the following. The statement "The watch sent for repair is the same as the watch I got back", which should be read as "There is a single watch such that it was sent for repair and later returned to me", is indeterminate in truth value. Because the persistence conditions for watches are not precisely defined, it is indeterminate whether the change that occurred at the watch-maker's counts as a mere change or as an end of the old watch and a beginning of the new one. Therefore, the watch sent and the watch returned are temporally vague objects, whose temporal boundaries are fuzzy to a great extent. Because of that vagueness the question "Is there a single watch such that it was sent for repair and later returned?" has no determinate answer. This view does not determinately lead to spatio-temporal coincidence, because it is indeterminate how many objects - in our case: watches - there are. It is determinate that there is at least one watch and no more than two, but there is no fact of the matter as to whether they are one or two. So, the most one is entitled to claim is that it is indeterminate whether spatio-temporal coincidence occurs, or not.

3.4. Perdurance and Indeterminacy

As we have seen on the perdurantist account persistence is defined in terms of the I-relations, which are in turn defined in terms of the R-relations, which hold between temporal stages. A given object a persists at a time t iff there is a temporal stage at t which is R-related to a's stages at the earlier times. The question "Is a at t_1 the same as a at t_2?" is not a question whether a at t_1 is numerically identical with a at t_2. Every sentence of the form "a at t_1 is numerically identical with a at t_2" is false on this account, for a at t_1 can only be numerically identical with itself; i.e. with a at t_1. The identity-over-time questions should be read "Are two (different) objects, a at t_1 and a at t_2, R-related?"

The R-relation consists of three relations: spatio-temporal continuity, similarity and causality. It is not an equivalence relation, for transitivity may fail. Moreover, it is a relation which - like other similarity relations - admits of degree. Thus, there are different degrees of being an A: a can be an A to a lower degree than b.

Both the I-relation and the R-relation are reflexive and symmetric. They are not transitive, though. Their nontransitivity follows from the fact that one stage can be a stage of more than one particular. Continuants can partially overlap; they can merge and have identical parts. They can either stay merged or divide up again. In order to avoid overpopulation and multiple counting of what seems just a single stage, we have to count persisting particulars by a weaker relation than identity. Assume that continuants c_1 and c_2 are identical-at-a-time-t iff they both exist at t and their stages are identical. Tensed identity holds between continuants and is a derivative relation induced by numerical identity between stages. It is not identity, but it is an equivalence relation and involves partial indiscernibility. It is an indiscernibility relation for those properties of a continuant that are logically determined by the properties at its stage at *t*.[69]

The first problem the perdurantists have to deal with is that a series of small and otherwise acceptable changes can add up to a large and significant change, as in the case of systematic exchange of planks in Theseus's ship. Perdurantists explain this phenomenon as follows. Each of the adjacent ships is a temporal stage of a ship. All of them are R-interrelated: no matter which two stages one picks out they will be spatio-temporally continuous, similar and causally related. All of them are ships to the same - maximal - degree. But some of the stages are stages of two different ships: the original Theseus's ship and the repaired ship, call it "Ship S". So, our series starts with stages that are unique to Theseus's ship and ends up with stages that are unique to the Ship S. Some stages in the middle of the series are stages of both Theseus's ship and Ship S. What is puzzling in this situation is that for some stages it will be indeterminate whether they are part of the aggregate called "Theseus's ship", the aggregate called "Ship S", or both these aggregates.

The addition of one more ship to the puzzle - namely the ship reconstructed from the old planks - does not really complicate the perdurantists' explanation. In the developed puzzle of the ship of Theseus, in which we have to do with the original ship, the repaired ship consisting of new planks and the ship reconstructed from the old planks, the solution is as above, only one has first to decide which R-relations are

---

[69] Lewis (1976), p. 64. If we count by tensed identity, spatio-temporal coincidence ceases to be a problem. Any spatio-temporally coincident objects are one and the same object (counting by tensed identity).

relevant for the survival of ships. Thus, one first determines what kind of similarity (e.g. whether it is similarity in the age of planks, or merely similarity in the form of planks) and causal relatedness between adjacent stages is needed in order for a Theseus's ship to continue its existence and then checks whether the relevant relations hold, or not. It is clear that indeterminacy will appear in the picture just as it did in the simple Theseus's ship puzzle.

Fission and fusion are dealt with in a way analogous to that used in the Theseus's ship example. In the case of fission we have to do with two objects which are identical up-to-the-certain-moment and then divide; in the case of fusion two different objects merge at a certain time; they share some temporal stages.

The last problem is the problem of objects which have undergone some significant changes. Those changes are of such a kind that they tamper with just those features that are significant for the persistence of those objects. Recall that the standard examples are the Brown and Smith example, the example of the pile of rubbish I swerved to avoid yesterday and the pile of rubbish which is by the roadside today, etc. All those cases are so set up that neither of the definitive answers to the question whether a given object survived through the change seems plausible. For perdurantists this question reads "Is the temporal stage which is earlier than the stage at which the change has occurred R-related to some later stage?" And it seems that in some cases this maybe a genuinely unanswerable question.

For instance, in the brain surgery example it seems that Brown and Smith are neither determinately the same person nor determinately different persons. We cannot help ourselves to the solution that the R-relation between Brown-stage and Smith-stage holds to some lower degree, for the example does not justify the claim that either Brown or Smith are persons to a lower degree. On the contrary, it seems that they are both persons to the maximum degree. What is unclear is not the degree to which the R-relation holds, but rather whether it does hold or not. So, it is indeterminate whether the R-relation holds, and hence it is indeterminate whether Brown and Smith are stages of the same continuant person. The puzzle can be phrased in terms of aggregates of temporal stages as well. One can ask whether the maximally R- and I-related aggregate of stages including Brown-stages is the same aggregate as the maximally R- and I-related aggregate of stages which includes Smith-stages.

As we can see, the questions that perdurantists are facing are exactly parallel to those encountered by endurantists. Therefore one may ask what is the gain of accepting the whole new ontology of four-dimensional objects, for the original indeterminate identity statements concerning continuants can now be translated into statements about stages. Take the watch-puzzle. Now the puzzle can be stated in terms of watches and watch-stages: There is a four-dimensional watch of which the watch sent for repair is a stage such that it is indeterminate whether it is the same as a certain four-dimensional watch of which the watch returned is a stage.

Recall that both the I-relation and the R-relation are kind-relative. For instance, identity among continuant persons induces an I-relation that holds between the stages of a single continuant person. In general, the I-relation holds between stages of a single continuant object of a certain kind. And the R-relation holds between just the same stages. So, continuant objects of a certain kind are defined in terms of R-relations (and I-relations). The idea here is that temporal stages are precise, but continuant objects are imprecise, and it is the R- and the I-relations that introduce the indeterminacy.[70] Temporal stages are themselves precise, but at the same time they are stages of continuant objects, and those objects are objects of certain kinds. So, although a stage is precise, it may be indeterminate whether it is a stage of the given object of a certain kind. The indeterminacy lies not in the stage itself but in the continuant object; i.e. in the relations which define that object.

It should be noticed that on this account indeterminacy is *not ontic*: it is a purely *conceptual* matter. The puzzles are not puzzles about objects (e.g. ships), but puzzles about concepts. First of all, it is vague exactly which relations are the relevant R-relations for a given kind; secondly the relevant relations are semantically vague, hence it is indeterminate which objects are related by them. Just as it is unclear whether it is Sue or George who stands in the "is Harry's best friend" relation to Harry, here it may be semantically indeterminate which of the post-change stages is adequately related to the pre-change stage.

G. Forbes writes:

"The stage theorist is proposing a particular way of redescribing certain facts on which a precise description of the world can be given: we can say exactly what thing-stages have what properties. Since this is the level of description at which everything is precise, we have to take the ontology of this level as the basic ontology. The precise facts about the stages then give rise to relations of degree between stages (...), or relations on stages that admit of indeterminacy, in a wholly unmysterious way".[71]

However, it seems that the temporal stages level is not "the level of description at which everything is precise" after all. First of all, it depends on what sort of temporal stages we are talking about. If personal temporal stages are to be

---

[70] Of the counterpart relation Lewis writes that " it is subject to great deal of indeterminacy (1) as to which respects of similarity and difference are to count at all, (2) as to the relative weights of the respects that do count, (3) as to the minimum standard of similarity that is required. ...". (Lewis (1968), p. 42) It is obvious that all those remarks apply to the R-relation as well.

[71] Forbes (1987), p. 152.

'person-like' - as Lewis apparently wanted - i.e. stages which walk, talk and in general are very like persons except from the fact that they are short-lived, then of course they are just as imprecise as persons themselves are. But it is not at all clear that even instantaneous temporal stages are precise. Firstly, it is not clear what justifies the claim that "we can say exactly what thing-stages have what properties" There are some, probably quite a few, properties with which we have a problem when we try to ascribe them to continuant objects, but which posit no problem when we attempt to ascribe them to thing-stages. But there are properties with which we still have problems even at the level of temporal stages. If it is vague whether a ripening tomato is red, then it will be equally vague whether a temporal stage of a ripening tomato is red. So, we cannot say exactly what properties this stage has.

Secondly, it is true that the temporal boundaries (or rather the temporal locations) of temporal stages are precise. But their spatial boundaries need not be. That is to say they are no more precise that the spatial boundaries of continuant objects, and those are in many cases very fuzzy. It seems, for example, that the spatial boundaries of a momentary stage of Snowdon are not more precise that the boundaries of Snowdon itself. Similarly, if it is vague whether Nouvelle Provence is identical with New Devon, then it will be equally vague whether a temporal stage of Nouvelle Provence is identical with the relevant temporal stage of New Devon. This is why Sainsbury's claim that although the terms "the watch sent for repair" and "the watch returned" fail to individuate continuant objects, they succeed in individuating watch-stages, seems contentious. As we have seen, it is characteristic of the four-dimensionalist view that all four dimensions are on a par. The temporal dimension is considered exactly analogous to the three spatial dimensions. Hence, if one insists on the determination of origin (i.e. temporal boundaries) being a necessary condition of individuation, one should also insist that determination of spatial boundaries is equally essential. Then, as far as a watch is a compositionally vague object, a watch-stage cannot be individuated. In so far as the doubt about temporal boundaries prevents the individuation of a temporally extended watch, the doubt about spatial boundaries should prevent the individuation of a spatially extended watch-stage.

Recall that material objects - on the perdurantist account - are identified with spatio-temporal regions filled with matter. Such definition may give an impression that they must be spatio-temporally sharp. But they are not regions defined by spatio-temporal co-ordinates. They are regions filled with matter which constitutes a given continuant object at a certain time. Hence, they are regions whose boundaries are circumscribed by this matter. A spatio-temporal region filled with Snowdon-matter has its spatial boundaries just where Snowdon has its boundaries. And these are fuzzy. So, it seems to me that we do not gain much precision by switching to the ontology of temporal stages. It is true that temporal stages allow us to avoid vague diachronic-identity by placing all the vagueness outside ontology. It seems however, that one still faces vague synchronic-identity statements. Since the spatial boundaries of temporal stages may be fuzzy, the statement "Is temporal part t of an X identical to a temporal part t of a Y?", where t indicates precisely a temporal duration, may be indeterminate in truth value. Consider our example of Everest and Gaurisanker, which are allegedly indeterminately identical. It seems that the question "Is a temporal part t_1- t_2 of Everest identical to a temporal part t_1- t_2 of Gaurisanker?" does not have a determinate answer.

It may well be that if we go down to the level of spatio-temporal points, then we will have a precise ontology. Then the whole vagueness would be in relations: both temporal and spatial. But this is a different story.

4. CONCLUSION

In this chapter we have been concerned with indeterminacy involved in the questions concerning some puzzling cases of identity over time.

The first problem that one encounters when one begins ones study of the issues concerning diachronic identity is that the intuitive account of intrinsic change and survival through such change is inadequate. Two conceptions have been developed, endurantism and perdurantism, which - allegedly - are free from the inconsistencies of the intuitive view. Each of these views has its own way of dealing with the puzzles.

It seems sometimes that the best answer to diachronic-identity puzzles is that it is *indeterminate* whether the objects that the puzzles are about, are identical or not. Endurantists in order to accommodate indeterminacy within their framework may argue that the objects involved are temporally vague objects, whose temporal boundaries are indeterminate. In some cases it might be indeterminate whether one has to do with a unique object or with more objects that are spatio-temporally coincident. Admittedly, such a view has some counterintuitive consequences - for instance, we have to grant that indeterminate spatio-temporal continuity is coherent. The view is most counterintuitive in the cases of fusion and fission, for in those cases the temporal boundaries of objects involved are vague to a great extent indeed and as a result the number of objects that have undergone fission or fusion cannot be determined.

Perdurantists define persistence in terms of the relations holding between temporal stages. Since it is vague exactly which relations are relevant for the persistence of a given object and moreover the relations themselves are vague, some cases of persistence are indeterminate. It has to be admitted that the perdurantists' solution to the diachronic-identity puzzles is much more refined than endurantists'. However, the main problem for that view is that the ontology of temporal parts is far removed from our intuitive, prescientific beliefs about the world.

It should be noticed that it is not the case that according to perdurantism all vagueness is in relations and none in stages. First of all, it might be vague whether a given stage has a certain property. Moreover, although the temporal boundaries of stages are precise, their spatial boundaries may not be. In such a case a temporal stage will be a spatially vague object. Someone who claims that temporal vagueness prevents the individuation of temporally extended objects, should acknowledge that spatial vagueness prevents the individuation of spatially extended objects (e.g. temporal stages). However, as I have tried to argue spatially and/or temporally vague objects can be individuated - at least they can be individuated in a way that is sufficient for our everyday purposes.

The vagueness of the spatial boundaries of objects usually does not play any role in diachronic identity puzzles, but it results in *the problem of the many* - i.e. a problem that arises for spatially vague objects at any given time of their existence. The fact that perdurantists' temporal stages as well as temporally extended objects are spatially vague makes the problem of the many a disturbing matter for both endurantists and perdurantists. In the next chapter we will try to find a solution to that problem.

Chapter IV

VAGUENESS AND THE PROBLEM OF THE MANY

1. THE PROBLEM OF THE MANY AND THE PARADOX OF 1001 CATS

1.1. Examples

The problem of the many is due to P. Unger (1980) and runs as follows: Imagine a cloud.[1] The cloud consists of many water droplets. In the middle of the cloud the droplets are quite densely packed, but the further we are from the middle the more the density of the droplets decreases. The cloud has no sharp boundaries. The density decreases gradually - there is no precise point which would mark 'the end' of the cloud and 'the beginning' of the sky. At the cloud's outskirts there will be droplets which neither determinately belong to the cloud nor determinately belong to its environment. Thus, it seems that there are many different collections of water droplets which can be the cloud. Some of those collections will include most of the borderline droplets, some will include only few - and it seems that there is no reason to prefer, say, the former to the latter. In other words, there will be many collections with equal right to be counted as the cloud. Since we do not have any grounds for choosing one rather than another, instead of one cloud, we have many of them. Alternatively, we could deny that any of the collections is a cloud, but then we would have no cloud at all. Hence, we have arrived at a paradox: in the face of the existence

---

[1] Lewis (1993), p. 23.

of distinct equally good candidates for being the cloud, we seem to be compelled to conclude either that there are many clouds or that there are none; and both these conclusions apparently contradict the common view that there is just one cloud.

D. Lewis considers another version of the problem of the many. He quotes P. T. Geach's paradox of 1001 cats.[2] The paradox concerns Tibbles the cat sitting on the mat. Tibbles has 1000 hairs: h_1, h_2, ..., h_{1000}. Let c be Tibbles including all these hairs; c_1 be all of Tibbles except for h_1; c_2 be all of Tibbles except for h_2; and similarly for c_3, ..., c_{1000}. Now, if we plucked out the hair h_n, c_n would clearly be a cat. Since it seems absurd to claim that plucking out a hair generates a cat, we have to conclude that c_n has been a cat all along. Thus each of the cs is a cat and instead of one cat on the mat, we have 1001 cats there.

The above reasoning can also be applied, e.g., to human beings. Take my friend Peter. Since Peter consists of many parts - let us call them *simples*[3] - from the assumption that Peter exists and the intuitive assumption that some of those simples are negligible parts of Peter, it follows that in the place occupied by Peter, there is in fact a huge number of men. It would be absurd to claim that the loss of one single simple can transform a man into something that is not a man. If the collection X of simples is a man, the collection $X - y$, where y is a single negligible simple, must also be a man. And the same goes for enormously many simples. So, this argument could be seen as a *reductio*. From the assumption that Peter exists, one arrives at the absurd conclusion that an enormous number of men exists roughly in the same place.

[2] Geach (1980), p. 215.
[3] This is van Inwagen's terminology. They can be cells, atoms, particles, *etc.*

Therefore the assumption must be rejected. One is forced to accept that Peter does not exist.[4] But this is absurd as well!

Lewis notices that Geach's paradox of 1001 cats is not a problem for the temporal-parts supporter.[5] The proponent of temporal parts can maintain that plucking out h_n turns c_n from a mere proper part of Tibbles into the whole of a cat. c_n becomes Tibbles in the sense that the c_n's post-plucking temporal part is identical with Tibbles's post-plucking temporal part. However, one need not identify c_n with Tibbles: c_n and Tibbles will not become identical *simpliciter*, since their histories differ. c_n's pre-plucking parts are not identical to Tibbles's pre-plucking parts.

Lewis goes on next to modify the paradox so that it applies to four-dimensional things as well. We are to imagine that Tibbles is shedding. The hairs become gradually looser and there will be hairs which are neither determinately parts of Tibbles nor determinately not parts of it. Let us assume that it is hairs h_1, h_2, ..., h_{1000} which are such questionable parts. As above, let c include all these hairs; c_1 include all of the hairs except for h_1, c_2 include all of the hairs except for h_2 and similarly for other 998 cs. Now, all the cs (c as well as c_1, ..., c_{1000}) have an equal claim to be the cat. So, we face the same problem as we have encountered in the case of the cloud.

The puzzle of 'many Peters' can be analogously adjusted. For instance, on the tips of Peter's fingers and hairs there are molecules such that they are neither definitely parts of Peter nor definitely not parts of him. For each such molecule n we may

---

[4] Cf. Unger (1979), p. 243.
[5] Lewis (1993), pp. 24-25.

construct an entity m_n which contains all the molecules but n and seems a perfect candidate to be Peter.

1.2. The role of vagueness

Now, one might ask what is the role of vagueness in the above puzzles. It seems to me that these puzzles can be divided into two groups. Unger's and Lewis's paradoxes (i.e. Lewis's version of Geach's paradox) arise for all materially composite things and are paradoxes of fuzzy boundaries. These are 'proper' paradoxes of the many. It is because clouds, cats and other materially composite objects do not have sharp, precise boundaries, that the problem arises. If every water droplet determinately belonged or did not belong to the cloud, there would be just one collection of droplets which would be the candidate for being the cloud. If cat's hairs came popping off, we would not have many candidates with the claim to be the cat. However, since there are droplets about which it is indeterminate whether or not they are parts of the cloud, and hairs about which it is indeterminate whether or not they are still attached to the cat, neither the cloud nor the cat are compositionally precise. Hence, vagueness is actually the source of the problem of the many. Were it not for indeterminacy, the problem of the many would not arise at all.

On the other hand, the original paradox of 1001 cats and the analogous puzzle of 'many Peters' illustrate a different problem.[6] That problem also arises for all materially composite things, but it has nothing to do with vagueness. We have

---

[6] That the problem is different is evident also from the fact mentioned above that while the problem of the many is a paradox for both perdurantists and endurantists, the paradox of 1001 cats puzzles only endurantists.

assumed in the paradox that Tibbles is the cat which determinately has all the 1000 hairs. Also for any of the *c*s we can precisely determine which hairs are their parts. So, in this example there is no indeterminacy involved.[7] We have lots of different cats extensively overlapping each other, but all of them are perfectly precise. The paradox of 1001 cats as formulated by Geach does not concern vagueness. The same goes for the problem of 'many Peters'. We tacitly assume that Peter is precise and consists of a precise number of simples. In these cases the problem arises when we consider 'very big' proper parts of composite objects. It is clear that if such parts became improper parts, we would count them as objects in their own right. Therefore, it appears that such a 'very big' proper part of a composite object O already deserves to be counted as O, and that fact alone generates the problem.[8]

Thus, there are - or so I would argue - two distinct problems of the many: one essentially connected with some kind of vagueness and another - independent of vagueness. If all composite objects had precise boundaries, the former problem would not arise, but the latter would still need a solution. On the other hand, if we had an

---

[7] Of course, we could construct Unger-type problem for any of the allegedly precise cats (there will be molecules (e.g. at the tips of the hairs) which are neither determinately parts of the cat nor parts of its environment. This is not the paradox Geach is concerned with, however.

[8] In this respect the paradox of 1001 cats is similar to **the problem of mereological change**. Here the problem is that each sufficiently big proper part of the cat seems good enough to be a cat. The problem about mereological change consist in the fact that from the assumption that the cat can survive the loss of e.g. one hair, it seems to follow that the cat is identical to the whole consisting of the cat minus that hair. The problem can be presented as follows:

(1) Tibbles is not identical with (e.g.) c_1. (contrapositive of Leibniz's Law)
(2) Tibbles is identical with Tibbles-minus-h_1. (survival ass.)
(3) Tibbles-minus-h_1 is identical with c_1. (complete coincidence)
(4) Tibbles is identical with c_1. (2, 3, transitivity of identity)
(4) directly contradicts (1).

This paradox is a problem merely for endurantists. Perdurantists simply deny (2). Endurantists usually solve the problem by denying (3) and claiming that constitution is not identity. (See Loux (1998), pp. 226-231 for a summary of the endurantists' positions and references). It seems to me that there is also another way to avoid the contradiction. One may use T. Merrick's way of reading identity-over-time sentences (see chapter III, section 2.2.) and argue that (2) really says that there is one cat whose name is Tibbles and she exists both at the time before she loses her hair and after that time. Since in that sentence identity does not appear one cannot use it to derive a contradiction.

argument which would entitle us not to treat proper parts of objects as objects of the same kind, the latter problem would not be a problem anymore. But the former problem would still remain a puzzle, unless all the objects had sharp boundaries.

Let us then keep the name "the problem of the many" for Unger- and Lewis-type of problems, while calling Geach's paradox by its original name "the paradox of 1001 cats". The problem of the many arises because of vagueness, whereas the paradox of 1001 cats demonstrates that even if materially composite objects were precise, some of us - namely those who do not believe in temporal parts - would still face a problem.

M. Johnston does not agree with the above diagnosis of the problem of the many. He argues that vague boundaries are not essential to the generation of the problem. According to him there are two sources of the problem of the many - namely the following thesis:

> (9) If y is a paradigm F and x is an entity that differs from y in any respect relevant to being an F only very minutely then x is an F.

and the following 'fact':

> (10) In the closest vicinity of any paradigm middle sized material F there are usually very many entities that differ only very minutely from the paradigm in any respect.

According to Johnston, observation (10) is a consequence of material atomism. Principle (9) gains its plausibility thanks to another principle, namely:

> (8) If y is a paradigm F and x is intrinsically exactly like y then x is an F.[9]

[9] Certain constraints on (9) and (10) are needed. For instance, the requirement that x be of an appropriate causal origin. Cf. Johnston (1992), p. 98 and Noonan (1993a), p. 136.

Johnston argues that if we agree that intrinsic sameness with a paradigm *F* is a sufficient condition of being an *F*, then (9) should also be true, for it seems that minute differences cannot make for the difference between a paradigm *F* and something that is not *F*. He claims that at least in the cases in which *F* is a sortal taught by ostension, (9) has a strong theoretical support. And it is (9), in connection with (10) which gives rise to the problem of the many.

Johnston claims that the problem of the many arises also for precise objects. The cloud is vague but it may be precisified. Take one of its admissible sharpenings. On such a sharpening the cloud is perfectly precise. However, on that sharpening, apart form the precise cluster k_0 constituting the cloud, there will also be lots of precise clusters k_1, k_2, ...k_n, each differing slightly from each other and from k_0. So, (10) is true on each sharpening. Hence, assuming (9), the problem of the many arises for the precise clouds as well.

However, it seems to me that vagueness does play an important role in the generation of the problem of the many. If we find (10) and (9) at all convincing, it is because of the vagueness of *F*. Were *F* completely precise, we would not be tempted to accept either of (10) and (9). The problem of the many gains its plausibility thanks to the fact that middle sized material objects have fuzzy boundaries. If we knew the exact boundaries of the cloud, we would not be convinced by an argument referring to the existence of many objects partly overlapping that cloud. We would know which droplets constitute the cloud and we would also know that there are some droplets that are in the closest vicinity of that cloud. Of course, we could construct different droplet-clusters partly overlapping the cloud in the same way as it is done in the problem of the many. However, we would all know that those clusters are not clouds, for one of the properties of the cloud of which we know that it exists in that place, is that it has specific spatial boundaries. The boundaries of the clusters may differ very minutely from the cloud-boundaries, but a very minute difference is still a difference. Roughly speaking, if all of us agreed that exactly such-and-such droplets constitute the cloud, the problem of the many would have no appeal for us.

Besides, it should be noticed that the status of (9) is highly dubious. Johnston claims that it is the problem of the many which forces us to reject this principle. However, there is also another strong reason to deny it: (9) is subject to the sorites paradox. By means of it we could prove that an object which is not *F*, is *F* after all, because between it and an *F* there is a series of objects each differing minutely from its neighbours. In other words, since the small insignificant differences add up to big significant ones,[10] (9) has to be false. It is the phenomenon of vagueness which gives us a *prima facie* reason not to accept this principle.

So, the upshot is this. Johnston argues that vagueness is not essential for the generation of the problem of the many, which, according to him, is caused by two principles, (9) and (10). As we will see below, his solution to the problem consists in denying the offending principle (9) (and also principle (8)). However, (9) is not plausible independently of the problem of the many. It should be rejected right at the start, because it can lead to sorites paradoxes. A better way of diagnosing the source of the problem is to claim that it arises because of the fuzziness of the spatial boundaries of everyday familiar objects. The vagueness of the boundaries gives rise to the problem, even if one rejects principle (9). Something like principle (9) is needed only if one assumes that there exist paradigm objects, i.e. that among the many *F*s

---

[10] Johnston tells us to "imagine that the minute differences do not add up to a perceptible difference" ((1992), p. 99), but this is clearly a counterfactual imagination.

overlapping each other there is such which is a paradigm *F*.[11] If this is so, then one needs both (9) and (10) to arrive at the problem: We have a paradigm *F*. According to (10) it is surrounded by entities differing very minutely from it. According to (9) these entities count as *F*s. Hence, there are many *F*s instead of one paradigm *F*. We get the same result, however, if we deny the existence of the paradigm *F*s. Anyone who acknowledges that objects do not have sharp boundaries, faces the problem of the many. One could even argue that the reason why the problem arises is that we thought that there was a paradigm *F* in front of us, whereas in fact there are many - practically indistinguishable - *F*s at this place, none of which is a paradigm *F*.[12]

It is worth noticing that if we understand "in the closest vicinity" as "extensively overlapping" and read (10) as:

---

[11] This assumption presupposes of course that objects have sharp boundaries. Johnston ignores vagueness when he discusses the principles (8), (9) and (10). He pretends that objects are precise, generates the problem of the many, and than argues that "this pretence was harmless", because the problem also arises for fuzzy objects: it can be reconstructed on each admissible interpretation. Johnston justifies his claim that the problem of the many arises in connection with vague objects by saying that the problem arises on each of the sharpenings. It is a rather strange procedure. The methodology here is: check which properties an object has in sharpenings first, and then you will be able to tell what properties it has definitely. However, while this is really so for many properties of the objects in sharpenings, it is not true for all such properties. So, for instance although red is sharp in each sharpening, it is not sharp definitely. Sharpening 'red' in order to check whether it is sharp or not is absurd. Analogously here. One precisifies a cloud, notices that in the presence of such a precise cloud a certain phenomenon occurs, and concludes that it must occur for an unprecisified cloud as well.
Besides, the principles (9) and (10) have been formulated with precise objects in mind. They do apply to precisified objects in sharpenings, but it is not clear how they should be reformulated to apply to vague objects. In the light of Johnston's argument, unless one can formulate such principles for fuzzy objects, the problem of the many does not arise for them.

[12] It is not clear what function the word "paradigm" plays in Johnston argument. In order to save (9) from the sorites, one might assume that paradigm *F*s are not the only *F*s, i.e. that not every *F* is a paradigm *F*. Such a reading does not seem plausible for (8), however. Moreover, if being an *F* need not be tantamount to being a paradigm *F*, then the problem of the many should not arise. Each paradigm *F* would be surrounded by very many *F*s, but the paradigm would be just one (even if it were indistinguishable from *F*s). If, on the other hand paradigm *F*s are the only *F*s, then (8) becomes trivial, while (9) is even less plausible.

(10') There are usually very many entities which extensively overlap any paradigm middle sized material object P and differ only very minutely from that paradigm in any respect,

(9) and (10') can be regarded as the source of the paradox of 1001 cats.

The claim that the problem of the many and the paradox of 1001 cats have different sources becomes more plausible if one realises that they have different solutions. As I have already mentioned solutions that solve the problem of the many do not solve the paradox of 1001 cats, and *vice versa*. Let us deal with the paradox of 1001 cats first.

1.3. Solutions to the paradox of 1001 cats

Geach's original solution to that paradox is the following. The many are cats, but they are all just one cat. Each of the *c*s is a lump of feline tissue and a different lump at that. However, although each of the *c*s is also a cat, they are not different cats - all of them are one and the same cat. The relation "is the same cat as" is a relative identity relation; it expresses "only a certain equivalence relation, not an absolute identity restricted to cats"[13]. In other words, "is the same cat as" is a partial indiscernibility relation restricted to properties somehow associated with the term "cat".[14] "Is the same lump of feline tissue" is a different partial indiscernibility relation. Therefore, two *c*s can be the same cat without thereby being the same lump of feline tissue. In general, when we count, we do not count by absolute identity; we count by relative identity. Thus, although there are many lumps (counted by the "is the same

[13] Geach (1980), p. 216.
[14] Lewis (1993), p. 175.

lump of feline tissue as" relation), there is only one cat (counted by the "is the same cat as" relation).

Whether or not one accepts Geach's proposal as a solution to the paradox of 1001 cats, depends on whether one takes the relative identity view to be plausible - whether one is prepared to accept the fact that two things may be one and the same cat, while at the same time being different lumps of feline tissue. Geach argues that all the *c*s stand in the "is the same cat as" relation to each other. This does not make them identical however, because "is the same cat as" expresses only a certain equivalence relation, and not the absolute identity of cats. Therefore the *c*s while being the same cat, may be different things of some other kind (in this case different lumps of feline tissue). Thus, all the *c*s are cats, and moreover they are one and the same cat; and all the *c*s are lumps of feline tissue and each is a different lump from any other. Therefore, this solution can work only as a part of a much broader view which denies that there is such thing as absolute identity. Anyone who believes in absolute identity and takes the relation "is the same cat as" as an absolute identity relation restricted to cats, will not accept the 'relative identity' solution.[15]

It seems to me that the following view can also be seen as a solution to the paradox of 1001 cats, but clearly is not a solution to the problem of the many. In connection with the principle:

(8) If y is a paradigm F and x is intrinsically exactly like y then x is an F,

Johnston and Noonan mention the 'maximality' requirement. They claim that if this principle is to be defensible at all, further restrictions are needed: e.g. the restriction of having a certain type of causal origins and the requirement of

[15] For a criticism of Geach's solution see e.g. Lowe (1982a; 1982b).

maximality.[16] The latter principle says that nothing that is a proper part of an *F* can count as another *F*. Johnston writes further: "The status of such a principle and the required qualifications for such a principle are delicate matters. Two tables can make up a third table, and the Pope's crown consists of three crowns".[17] It seems to me that we may attempt to improve that principle and use it as a solution to the paradox of 1001 cats.

The improved version of the principle would read:

(R) Nothing that is a part of an *F* can count as another *F* unless the original *F* divides into *F*s without any remainder.

This version takes care of the above alleged counterexamples: a crown which is a proper part of the Pope's crown can be a crown, because the Pope's crown divides into three crowns without any remainder. The same goes for the example of the table.[18]

In order to solve the paradox of 1001 cats one has to assume that the object is always the maximal collection of relevant parts. The cat is the lump which contains all the hairs h_1, h_2, ..., h_{1000}. The cloud is the biggest collection of water droplets, *etc.* In accordance with the principle of maximality, nothing which is a part of the largest cloud is itself a cloud and nothing which is a proper part of the biggest cat is a cat. Hence, the solution is as follows: although there are many lumps of feline tissue, there is the biggest admissible one and this is the cat. Other lumps are disqualified, since

---

[16] See Johnston (1992), p. 98 and Noonan (1993a), p. 136.
[17] Johnston (1992), p. 98.
[18] Admittedly, in some cases (R) would have rather implausible consequences. For instance, if one has a car with extra bumpers, the part consisting of the whole car without bumpers would not count as a car. One would have to remove the bumpers in order to count the rest as a car.

they are contained in the biggest one and hence do not count as cats. And the same goes for clouds.

Admittedly, this is an arbitrary solution. However, the charge of arbitrariness is lessened, once we realise that we use the principle of maximality all the time in our everyday life. We take a chair to be the biggest chunk of wood which serves a certain function, has a certain shape, etc. We do not count as chair any proper part of that chair independently of how big it is (as long as it constitutes the proper part of that chair).

Of course, this proposal is not a solution to the problem of the many. Since objects have fuzzy boundaries, in most cases it will be indeterminate which is the maximal collection. For instance, it may be indeterminate which lump of feline tissue is the biggest one: a person A may claim that it is the lump x, while a person B may claim that the biggest is y, since x contains already some hairs (molecules) which do not belong to the lump. And there may be no way to decide between them.

2. THE PROBLEM OF THE MANY

2.1. Solutions

I hope that in the light of the above considerations it has become clear that vagueness is an essential factor in the generation of the problem of the many. Therefore, every solution to that problem is required to provide some treatment of the phenomenon of vagueness. First of all, the solution should locate the vagueness itself, i.e. should determine what is vague in our paradoxical situation - where the vagueness comes from. It should determine e.g. whether it is (i) material objects, such as the cloud and the cat; (ii) predicates, such as "is a cloud", "is a cat"; or (iii) subject terms, such as "the cloud" and "the cat", which are vague.

Second, having pinpointed the vagueness, a solution ought to instruct us how to deal with it. It should tell us either how we can remove the vagueness and so get rid of the problem, or else how we can avoid the problem, despite the vagueness involved.

In this section I will present the solutions to the problem of the many which Lewis collects in (1993) and summarise briefly some of the problems which - according to him - they face. Next, I will try to assess whether the solutions described by Lewis really are as bad - or as good - as Lewis pictures them. I will focus especially on how vagueness is dealt with in these solutions. In the next section I will present a version of one of the solutions considered by Lewis, which seems to me the most promising.

If we agree that it is vagueness that generates the problem of the many, we may argue that the problem arises because of the following assumptions:

(a) For many composite objects X there are objects y_0, ..., y_n such that it is indeterminate whether they are part of X or not.[19]

(b) For each such object y_i there is an object Z_i which consists of y_i and all the unquestionable parts of X.

(c) Z_i are so similar to X, that they should count as X (i.e. there is no obvious reason not to count them as X).

[19] This statement does not settle the matter of the source of vagueness in the problem: it can be e.g. the object X, the name "X", or the relation "is a part of" which might be vague.

Anyone who takes all the assumptions (a), (b) and (c) to be true, faces the problem of the many. It appears that in many situations of which we would ordinarily think that there is just one *X*, there are in fact many *X*s. In order to solve the problem we have to reject at least one of the above assumption.

Lewis lists the following **solutions** to the problem of the many.

(1) The first type of solution: none of the many are cats (i.e. none of the *Z*s is an *X*)

(i) **The 'constituters' solution**:[20] The many are cat-constituters, but none of them is a cat. Cats are constituted by parcels of matter but are by no means identical to them. The proponents of this solution have to introduce a distinction between parcels of matter and things, and support the claim that constitution is not identity. The matter constitutes the thing, but is not identical with it. Although x is entirely (perhaps for its entire history) constituted by y, x is not identical to y.

As far as the paradox of 1001 cats is concerned, the solution says that Tibbles is constituted by c, and she would be constituted by c_n if h_n were plucked out. In order to solve the problem of the many the extra claim is needed to the effect that it is indeterminate which of the cat-constituters actually constitutes Tibbles.[21]

(ii) **The 'vagueness-in-the-world' solution**:[22] The many are cat-precisifications, but none of them is a cat. The many are not cats, for they are all precise, while cats are vague. This solution places vagueness in the world and assumes that there are vague objects such as cats, in addition to the precise ones, such

---

[20] This solution has been proposed e.g. by Lowe (1982a; 1995) and Johnston (1992).

[21] At this point the 'constituters' solution uses supervaluationist method to prove that there is only one cat. Thus, its plausibility depends on the plausibility of supervaluationist treatment of vague terms.

[22] Compare e.g. Sainsbury (1989). Parsons and Woodruff's solution differs in that they argue that it is indeterminate whether cat-precisifications are cats. See section 3.2.1.

as cat-precisifications. The precisifications are not identical with the cat, nor do they constitute it. They are a separate kind of objects existing alongside vague objects.

(2) The second type of solution: one of the many is the cat (i.e. one of the *Z*s is the *X*)

(iii) **The supervaluationist solution**:[23] The many are cat-precisifications, and one of them is the cat. Words such as "cat", "cloud", "Tibbles" are vague and do not denote anything determinately. They refer determinately neither to precisely delimited objects nor to imprecisely delimited ones. Instead, they refer indeterminately to one of the cat-precisifications. Although there is no unique correct interpretation of the word "cat", there are many admissible interpretations, each one picking out one of the cat-precisifications to be the referent of "the cat". Hence, on each admissible interpretation just one of the many is the cat. This is essentially a traditional supervaluationist solution to vagueness applied to subject terms instead of directly to predicates. It does not posit the existence of vague objects and locates vagueness exclusively in the language.

(3) The third type of solution: the many are cats but the cats are not many (i.e. the *Z*s are the *X*s, but the *X*s are not many)

(iv) **The 'relative-identity' solution**: This is Geach's solution, which has been described in the preceding section.

(v) **The 'almost-identity' solution**: The many are cats, but cats are almost one. No two cats are completely identical, but any two are *almost* completely identical. The statement "There is one cat on the mat" is almost true; the idea is that it is true enough:

---

[23] Cf. *Introduction*. Supervaluationism has been applied to subject terms by e.g. Sainsbury (1980) and Noonan (1982).

"The cats are many, but almost one. By a blameless approximation, we may say simply that there is one cat on the mat. Is that true? - Sometimes we'll insist on stricter standards, sometimes we'll be ambivalent, but for most contexts it's true enough."[24]

On this view we are to think of absolute identity as a complete overlap relation; its opposite is not qualitative distinctness, but disjointness (i.e. complete non-overlap).[25] Almost-identity in turn is a relation of almost-complete overlap. It is not even an equivalence relation, because it is not transitive. Moreover, it does not guarantee indiscernibility of its relata. Lewis claims that it is not even a partial indicernibility relation; almost-identical objects will probably be very similar, but need not be indiscernible in any respect. Thus, objects may be partly identical without being partly indiscernible.

Since the cats overlap each other extensively, they are almost-identical and almost-identical objects are almost one object.

This is Lewis's favourite solution. He acknowledges however, that it does not work for all cases. Johnston[26] has offered the example of Michael's house, which has a garage attached to it. We can either treat his house as including the garage or as excluding the garage. However, the house which includes the garage does not overlap extensively with the house which excludes the garage. Therefore, they are not almost identical and the solution does not apply to that case. This is why Lewis favours two solutions at the same time: the 'almost-identity' solution and supervaluationism. Together they allegedly take care of all cases.

It is worth noticing that all the solutions accept the existence of the many and their equal status. The first two solutions treat the many as cat-constituters and cat-

---

[24] So, the statement "There is one cat on the mat" has different truth-values in different contexts, and in some contexts it is gappy. In consequence counting is context-dependent.
[25] *NB* Clearly such notion of identity does not apply to partless or abstract objects.
[26] Johnston (1992), p. 101.

precisifications respectively and deny them any right to be the cat. The 'relative-identity' solution admits that the many are all cats but claims that they should be counted as one. The 'almost-identity' solution also argues that the many are cats, but urges that they are almost one cat. The supervaluationist solution seems a bit different, for it claims that only one of the many is a cat, so it may appear that it ascribes a special status to one of the many. It should be noticed, however, that there is no single cat-precisification which is so favoured. The one which is the cat is different in every precisification. So, although on each precisification there is one cat-precisification which is distinguished, each cat-precisification is distinguished on some interpretation. Hence, it seems that it may be claimed that all of the many have the same status. Thus, each solution accepts the fact that there are many candidates to be the cat and tries to justify the claim that there is only one cat nevertheless.

2.2. Problems about the solutions

At first sight it may seem that there is a fourth type of solution possible - namely one which claims that the many are cats and the cats are many. However, this is not a solution at all, this is just a re-statement of the problem itself. And it seems to me that **the 'almost-identity' solution** - one of Lewis's favourites - comes dangerously close to being just such a 'solution'. It admits that the cats are many *and* that the many are cats. It merely adds that since the cats overlap each other we can count them as one. What is worrying about this solution is the fact that if we count 'normally', i.e. by strict identity, we obtain the result that many cats occupy roughly the same place. It is not very helpful to say: it does not really matter that they are many; they overlap extensively, so they are almost one. First of all, one usually thinks that cats do not overlap one other. Secondly, it is obvious that since the cats are *almost* one, they are *not* (exactly) *one* (they overlap extensively but not completely). We can pretend that they are one, if it is convenient for us, but we should not be blind to the fact that in fact they are not. This solution amounts to accepting the problem, while saying that there is nothing paradoxical about it, because there is a sense in which our common intuition that there is just one cat on the mat can be saved. However, it is saved at a very high price: one is to accept that in fact on the mat there are lots of genuine cats overlapping each other. And this is not at all intuitive.

Noonan in his 1993 paper offers a similar solution, which is, however, even less plausible. I mention it here because Lewis's solution seems to be an improvement on Noonan's. Noonan offers the following sufficient condition for identity for clouds:

(11) For any x and y, if x is a cloud and y is a cloud and x is highly coincident with y then x is identical with y.

It seems to me though that this principle cannot be accepted. To say that two clouds are highly coincident is another way of saying that they are not entirely coincident. So, what the principle (11) really tells us is that two not wholly coincident clouds are identical. I can see no reason why one should accept such a claim. First of all, it certainly should be argued for and not simply offered as a "plausible principle governing the concept of a cloud, and other concepts for which the problem of the many can arise".[27] Furthermore, if the precise clusters, x and y, are not wholly coincident, then it is in general possible to find a water droplet, z, which is a part of x,

[27] Noonan (1992), p. 139.

but is not a part of *y*. *x* will then have a property of having *z* as a part, whereas *y* will not have this property. Hence, (11) amounts to the denial of Leibniz's Law.

Lewis's solution, which talks about "almost identity" is much better in this respect. First of all, it says explicitly that it departs from the most common understanding of identity as absolute indiscernibility. (Strictly speaking, Lewis's solution does not deny that complete identity involves absolute indiscernibility, but does not treat the latter as the definitional feature of the former.) Moreover, it is more plausible, for it requires us to accept that highly coincident objects are *almost* identical, not identical *simpliciter*, which does not force us to deny Leibniz's Law. On the other hand, it should be noticed that since almost-identity is defined in terms of extensive overlap, it is bound to be a vague notion. Extensive overlap is a matter of degree and does not have a precise definition (e.g. is 85% overlap an extensive overlap, or not?). In consequence, there might be cats for which it will be vague whether they are almost identical or distinct; whether they are (almost) one or many.

The supervaluationist solution - the second of Lewis's favourites - is the most familiar. It is a modification of the well-known supervaluationist treatment of vague predicates (see *Introduction*). Supervaluationism as an analysis of the vague predicates remains still one of the best semantic theories of vagueness. There seems to be no reason why it should not be applied to vague subject terms as well. As is also well-known there are some serious objections against supervaluationism.[28] There is no room to go into details here, but it seems obvious that the supervaluationist account of vague predicates and the supervaluationist treatment of vague subject terms stand or fall together. One of the main problems of supervaluationism is its

---

[28] See for instance Williamson (1994), Ch. 5.

counterintuitiveness. In this case the counterintuitiveness consists in the fact that we are asked to acknowledge that although one and only one of the cat-precisifications is the cat (since on any admissible interpretation (sharpening) there is only one cat), there is no cat-precisification such that *it* is the cat (on each admissible interpretation a different cat-precisification is the cat).

Lewis himself clearly sees no insurmountable problems for supervaluationism, understood as a general theory of vagueness. Nevertheless, he couples it with another solution - he claims that supervaluationism on its own is insufficient as a solution to the problem of the many. His reasons are the following: Firstly, the supervaluationist solution sometimes works too well. Since on every interpretation there is only one cat, the problem of the many should not arise at all. Well, the problem does arise; moreover sometimes we may want to say that there are many cats: "for instance when we have been explicitly attending to the many candidates and noting that they are equally catlike... . [...] But even then, we still want some good sense in which there is just one cat (...). That is what almost-identity offers".[29]

Secondly, the application of supervaluationism to, for instance, unrelated homonyms, is unnatural. It is natural only if the alternative interpretations do not differ too much. Almost-identity may be a measure of whether the interpretations are similar enough in order to apply supervaluationism to them.

Neither of these reasons appears convincing to me and hence I cannot see why one should accept the almost-identity solution at all. It seems to me that the first reason is based entirely on common intuitions. To put it more precisely, what the first argument says boils down to the fact that the supervaluationist solution does not

[29] Lewis (1993), p. 35.

agree with common intuitions as is testified by the problem of the many and our will to say sometimes that there are many cats at the same place. However, both these facts can be explained within the supervaluationist framework. We do not have merely the 'one-interpretation' perspective (or rather 'from-within-one interpretation' perspective). We are fully aware that there are many admissible interpretations; in fact to assign the truth-values to statements such as "The cat on the mat has hair h_{17}" we have to assume the 'all-admissible-interpretations' perspective; i.e. we have to check how such statements behave in all admissible interpretations. We usually adopt the one-interpretation perspective, but it may happen that we adopt the all-admissible-interpretations perspective instead and this is when the problem of the many arises. From that latter perspective we see that there are in fact *many cat-precisifications* with an equal claim to be the cat, and this realisation should satisfy our temptation to say that there are many cats. Indeed, we are never allowed to assert that there *are many cats* on the mat, since such an assertion is false on every interpretation, but this is hardly a disadvantage.

The second reason is even less convincing. One way to defeat it would be to claim that the application of supervaluationism to ambiguous terms (i.e. Lewis's unrelated homonyms) is natural, but this probably is a hard way to go. However, there is an easier way. It is enough to point out that vagueness and ambiguity are two different phenomena and the correct analysis of one need not be a correct analysis of the other. In the case of vagueness we usually have some undefined number of very closely connected meanings.[30] Someone who utters a sentence with a vague expression in it need not be (and usually is not) decided which of those minutely

[30] Alternatively one might argue that vague terms have just one meaning, which is not precisely defined. If this is the case, then vague terms are essentially different from ambiguous terms.

differing meanings of the vague expression he intends his sentence to convey. Moreover there will be quite a few meanings for which his utterance comes out true. Whereas in the case of ambiguity we have a finite and usually very small number of unrelated meanings. A person who utters a sentence containing an ambiguous expression usually knows precisely which meaning he has in mind. Moreover, although it may happen that such an utterance is true for more than one meaning of the ambiguous expression, usually it is true just for one.

Besides, according to Lewis, the almost-identity view cannot do without supervaluationism. I have already mentioned one reason why the almost-identity view needs supervaluationism - namely the house/house+garage case. The second reason, which Lewis gives, is that it cannot help with such sentences as "The cat on the mat has the hair h_{17}". Intuitively such sentences are gappy, and the only way we can get the desired gappiness is to appeal to supervaluationism.

Hence, it seems to me that, if one is prepared to ignore the objections raised against supervaluationism in connection with vague predicates, then one may make do with supervaluationism as the only solution to the problem of the many. Supervaluationism can do without almost identity, but almost identity cannot do without supervaluationism.

The main problem with **the 'relative-identity' solution** is that the appeal to relative identity does not seem to help solve the problem of the many. This solution tells us that there are many ways of counting, not all of them necessarily involving identity. And it invites us to count by a weaker equivalence relation. So, the answer to the problem of the many is that although there are many cats counting by identity, there is only one cat counting by some other relation (namely by the relation of *being* *the same cat*).[31] The question "Are all the *c*s the same?" is now replaced with two distinct questions "Are all the *c*s the same cat?" and "Are all the *c*s the same lump?", but the answer to these latter questions is not easier than the answer to the former question. The proponent of this solution still owes us an explanation why the cats are one instead of many. Lewis writes: "Just as I was of two minds about 'same', so I am still of two minds about 'same cat' and 'same lump of feline tissue'".[32] The 'relative-identity' solution does not seem to work in vague cases.

On the other hand, one might argue that the relative-identity solution works just as well in the vague case as it works in the non-vague case. If one is convinced by Geach's arguments concerning relative identity, one can maintain that the problem of the many is solved: There are many *c*s, each of which is a different lump of feline tissue, but all of which are the same cat. Tibbles can be all the *c*s at once, provided that we count them by "is the same cat as" relation. If we count them by "is the same lump as" relation, than there are many *c*s, but neither of them *is* Tibbles. Thus, the questions asked by Lewis: "Are all the *c*s the same cat?" and "Are all the *c*s the same lump?" can easily be answered: the answer to the former is "Yes", the answer to the latter "No". Again, only someone who takes the relative identity view to be plausible, can accept that solution.

Lewis claims that Geach's arguments against absolute identity are not persuasive. He argues that we do have the concept of absolute identity and therefore "if we are to justify denying that the cats are many, we need to show that they are interrelated by a relation closely akin to identity itself".[33] It is rather striking that

---

[31] Geach would agree only with the second clause of this sentence, for according to him there is no absolute identity relation at all.
[32] Lewis (1993), p. 176
[33] Lewis (1993), pp. 32-33.

although Lewis thinks of his almost-identity relation as "a relation closely akin to identity", he does not consider Geach's partial indiscernibility relation to be such a relation. The partial indiscernibility in Geach's sense is at least an equivalence relation, whereas almost-identity is not transitive and is a matter of degree.

Let us now turn to the two solutions which say that **none of the many are cats**.

It seems to me that the 'constituters' solution and the 'vagueness-in-the-world' solution suffer from a common failure: they fail to tell us what the cat is and where it is. They both claim that none of the many are cats - i.e. whichever *c* we take it is not a cat. Hence, it seems that they owe us an explanation of what has happened to the cat. Is it still on the mat? If it is, then it seems to follow that on the mat there are not only 1001 cat-constituters - and cat-precisifications respectively - but the cat as well. And if the cat is none of the *c*s, then where is it?

Lewis argues that the problem about **the 'constituters' solution** is that it seems to replace the problem of the many cats with the problem of the many cat-constituters. Moreover, cat-constituters are very much like cats. Why then are they not cats? As Lewis puts it: "They are all too cat-like not to be cats".[34] So, we have Tibbles the constituted cat, and also 1001 cat-constituters.

The **'vagueness-in-the-world' solution** is - according to Lewis - better than the 'constituters' solution, because it cannot be charged with transforming the problem of the many cats into the problem of the many cat-precisifications. Vague objects have many precisifications and there is nothing problematic about this. However, the second objection raised against the 'constituters' solution can be repeated here. The

---

[34] Lewis (1993), p. 26.

cat-precisifications seem to be too cat-like in order not to be cats. Even if 'normal' cats are vague objects, vagueness is not their essential feature: it could happen that cats would be precise.[35] Therefore, it is at least possible that the cat-precisifications are genuine cats. Thus, we end up with a paradox of 1002 cats: one vague and 1001 precise ones.

2.2.1. Constitution is not identity[36]

The 'constituters' solution has been advanced by Lowe and Johnston. Lowe (1995) addresses directly the objections raised by Lewis. He replies that one need not say that Tibbles has many constituters. One can use the method of supervaluationism and argue that Tibbles has just one constituter, but there is no constituter of which it would be definitely true that it is the constituter of Tibbles. In other words, "the constituter of Tibbles" is a vague designator: the reference of that expression is different on different sharpenings. Moreover, Lowe argues that even if one insisted that there are many constituters, this would be an improvement on the claim that there are many cats. After all our intuitions about cloud-constituters are not as strong as our intuitions concerning clouds. Although we have a 'firm pre-theoretical intuition' that there is just one cat on the mat, we do not have such an intuition regarding cat-constituters.

---

[35] This could be questioned. Compare Lowe's reply to Lewis's argument below.

[36] The question of whether constitution is, or is not, identity lies at the heart of two more problems: the problem of mereological change and the problem of contingent identity. It is often argued that the only way the endurantists may solve those problems is to deny that constitution is identity. Cf. fn. 8. Perdurantists claim that identity is a limiting case of constitution understood as 'the overlap of the temporal parts of persisting quantities of matter and of persisting material objects' (Johnston (1992), p. 101, fn. 11). So for perdurantists constitution sometimes is identity. Therefore they cannot introduce any ontic distinction between objects and their matter (see ibid.)

Lowe also addresses Lewis's complaint that cat-constituters "are all too cat-like not to be cats". Lewis goes on to say that cat-constituters may have unfeline pasts and futures, but that does not show that they are never cats.[37] Lowe counters that "the concept of a cat is an essentially historical concept",[38] so something which is not a cat cannot become a cat for a while.

It should be noticed that both Lewis's remark and Lowe's reply refer to the paradox of 1001 cats, and not to Lewis's modified version of this paradox. In the problem of the many all the *c*s have an equal right to be the cat. Although one might argue that it is indeterminate which of them actually is the cat, there is no problem of one of them *becoming* the cat.

Another proponent of the constituters solution is Johnston. He considers the example of a cloud and argues that there are many cloud-constituters, but not many clouds. He treats all the water-droplet clusters k_0 , k_1, k_2, ...k_n not as clouds but as quantities of matter which may constitute clouds.

> "On ordinary ways of talking, when counting the number of clouds we do *not* contemplate a count of all the distinct, precise, cloud-shaped clusters of water droplets in the nearest vicinity of any cloud. These do not count as clouds."[39]

Therefore, Johnston claims that a categorial distinction between an object and the matter which constitutes it has to be introduced. The principle:

(9) If y is a paradigm F and x is an entity that differs from y in any respect relevant to being an F only very minutely then x is an F,

which according to him - as we have seen - is the source of the problem of the many should be replaced with:

---

[37] Lewis (1993), p. 26

[38] See Lowe (1995), p. 181.

[39] Johnston (1992), p. 100.

(9') If y is a paradigm F and x is an entity that differs from y in any respect relevant to being an F only very minutely *and x is of the right category, i.e. is not a mere quantity or piece of matter*, then x is an F.

None of the water-droplets clusters counts as a cloud because these clusters are mere quantities of matter and hence cannot *be* clouds.

In order to solve the problem of the many Johnston needs the relation of constitution which is vague as well as different from identity.

"Our cloud c is not only not identical with any one of k_0, k_1, k_2 but also it is not definitely constituted by any one of k_0, k_1, k_2 ... Rather, on one legitimate sharpening it is constituted by one of the ks, on another, another of the ks, and so on. [...] On no legitimate sharpening is c identical with any one of the ks. For if it were so [...] [w]e would be back with the problem of the many."[40]

The existence of the distinction of category between mere quantities of matter and objects constituted by this matter is by no means self-evident. Johnston acknowledges that there is "no credible metaphysical extra"[41] which would justify the distinction between an object and its constituting matter. He claims however, that we should not draw the conclusion that there is no justifiable distinction to be made at all. It is true that the distinction is not a metaphysically grounded one, but we can justify its existence by turning to our practice. The fact is that we do distinguish between an object F and its F-shaped constituting matter. We do not, for instance, count F-shaped constituting matter as an F. A practice-dependent justification consists in first asserting that we do observe the distinction in our practice, and then giving "an

---

[40] Johnston, ibid. *NB* The remark that we *do not count* F-shaped constituting matter as an F is reminiscent of the 'relative-identity' solution.
[41] Johnston (1992), p. 103.

internal and pragmatic justification of this in terms of how practice which marks this distinction serves our purposes".[42]

Johnston concludes that:

"[O]ur practice and the distinction it embodies is acceptable as it stands and what is bogus is the conception of justifying our practice which requires that, for the distinction to be justified, the difference between an *F* and its constituting matter must be a deep metaphysical difference secured by an extra ingredient of the *F*."[43]

Hence, the claim is that the cloud - cloud-constituter distinction is practice-dependent. The only justification of the existence of such a distinction is an appeal to our practice of distinguishing between an object *F* and its *F*-shaped constituting matter. Do we make such a distinction, however? It might seem plausible as regards all living creatures. We do not think that a donkey is just the donkey's body. A dead donkey is not so much of a donkey as an alive one. For something to count as a donkey it is important that it is alive, that it walks and runs, sometimes is hungry and thirsty, and so on. A donkey is constituted by its body, but is not identical to it. However, the consequence of this view seems to be that a dead donkey is not a donkey at all. It used to constitute a donkey, but never was (identical to) one.

Moreover, the distinction fades completely when we consider such things as clouds and lakes. It seems that a cloud not only consists of a cluster of water droplets, but just *is* such a cluster. There is nothing more to the cloud than the collection of water droplets. To repeat Lewis's point: the clusters of water droplets are too similar to clouds not to count as clouds. And, as I have said above, if the cloud is not any of the constituters, then it is utterly unclear what it is and where it is.

---

[42] Johnston (1992), p. 102.
[43] Johnston (1992), p. 103. This is Johnston's Minimalism.

Johnston claims that we do not count cloud-shaped constituting matter as clouds. This very claim enables him to solve the problem of the many. We can agree to that. Generally we do not count all clusters located roughly at one place as different clouds. However, we do not count them as cloud-constituters either. It is not our normal practice to realise that there are many extensively overlapping clusters at the same place, distinguish them from the cloud and claim that although the cloud is one, the clusters are many. It seems to me that commonly we do not realise at all that there are many objects at one place, no matter whether they are clouds or cloud-constituters. We do think that there is just one cloud present, but we also think that there is just one cluster of water-droplets. Presented with the problem of the many we are equally baffled by the apparent presence of many clouds as by the apparent presence of many cloud-constituters.

Thus, it is not at all apparent that such a practice-dependent distinction exists. Were it the case that the constituters solution to the problem of the many were the only available one, then perhaps we should acknowledge the distinction. But we have seen already that there are many solutions to this problem, and it is not even the case that this solution is the least problematic one.

For instance, Noonan claims that if we take the word "cloud" to be vague, then Johnston's solution does not work. According to supervaluationism - which for both Noonan and Johnston is the default theory of vagueness - if the word "cloud" is vague, then on each admissible sharpening it refers to slightly different clusters of water-droplets. In other words, on each sharpening of the word "cloud", a slightly different object is a cloud. If one accepts Johnston's contention that none of the clusters k_0, k_1, k_2, ... is of the right category to be a cloud, then the indeterminacy of the word "cloud" can only be explained by postulating in addition to k_0, k_1, k_2, ... another class of entities, c_0, c_1, c_2, ... which are of the right category to be a cloud, and which are such that each is a cloud on some admissible sharpening.[44] It is obvious, however, that if we admit those other entities c_0, c_1, c_2, ..., the problem of the many will re-emerge. In order to avoid the problem of the many, Johnston can reject the linguistic theory of vagueness and claim that it is the object cloud which is vague, so that the indeterminacy in the situation is due to the vagueness of the object c and not to that of the word "cloud". Noonan concludes that "Johnston's solution *can* work, but only if it is a part of a package deal, including an acceptance of an ontology of (compositionally) vague objects,"[45] which - in his opinion - is an unacceptably high price to pay.

It seems that Noonan is right in claiming that if Johnston's account is to work the word "cloud" cannot be vague in the standard sense. For a word "cloud" to be vague there would have to be various clouds present and it would have to be indeterminate to which of these clouds the word refers. It is essential for this solution however, that there are not many clouds. The cloud is one. Moreover, one cannot claim that the word "cloud" is vague because it refers to different cloud-constituters on different sharpenings, for "cloud" does not refer to cloud-constituters at all. If the word "cloud" referred to cloud-constituters, then cloud-constituters should be clouds (only *x*s can belong to the denotation of "*x*"). On the other hand, it is hard to imagine how "cloud" can refer to a cloud without referring to any of its constituters. But "cloud" can only refer to a cloud-constituter if the cloud-constituter is not only a

---

[44] Noonan (1993a), pp. 137-138.
[45] Noonan (1993a), p. 138.

cloud-constituter, but also a cloud. And this seems to be excluded by Johnston's distinction.

One might argue - as Noonan suggests - that since the cloud is constituted by different clusters on different sharpenings, it is the cloud itself, i.e. the object cloud, which is vague. And it seems that this is the picture that Johnston has in mind. When he considers the role played by vagueness in the problem of the many, he concentrates explicitly on sharpenings of the boundaries of the cloud. He takes the sharpenings to be ways of fixing on a sharply defined droplets-cluster to constitute the cloud. Such a view is tantamount to introducing vague objects into one's ontology. And while the existence of vague objects as such need not be worrying,[46] the existence of 1000 precise cloud-constituters and one vague cloud in the same place is a bit too much. Although on each sharpening the vague object is constituted by one precise cluster, it is never identical to that cluster. It is something 'more' than the constituter, but that 'more' is nothing metaphysical. Since there is no "metaphysical extra" to vague objects, it is not clear what would be the use of such objects. Thus, the ontology to which this view commits us is pretty abundant.[47]

Johnston himself claims that it is the relation of constitution which is vague. Recall that his picture of the situation is the following. On each sharpening there are many precise clusters k_0, k_1, k_2, ... On one admissible sharpening, the cloud is constituted by k_0, on another by k_1, and so on. Hence, his claim is that "our cloud c is not only not identical with any one of k_0, k_1, k_2 but also *it is not definitely*

---

[46] See chapter III.

[47] It is worth pointing out that this view has to assume that the vague object cloud is determinately denoted by the singular term "the cloud". Still, one does not have to hold that "the cloud" is precise, provided that the cloud is indeterminately identical to something. If this is the case, then it is indeterminate whether "the cloud" singles out the cloud uniquely, or not; i.e. it is imprecise in the non-standard sense (cf. chapter II and III).

constituted by any one of k_0, k_1, k_2 ...".[48] Now, is Johnston's argument that it is constitution which is vague in this situation a legitimate one?

It seems to me that it is not. Take the sentence "The cloud c is (constituted by) k_2". This sentence is indeterminate in truth-value, because on different sharpenings the cloud is constituted by different ks. The usual explanation would have it that the indeterminacy in question is due to the vagueness of the cloud. Since the cloud is not definitely constituted by any one of k_0, k_1, k_2 ..., it is definitely not constituted by any precise cluster and therefore has to be vague. In fact, the various sharpenings we are talking about, are sharpenings of the cloud. On Johnston's account, however, the sharpenings cannot be cloud-sharpenings unless a sharpening can change the ontic category of an object. As we have seen, a sharpening of a cloud results not in a sharp cloud, but in a sharp cloud-constituter. On different sharpenings the cloud is constituted by a different k, but on no sharpening is the cloud identical with a k. Therefore, it appears that a sharpening of a cloud changes its ontic category: one begins with a vague cloud, sharpens it and gets precise cloud-constituters - i.e. objects of a different category from the original vague object. This is a rather striking feature, but Johnston would probably have answered that this is just the lesson that the problem of the many teaches us.[49] To solve that problem, we cannot assume that on different sharpenings of a cloud we get different precise clouds.

Johnston claims, however, that the indeterminacy does not arise on account of the vagueness of the boundaries, but on account of the vagueness of constitution. He seems to think that even if the cloud were precise, it would not have a definite

---

[48] Johnston (1992), p. 100 (my emphasis).

[49] If by sharpening the cloud we obtain objects of a different category, then Johnston's procedure of examining the vague object by examining its sharpenings is even more suspect.

constituter. But, if it is the relation of constitution which is vague, then it should be possible to sharpen that relation, and the sharpenings we have been talking should be precisifications neither of the cloud, nor of the word "cloud", but of the relation "constitution". What does sharpening of a relation consist in, however? Take our relation of being the best friend of Harry, for instance. Recall that this relation is taken to be vague, for it may be indeterminate whether it is Sue or George who is the best friend of Harry, although there is no doubt as to the identity of Harry, Sue and George. The relation of friendship that Harry has to Sue is slightly different from the relation that Harry has to George and it is indeterminate which of these relations counts as 'better' friendship. According to how we precisify the relation of being the best friend, either Sue or George will appear to be the best friend of Harry. The situation of the cloud and the constituters is different, however. Here, the cloud stands in exactly the same relation to each of the constituters. Each constituter has the same right to constitute the cloud as any other. Therefore, the sharpenings do not sharpen the relation of constitution. It is not the case that if we sharpen that relation in one way it will pick out k_1 to constitute the cloud, and if we sharpen it differently it will favour k_3. Besides, we are not even told what the relation of constitution consists in. How could we sharpen it, then?

Hence, a better option is to reject the claim that constitution is vague and claim that the cloud is an object with fuzzy boundaries, which accounts for the indeterminacy of the sentence "The cloud c is (constituted by) k_2".

So, to sum up the issue of vagueness: There are three objects which could in principle be vague: the word "cloud", the object cloud, and the relation of constitution (recall that it has been explicitly assumed that the clusters are precise). Noonan shows that the constituters solution cannot accept the view that the word "cloud" is vague, because there are no candidates to (indeterminately) be clouds on this account. Johnston's chosen answer, that it is the relation of constitution which is vague, does not seems right: it is not the relation which we precisify when we pick out different clusters to constitute the cloud. The fact that there is no cluster that definitely constitutes the cloud does not in this case bear witness to the claim that constitution is vague. It is rather the object cloud which is fuzzy. The cloud is a vague object, which can be sharpened in different ways and therefore different precise clusters constitute it on different sharpenings.

3. THE "FOR WANT OF SOMETHING BETTER" SOLUTION

3.1. The upshot

Thus, the upshot of our considerations up to this point is this.

As I have mentioned, the problem of the many arises because of the assumptions:

(a) For many composite objects X there are objects y_0, ..., y_n such that it is indeterminate whether they are part of X or not.

(b) For each such object y_i there is an object Z_i which consists of y_i and all the unquestionable parts of X.

(c) Z_i are so similar to X, that they should count as X.

All but one solution to the problem assume that what we ordinarily think is right, i.e. X is just one. Since there seems to be nothing wrong in the construction of the *Z*s, in order to solve the problem one has to provide reasons why the *Z*s do not count as the *X*s. In other words one has to explain why assumption (c) is false.

The 'constituters' solution argues that the *Z*s (the water-droplet clusters) do not count, because they are mere constituters of the *X* (the cloud). The weakest point of this solution is that it relies on a distinction whose existence is highly dubious. And even if the distinction does exist, the solution transforms the problem of the many clouds into a problem of one cloud and many cloud-constituters. Besides, since the cloud is not identical to any of the cloud-constituters, it is unclear what and where the cloud is on this account. Moreover, although the solution acknowledges the existence of indeterminacy in the problem, it locates it in a wrong place. Nothing of what we have been told justifies the claim that constitution is a vague relation.

The supervaluationist solution claims that each of the *Z*s (the cat-precisifications) is the *X* (the cat) on one of the admissible sharpenings of the *X*. This solution to the problem of the many faces similar problems to those faced by the supervaluationist treatment of vague predicates. One of its main drawbacks is that it assumes that the cat is an absolutely precise object - i. e. there is only one precise object, among many others which differ only minutely, which is the cat. Still, as I have already mentioned, there is no precise object such that it is the cat. And this solution is committed to the existence of cat-precisifications: for on every sharpening it is true that there are many cat-precisifications. These precisifications cannot be mere constructions, for each of them is the cat on some sharpening. In fact there cannot be any metaphysical differences between the cat and its precisifications. So on this solution we still have quite a lot of objects to deal with.

The 'relative-identity' solution says that the *Z*s (the lumps of feline tissue) are different *Z*s (lumps) but the same *X* (the same cat). According to this view the cat can be different lumps of feline tissue at the same time. The problems with this solution are that (i) it says that if we count by "is the same cat as" - and not by "is the same lump of feline tissue as" - relation we will get the right result, but it does not explain why this is the case; and (ii) it is acceptable only for someone who is prepared to forget about absolute identity.

The 'almost-identity' solution is the only solution that throws some doubt upon the intuitive assumption that the *X* (the cloud) is one. It is committed to the existence of many clouds at the same place, and the only relief it offers is that we may count them as one since they are almost entirely overlapping. It is counterintuitive and does not really solve the problem. It tells us merely how we can try to live with it. Moreover, according to its own proponent it works only if paired with the supervaluationist solution. However, if we appeal to supervaluationism at all, we may as well let it do the whole job. This solution is a semantic-theorist solution, so vagueness is explicitly located in the language.

3.2. A new interpretation of the 'old' solution

Now, it might seem that **the 'vagueness-in-the-world' solution** is not essentially different from that version of the 'constituters' solution, which claims that the object cloud is vague. According to the version that I have favoured over Johnston's account, the *X* (the cloud) is a vague object and is distinct from any precise objects (the *Z*s, which are cloud-constituters). The 'vagueness-in-the-world' solution makes the very same assumptions. So, on top of 1001 cloud-precisifications there is one vague cloud.

This is not the only interpretation of that solution, however. In what follows I will try to make the case for the 'vagueness-in-the-world' solution and claim that there is a sense in which it may be considered a satisfactory solution to the problem of the many.

3.2.1. The p-cats' solution

Let us first have a look at a solution advanced by Parsons and Woodruff, which also appeals to the vagueness in the world. Parsons and Woodruff believe in vagueness in the world and argue that cats have imprecise boundaries. They ask us to

> "[s]uppose that given any reasonable way of making the cat's boundaries precise throughout its life it is indeterminate whether the cat has exactly those boundaries. But those boundaries are filled with matter. So suppose that each such continuous matter-filled boundary determines a physical object - one that has precisely those boundaries. Call such an object a p-cat."[50]

Now, the question arises whether the p-cats are identical to the cat, or not. At first glance, there are three possibilities: they are identical, they are non-identical, or else it is indeterminate whether they are identical. The first possibility is not an option, for if the p-cats were identical to the cat, the cat would have precise boundaries, which contradicts our assumption. The second possibility

> "leads to a kind of ontological explosion: in addition to there being a physical object corresponding to every filled region of space-time, there are additional physical objects,

---

[50] Parsons, Woodruff (1995), p. 332.

objects that are contained in the region exhausted by the others, yet distinct from all the others".[51]

Parsons and Woodruff admit that they cannot prove that such a view is incoherent, but invite us to consider the third possibility, which is much more economical. On this view the p-cats are indeterminately identical to the cat; in other words each of them is indeterminately a cat. The p-cats (definitely) are distinct from one another, because they (definitely) have different precise boundaries. But for each p-cat, it is indeterminate whether it is identical to the cat. This account, according to its proponents, allows us not to multiply entities beyond necessity. There are very many p-cats, but only one cat. Strictly speaking, there are very many indeterminate cats (i.e. objects x such that ∇(x is a cat)), but only one definite cat (i.e. x such that x is a cat and $\neg\nabla$(x is a cat)).[52]

It seems to me that Parsons and Woodruff decide the issue at the very outset when they say that "given any reasonable way of making the cat's boundaries precise ... it is indeterminate whether the cat has exactly those boundaries". If it is indeterminate whether the cat has certain precise boundaries, then it becomes plausible that the cat and the object with those boundaries are indeterminately identical. However, in such a case we cannot assert - as Parsons and Woodruff do - that the cat has imprecise boundaries. On the other hand, if we acknowledge that the cat's boundaries are imprecise, then "given any reasonable way of making the cat's boundaries precise" it is *determinate* that the cat *does not have* exactly those

[51] Parsons, Woodruff (1995), p. 333. It is just such an "ontological explosion" that I protested against in connection with the vagueness-in-the-world solution and the constituters solution.
[52] Parsons and Woodruff offer a modelling on which the above claims come true. See (1995). The modelling is meant to be classical and is formulated in neutral terms. For instance, on this modelling each object is a set of ontons, which are logical constituents of objects. It is clear however that, strictly speaking, a cat is not a *set* of ontons, but at most a *fuzzy set*.

boundaries. It appears that in order for Parsons and Woodruff's solution to work, one has to think of the cat not as a genuine vague object - i.e. object with no precise boundaries; but as an object such that it is indeterminate whether it has precise boundaries. If the cat is a genuine vague object, then the cat is (definitely) not identical to any of the precise p-cats.

3.2.2. 'Genuine' vague objects and precise precisifications

Let us come back now to the 'vagueness-in-the-world' solution. It may be argued that the world to which that solution commits us need not be as overpopulated as Lewis has claimed. One might maintain that the correct picture of the situation involving e.g. the cloud is this. Lots of water droplets are concentrated in one place. The boundaries of this aggregation are fuzzy, but they are precise enough for most of our purposes. (We learn to live with fuzziness of our everyday objects.) There is no non-arbitrary unique way of delimiting its surface. Various ways of precisifying it are equally admissible, however. Such precisifications are merely our constructions: each precisification is an arbitrary way of sharpening the naturally vague boundaries of the cloud. Hence, the precisifications do not count as objects in the same sense as the cloud does; i.e. they do not count as objects that belong to our everyday ontology. And there is no mystery in the fact that they are roughly in the same place. They are after all precisifications of the same matter.[53] So, the answer to the problem of the many is that there is just one cloud which is vague in a sense that it has fuzzy boundaries. The appearance of there being many clouds is a mere illusion caused by

[53] It is as if someone was puzzled by the fact that the mereological set of 100 peanuts, the set of 101 peanuts and the set of 102 peanuts are all situated roughly in the same place.

the fact that the cloud may be precisified (approximated) in various different ways. For any way of delimiting the surface of the cloud, the cloud does not have that surface. It is not identical to any object with a precise surface. This view does not lead to 'ontological explosion' because the 'proper' object is just one. The essential feature of our familiar objects such as clouds is the fuzziness of their boundaries. Only something with fuzzy boundaries can count as a cloud. The things with precise boundaries that can be constructed out of the cloud and its surroundings may at least be called "cloud-precisifications". One can think of them as mere carvings on the surface of the cloud. They have no ontological significance for us.

3.2.3. Van Inwagen's fuzzy living organisms

A solution slightly similar to the above has been offered by Peter van Inwagen in his book *Material Beings*. He tries to answer what he calls the special composition question, namely - When is it true that there is a y such that the xs compose y? The answer he gives and defends in chapters 1 -16 is the following:

$\exists y$ the xs compose y iff the activity of the xs constitutes a life.

It follows from this that the only composite objects are animate objects - living organisms. Familiar objects from our environment, such as tables, stones, clouds etc., are in fact collections of many small simple objects - *simples* in van Iwagen's terminology - that are arranged in particular ways. So, for instance, there are no tables, but only simples arranged tablewise and no clouds but only simples arranged cloudwise. His argument to the effect that living organisms are unlike tables and chairs in that they exist, rests on his conviction[54] that he exists. The problem of the many forces him to defend that conviction and to modify his answer to the special composition question.

Van Inwagen argues that behind the problem of the many applied to human beings there are the following three crucial assumptions:[55]

(1) If he (e.g. Peter van Inwagen) exists, there is a man.

(2) In every situation of which we would ordinarily say that there is just one man, there are many sets of simples which are equally good candidates to compose a man.

(3) The members of each of these sets compose something.

Anyone who wants to hold on to those three assumptions and does not believe in spatio-temporal coincidence must find a suitable selection principle - i.e. in this case a principle which would allow to claim that one (and only one) of the huge number of overlapping men is Peter van Inwagen. Either the others are men but are not van Inwagen or else they are not men, but merely men-candidates. Since the differences between the overlapping composite objects are negligible, the principle has to be "intolerably arbitrary"[56]. Van Inwagen avoids this problem by rejecting assumption (3). He claims that he exists, and that in the relevant situation there are many sets of simples whose members are suitably arranged to compose men, but he denies that the members of those sets compose anything. He denies that in such situations there are many things which are barely distinguishable and which are candidates to be himself. On the contrary, he argues that although he is present in such cases, none of the other

---

[54] For reasons for holding that conviction see van Inwagen (1990), Ch. 12.
[55] Cf. van Inwagen (1990), p. 216
[56] van Inwagen (1990), p. 216.

things present in those cases is even similar to him. In particular, according to him a collection consisting of simples that compose him minus one simple, does not compose anything at all.

As has been said the *x*s compose *y* iff the activity of the *x*s constitutes a life, and constituting a life is obviously a vague notion. Being caught up in the life of an organism is not a precise condition, and it may be indeterminate of some simples whether they satisfy that condition or not. Therefore, composition and parthood are also vague notions: for some simples it can be vague whether they are parts of a living organism; it can be vague whether they compose something. In particular, there are simples such that it is vague whether they compose van Inwagen; whether they are parts of him. Thus, he argues that no *set* is the set that contains just the simples that compose him. Sets have precise membership-conditions; each object must either be or not be a member of a given set. So the simples that compose him do not constitute a set. No matter which of the competing sets of simples we take, it will not be the set of simples that compose van Inwagen. Hence, although there are many distinct sets of simples, there is no problem of the many: none of the many sets is van Inwagen. What is van Inwagen, then? The simples that compose van Inwagen constitute a *fuzzy set*. Membership in a fuzzy set is a matter of degree. For each fuzzy set there are objects that definitely are members of that set, objects that definitely are not members of that set and objects that are neither definitely members nor definitely non-members of that set. These last objects are members of the fuzzy set only to a certain degree. It is usually assumed that there are as many degrees of membership as the real numbers from 0 to 1. Specifying a fuzzy set amounts to specifying for each object the degree to which it is a member of that set. Objects that are members to the degree 1 are definite members, objects that are members to the degree 0 are definite non-members, while objects that are members to the degree d, where $0<d<1$, are indefinite members of the fuzzy set in question. Now it can be explained what is meant by the phrase "I am composed by a fuzzy set of simples". In general:

The fuzzy set of simples whose members compose (or equivalently: are parts of) x $=_{df}$ The fuzzy set y of simples such that $\forall z$ a simple is a member of y to the degree z iff that simple is a part of x to the degree z.[57]

Van Inwagen assumes that each simple (at any given time) is a part of x to some specifiable degree d, where $0\leq d \leq 1$. It follows from this assumption and the above definition that (at any given time) the members of exactly one fuzzy set of simples will compose x, and in particular - van Inwagen. The degree of membership is the degree of parthood: the degree to which x is a member of F is the degree to which z is a part of y. Therefore the problem of the many disappears: there is only one fuzzy set whose members compose van Inwagen.

Thus, in the situation envisaged in the problem of the many there are many (classical) sets, none of which is a suitable candidate to be the one whose members compose van Inwagen, and one fuzzy set, whose members do compose him. The refined version of the answer to the special composition question looks like this:

$\exists y$ the members of the fuzzy set of simples x compose y iff the activity of the members of x constitutes a life.

Thus, the problem of the many is not a problem anymore. As van Inwagen himself notices, the solution hinges on the assumption that there is only one life present in the case in question. The crucial assumption for him is that every situation

---

[57] van Inwagen (1990), p. 223.

of which we should usually say that it contained just one man, contains just one life. He does not try to justify that claim: he takes it to be a common sense assumption and argues that we have no reason whatsoever to believe that "there are very many more human lives than the census-takers say there are human beings"[58].

So, to sum up: Since for van Inwagen the only complex objects are animate objects, the problem of the many constitutes a puzzle only in the case in which living organisms are involved. And he solves the puzzle by rejecting the very idea that motivates the problem: namely, the idea that in fact there are many complex objects - many distinct sets of simples, the differences between which are negligible - in the place we thought was just one object. The object is just one: the fuzzy set whose members are parts of the complex object in question. Such a set is fuzzy because parthood is a vague relation and is just one because in every such situation there is only one life present.

3.3. Conclusion

Thus, it appears that the problem of the many can be solved if one acknowledges that there is vagueness in the world and that it is an important feature of this world. Van Inwagen's solution concerns only animate objects, but it seems to me that it can be generalised to cover all macro-objects, for which the problem of the many arises. The solution I have proposed pertains to all objects, not only living organisms. Roughly speaking, it consists in the realisation that objects from our everyday experience are vague objects devoid of precise spatial boundaries. I have

---

58 van Inwagen (1990), p. 227.

said that the solutions are a bit similar, for while van Inwagen denies classical sets the right to count as objects, I deny precise objects the right to count as objects of our common everyday ontology.

One might think of objects from our daily experience as fuzzy sets, but it seems to me that it is better to regard them as *rough sets*.[59] For it might be objected that fuzzy sets are not vague enough. Since each object can be ascribed a specified degree to which it is a member of a given fuzzy set, one might argue that vagueness disappears. For instance, there will be a clear boundary between objects that are members to the degree 1 and objects that are members to the degree lesser than 1. If one assumes that composite objects are rough sets rather than fuzzy sets, then there is no danger that vagueness will go away. Such sets are determined by an indiscernibility relation and their boundaries cannot be precisely determined. The best one can do is to specify their upper and lower approximations, which determine the region within which the 'proper boundaries' are confined.[60]

The problem of the many arose because in every situation of which we would usually say that it contained just one complex object (the *X*), there seemed to be many equally good candidates (the *Z*s) for constituting that object. However, the common feature of all these 'candidates' is that they have precise boundaries; a definite spatial location, whereas the *X*'s boundaries are fuzzy. If one thinks that the *Z*s are sufficiently similar to the *X* to count as an *X*, one needs to find a distinguishing principle - something that would allow to select the 'genuine' *X* from the rest.

---

59 The theory of rough sets have been developed by Pawlak (1983). Orlowska (1983) has applied his theory to vague expressions.
60 See Orlowska (1983), p. 469. I deal with rough sets in the fourth chapter of Odrowąż-Sypniewska (2000).

However, someone who maintains that vagueness is a significant feature of 'genuine' objects can avoid that problem. The solution consists in the rejection of

(3) Z_i are so similar to X, that they should count as X.

The Zs are not sufficiently similar to the X to count as Xs. The difference consists just in the fact that the former are precise, while the latter is vague.

4. VAGUE EXISTENCE

4.1. Proxy borderline objects

Van Inwagen's answer to the special composition question commits him to the thesis that identity and existence are vague, which is tantamount to the claim that vagueness resides in the real world. Recall that composition, parthood, and being caught up in life are vague relations. In a case in which it is indeterminate whether the activity of certain simples constitutes a life, it is also indeterminate whether these simples compose anything. And if it is indeterminate whether the simples compose anything, it is indeterminate whether a composite object exists. Moreover, it can also be the case that it is indeterminate whether a life going on at t is the same event as was going on at an earlier time t_1. In such a case it will be indeterminate whether the composite object existing at t_1 is identical to the composite object existing at t. Van Inwagen is well aware of this. He argues in effect that no linguistic theory of vagueness is correct, for vagueness is not a mere linguistic phenomenon. It resides in the extralinguistic world as well. According to van Inwagen one has to resign oneself to the claim that vagueness is a phenomenon existing in the real world.

First of all, he claims that anyone who believes in the existence of heaps, chairs and clouds has no choice but to accept that existence and identity are vague. Anyone witnessing a systematic sorites-type destruction of a heap H, has two questions to answer: (1) Does H still exist? and (2) Is H still a heap? The second question can be answered without invoking vagueness *de re*. One may argue that because of the vagueness of the predicate "is a heap" it is indeterminate at some stages whether H satisfies that predicate or not. Such an answer can easily be accommodated by a linguistic theory of vagueness. The first case is different, however. In this case we ask whether it is true of H that it exists and the answer that it is neither definitely true nor definitely not true, seems to commit one to borderline objects that "dwell[...] in the twilight between the full daylight of Being and the night of Nonbeing"[61]. As far as only inanimate objects, such as heaps, are concerned, the adherent of van Inwagen's ontology is in a better situation. He does not have to answer the first question at all, because for him there are no such things as heaps in the first place. And in order to answer the second question it suffices for him to adopt some suitable linguistic theory of vagueness. Therefore, as far as heaps are concerned, ontic vagueness does not come into the picture. However, as we have seen, in van Inwagen's ontology there are some composite objects - namely living organisms. And according to him their existence is bound to result in real-world vagueness, for "being caught up in the same life as" (which holds between simples) is a vague relation. There are two sources of the vagueness of this relation: firstly, the relation of being caught up in - just as the relation of being a part of - is vague; and secondly the notion of a life is a vague notion. There are events such that they are neither definitely lives nor definitely not

[61] van Inwagen (1990), p. 274.

lives; there are simples of which it is neither definitely true nor definitely false that the activity of those simples constitutes a life. The first source of vagueness can be dealt with by a linguistic theory of vagueness, the second cannot, for this latter source has significant consequences for ontology. If it is vague whether the activity of the simples constitutes a life, then - according to the proposed answer to the special composition question (see section 3.2.3) - it is vague whether they compose anything, in which case it is vague whether the composite thing exists. Saying that "compose something" is a vague predicate, which some objects may satisfy only indefinitely, does not solve anything. For even if we said this, we would still have to say something about the object of which it is only indefinitely true that it is composed by the simples; i.e. the objects such that it is only indefinitely true that it exists. Hence, as far as living organisms are concerned van Inwagen's ontology faces the same problem as the believer in composite inanimate objects faces in connection with heaps and clouds. It seems that one has to

> "accept the existence of vagueness which is real, inherent feature of objects and which does not derive from the indeterminacy of the rules governing talk about these objects".[62]

The only difference is that for a 'traditional' ontologist real vagueness is a much more widespread phenomenon than for van Inwagen.

Furthermore, just as vagueness in existence is a consequence of his answer to the special composition question, vagueness in identity follows from his principle *Life*[63] which describes the persistence conditions of composite objects. For not only is the notion of life vague in a sense that there are objects such that it is indeterminate

---

[62] van Inwagen (1990), p. 235.

[63] The principle *Life* is formulated thus: "...[I]f the activity of the *x*s at t_1 constitutes a life, and the activity of the *y*s at t_2 constitutes a life, then the organism that the *x*s compose at t_1 is the organism that the *y*s compose at t_2 if and only if the life constituted by the activity of the *x*s at t_1 is the life constituted by the activity of the *y*s at t_2". Van Inwagen (1990), p. 145.

whether they satisfy the predicate "constitutes a life", but it is also vague in a sense that for some objects it may be indeterminate whether they constitute the same life It is obvious that there are various ways in which one's life may be disrupted, and some of those disruptions are such that it is neither true nor false that one would survive them. In other words, there are "indeterminate adventures" which neither determinately suspend the life, not determinately disrupt it. And if it is indeterminate whether the life that is going on after an indeterminate adventure is the same life that was going one before that event, it will also be indeterminate whether the object existing before the adventure is the same as the object existing afterwards.[64]

Van Inwagen concludes that he has no option but to find a suitable theory which would be able to account for extralinguistic vagueness. He faces two challenges in particular: Evans's argument and the intuitive thought that there are no objects suspended between existence and non-existence. I will not go into details of his solution here, but let me just mention that he meets both these challenges by constructing a formal semantics (for monadic first-order logic with identity and property abstraction) in which certain troublesome inferences are invalid. He escapes Evans's argument by invalidating one of the abstraction operations used in this argument, namely the step from (3) $\neg\nabla(a = a)$ to (4) $\neg\lambda x\ [\nabla(x = a)]a$.[65] The second inference that has to be invalidated if one thinks of statements like "*That* is such that it is neither definitely true nor definitely false that it exists" as absurd, is the following: $\nabla\ \exists x\ Fx \vdash \exists x\ \nabla Fx$. His semantics does invalidate that inference by introducing so-

---

[64] Van Inwagen notices at this point that this situation need not trouble perdurantists. They can hold on to the view that all vagueness is linguistic. They treat the spread in time as endurantists treat the spread in space. "Is a persisting object" is a vague predicate on a par with predicates like "is a spatially continuous object" and its vagueness does not have any consequences for ontology. See van Inwagen (1990), p. 243. Cf. also my chapter III, section 3.4.

[65] See van Inwagen (1990), pp. 246-270.

called "proxy borderline objects" which are fuzzy sets of which it is neither definitely true nor definitely false that their members compose anything.[66]

It is interesting that van Inwagen has no *general* objections to the inference: $\nabla\exists x\ Fx \vdash \exists x\ \nabla Fx$. It is vagueness in composition which forces him to invalidate it, because it results in instances which lead to 'real borderline objects' - i.e. objects that neither definitely exist nor definitely do not exist. If it were not for that kind of vagueness van Inwagen would probably want us to accept that inference. For instance, he has no qualms about the inference: $\nabla\exists x\ x$ is wise $\vdash \exists x\ \nabla x$ is wise. In this case the truth of the conclusion means that there is an object such that it is a borderline case of the predicate "is wise". The vagueness of composition presents us with more troublesome cases. Suppose that the activity of certain ten simples, each of which weighs exactly one ounce, is such that it is neither definitely true nor definitely false that it constitutes a life.[67] Therefore, in this situation it is vague whether these simples constitute anything. Now, take the sentence "$\exists x\ x$ weighs more than four ounces". It appears that that sentence is indeterminate, hence the sentence "$\nabla\ \exists x\ x$ weighs more than four ounces" should be true. However, even if this is so, its indeterminacy is not due to the fact that there is an object such that it is a borderline case of the predicate "weighs more than four ounces". Rather, the indeterminacy arises because it is indeterminate whether there exists an object composed by the simples in question. If it existed, it would certainly not be a borderline case of "weighs more than four ounces", for it would weigh exactly ten ounces. If it did not exist, the predicate "weighs more than four ounces" would be definitely false of it. Hence, while

[66] See van Inwagen (1990), pp. 277-278.
[67] See van Inwagen (1990), pp. 271-272.

in the former case if the sentence "$\nabla \exists x\ x$ is wise" is true, it is true in virtue of there being an object such that it is neither definitely wise, nor definitely not wise, in the latter case the sentence "$\nabla \exists x\ x$ weights more than four ounces" is true in virtue of the fact that it is indeterminate that x exists. Therefore the right hand side of the inference "$\nabla\exists x\ Fx \vdash \exists x\ \nabla Fx$" is not definitely true and the inference has to be rejected.

The fact that there are two different reasons for the indeterminacy of the sentence "$\nabla \exists x\ Fx$" can be easily overlooked. In the general case in which we move from *de dicto* ascription of indeterminacy to *de re* ascription: i.e. from $\nabla\varphi x$ to $\lambda z\ (\nabla\varphi z)\ x$, we do not have any reason to question the importation of "∇".[68] Therefore, it might seem that also the move from "$\nabla\exists x\ Fx$" to "$\exists x\nabla\ Fx$" is legitimate. And, of course, had one assumed that the sentence "$\nabla\ \exists x\ Fx$" is true in virtue of the fact that the only object that satisfies "F" does so only indeterminately (i.e. there exists a borderline case of "F" and there are no objects that definitely are F), that move would have been valid.

4.2. A substantive thesis of ontic vagueness

As we remember,[69] Sainsbury has rejected the thesis:

(1) x is a vague object iff, for some φ, it satisfies the predicate $\lambda z\ (\nabla\varphi z)\ x$

as a substantive thesis of ontic vagueness on the grounds that it entails that every borderline case is a vague object. Recall that his argument is that if a tomato is a borderline case of "red" [∇Rt], then it must also satisfy the predicate "is such that it is

---

68 Cf. Sainsbury (1994). See also chapter II, section 3.1.

69 See chapter II, section 3.1. The most notorious exception is the case where "φ" contains identity. Cf. chapter I, section 1.3.

vague whether it is red" [λz (∇Rz) t)]. It seems that if there exists a borderline case b of the given predicate φ, then the statement "b is such that it is indeterminate whether it is φ" is true. There seem to be no reason why we should not predicate of b that [it is such that] it is a borderline case of φ (for this is in fact what the statement "[λz ($\nabla\varphi z$)]b" amounts to). Thus (1) does not sieve out 'real' vague objects from 'common' borderline cases of vague expressions.

Sainsbury tries to obtain a better formulation of the thesis of real vagueness by imposing some restrictions on "φ". Eventually he requires that "φ" be sharp and focuses on identity, which he takes to be the most certain candidate for a sharp predicate. As we have seen, even that restriction does not work in Sainsbury's opinion - it does not help formulating the thesis that Sainsbury was after. Van Inwagen's analysis throws a new light on this quest. It seems to me that one may try concentrating on existence instead of identity and formulate the following thesis:

(V) There is vagueness in the world if, for some F, although the sentence "$\nabla\exists x\ Fx$" is true, the sentence "$\exists x\nabla\ Fx$" is not true; where positive and borderline cases of F are excluded from the range of x.

The idea here is this. Take the predicate "weighs exactly ten ounces". Ignore all its positive cases (I assume that it is precise and does not have any borderline cases). Now, if we consider the remaining objects, we will see of course that neither the sentence "$\nabla\exists x\ Fx$" is true nor the sentence "$\exists x\nabla\ Fx$" is false. However, when we think of "the remaining objects", we think of objects that (definitely) exist. If the possibility that there might be objects such that they neither definitely exist nor definitely do not exist, is allowed, the conjunction on the right hand side of (V) may be true.

Without the restriction imposed on the range of x, thesis (V) would say in fact that there is vagueness in the world if F is a sharp empty predicate - i.e. a predicate which has no positive and no borderline cases. Take for instance the predicate "is tall". This is one of the token vague predicates and has positive, negative and borderline cases. If we substitute this predicate for "F", the sentence "$\nabla\exists x\, Fx$" will be false (due to the existence of positive cases of tallness), while the sentence "$\exists x\, \nabla Fx$" will be true (due to the existence of borderline cases of tallness). The same result can be obtained for any 'typical' vague predicate. So the unrestricted (V) does not get us any closer to vague objects: for every 'typical' vague predicate the right hand side of the biconditional is false. The restricted (V) is a different matter, however. With the restriction, positive and borderline cases are not taken into account in the evaluation of the relevant sentences. In particular, the situation in which the sentence "$\nabla\exists x\, Fx$" is made true by an object such that it is indeterminate whether it is F, is excluded (for if borderline cases were taken into account, also the sentence "$\exists x\, \nabla Fx$" would be true). If it is not a borderline case of F that makes "$\nabla\exists x\, Fx$" true, then it must be the fact that it is indeterminate whether there exists an object which is F. In other words, there must be an object whose existence is indeterminate; which neither definitely exists nor definitely does not exist. This object - if it existed - would have to be either F or indefinitely F. If it were definitely not F, its existence or non-existence would have no impact on the truth-value of the sentences under discussion. Therefore in order to make "$\nabla\exists x\, Fx$" true and "$\exists x\, \nabla Fx$" false there must be a borderline case of the predicate "exists" such that if it existed it would be F or at least ∇F.

Three remarks are in place:

Firstly the condition that a borderline case of the predicate "exists" has to be *such that if it existed it would be F or at least* ∇F does not really add anything. Thesis (V) says that there is vagueness in the world iff there is an F such that $\nabla\exists x\, Fx$ and $\neg\exists x\, \nabla Fx$. It seems however that for every object which neither definitely exists nor definitely does not exist there are bound to be some Fs such that if that object existed it *would be F*.

Secondly, and more importantly, we must remember that the phrase "a borderline case of the predicate 'exists'" is a sort of metaphor. We certainly do not want to say that there is an object which is a borderline case of "exist", for this would amount to the claim that there exists an object which indeterminately exists, which sounds ridiculous. In fact the whole talk of an object that neither definitely exists nor definitely does not exist is just a figure of speech and should not be read literally. It is short for the following situation: it is indeterminate whether certain xs compose anything. And since it is indeterminate whether they compose any object, we cannot predicate anything of *that* object. In particular we cannot attribute to it the property of indeterminately existing; i.e. of being a borderline case of "exists". While it is true that it is indeterminate whether there exists an object composed by the simples, it is not true that the object composed by the simples is such that it indeterminately exists, just because it is indeterminate whether there exists any object composed by the simples. What exists is a set (or rather a fuzzy set) of xs of which it is not definitely true and not definitely false that its members compose anything. Such a set is called a "proxy borderline object".[70]

[70] The exact definition accommodates the possibility of mereological change and defines a proxy borderline object as a function from moments of time to sets of simples (see van Inwagen (1990), p. 277).
Van Inwagen claims that the role of proxy borderline objects is similar to the role that merely

Thirdly, it should be noticed that thesis (V) does not reduce vagueness in the world to vagueness in existence. It gives only a sufficient condition of being a vague object. In this way e.g. the possibility of counting vagueness in identity as a kind of vagueness of the real world is not excluded.[71]

Thesis (V) has an advantage over the attempts considered by Sainsbury, for it does not force us to regard 'common' borderline cases as vague objects. In fact it does not give us vague objects at all. All it speaks about is vagueness in the world. We encounter vagueness in the world when we have to do with a situation in which it is indeterminate whether a collection of microobjects composes a composite object, because in each such situation it is vague whether the composite object in question exists. It cannot be said that that composite object is a vague object, for it is not clear whether there is any object to speak about in the first place. This picture fits well with van Inwagen's ontology, in which the simples compose bigger objects just in the cases in which their activity constitutes a life. Since "life" is a vague notion, sometimes it may be indeterminate whether they constitute an object or not.

It seems to me that this account can be applied to our 'common' ontology as well.

Following van Inwagen we can divide metaphysicians into universalists, nihilists and the moderate ones. Universalists claim roughly that for any nonoverlapping *x*s, those *x*s compose something.[72] Nihilists argue that no composite

---

possible objects play in modal logic. He argues that someone who does not believe in merely possible objects, but wants to use a Kripke-style semantics for quantified modal logic may "treat the so-called possible objects as objects which are not literally non-existent but which mimic in some semantically useful way some of the behaviour that, on the intuitive level, one expects of non-existent objects" (p. 276). Analogously, proxy borderline objects can mimic some of the behaviour that, on the intuitive level, we expect of borderline objects. See pp. 276-277.

[71] Compare chapter II, section 3.1.

[72] Cf. van Inwagen (1990), e.g. p. 234.

object whatsoever exists. It is clear that for universalists and nihilists vagueness in existence does not exist. For them composition is a precise notion and has no borderline cases. For universalists the claim that certain *x*s compose something is always true, whereas for nihilists such a sentence is never true. The sentence can be indeterminate for neither of them. Since composition is precise, existence has to be precise as well.[73] The situation is different with moderate metaphysicians. For them the existence of composite objects depends on whether or not certain conditions are satisfied, and at least in some cases the question of whether or not those conditions are satisfied will have an indeterminate answer. Our common 'pedestrian' ontology, as well as van Inwagen's, is an ontology of a moderate metaphysician. The vast majority of our familiar objects are composite objects but it is not the case that no matter which *x*s we pick out, they compose an object. We take it, for instance, that although my mug, van Inwagen's pen and the Eiffel Tower are composed by some *x*s, the totality of the *x*s that compose these three objects do not compose any further composite object. So, although we agree that there is a set consisting of the *x*s that compose my mug, van Inwagen's pen and the Eiffel Tower, we do not think that that set composes any 'ontologically significant' object. Moreover, it seems clear that our composite objects are not (classical) sets of *x*s, but rather fuzzy (or better: rough[74]) sets of *x*s: macro-objects from our ontology have fuzzy spatial and temporal boundaries. The conditions that we lay down for fuzzy (rough) sets to count as objects are hard to state.[75] First of all, van Inwagen's condition of constituting a life,

[73] I have already pointed out that the idea of vagueness in existence makes sense only as far as composite objects are concerned. The notion of a simple object that indeterminately exists is absurd.
[74] See section 3.3. above.
[75] It should be noticed that we do not *define* objects as collections of simples. In particular, we do not want to identify objects with parcels of matter that constitute them, for the persistence conditions for objects are different from the persistence conditions for matter. The persistence of a macroobject

although not necessary, is a sufficient condition: if something is a composite thing in van Inwagen's ontology, it will also be an object of our ontology. However, since in our ontology there are composite inorganic things as well, the mere fact that the activity of the *x*s does not definitely constitute a life, does not justify treating the *x*s as if they did not compose anything - they can still compose something lifeless. And as far as inanimate objects are concerned, we usually require that they be spatio-temporally continuous and capable of causal interaction with other things. So the *x*s (whatever we take them to be: cells, atoms, particles, *etc.*) in order to compose 'ontologically significant' objects - let us call them *things* for simplicity - have to be spatio-temporally continuous and causally related. (I am sure that there are some counterexamples to that thesis, but it appears to be true for most familiar objects of everyday experience.) Clearly both spatio-temporal continuity and causal relatedness are vague relations. Hence, there are bound to be such sets of *x*s that it will be indeterminate whether they are sufficiently interrelated in order to constitute a thing. In some other cases it may be indeterminate whether there are enough *x*s to compose a thing of a certain kind. In some of those cases it will be indeterminate whether the *x*s compose a thing of the kind in question or something else (if we, say, break a chair in half, it can be indeterminate whether the *x*s that compose one half of a chair compose a chair or merely a piece of wood). In other cases however, it will be indeterminate whether the *x*s compose anything at all (if we take the *x*s to be grains of sand, then it might be indeterminate whether there is enough of them to compose a heap).

usually does not consist in possessing the same simples. An object x that exists at t_1 and is composed by a set of simples z may still exist at t_2 but be composed by a set z-w, which is what is left after the set z was destroyed.

The question "How many composite things are there in the given situation?" appears to be a real, metaphysical problem. Hence, it seems that the situation in which it is indeterminate whether there exists a thing constituted by the simples should be regarded as a 'serious' case of vagueness in the world.

4.3. Conclusion

Any moderate answer to the question "When is it true that there is a y such that the xs compose y?" commits one to vagueness in the world: namely to vagueness in composition, identity and existence. We have already dealt with compositional and individuative vagueness in the previous chapters and we have seen that these notions are coherent and comprehensible. At first glance, it might seems that there is no way of making vagueness in existence coherent and comprehensible. Van Inwagen claims, however, that vagueness in existence is no more troublesome than vagueness in identity or composition. He argues that vague existence is inevitable for any theorists who thinks that some (but not all) collections of simple objects compose composite objects and therefore we should better learn how to live with it. The talk about objects that "dwell ... between Being and ... Nonbeing" sounds weird, but we do not have to think about objects whose existence is indeterminate in such terms. We are not forced to claim that there are objects which *are such that* it is indeterminate whether they exist. If we accept that the inference "$\nabla\exists x\ Fx \vdash \exists x\ \nabla Fx$" is not valid, we will not have objects of which it is true that they indeterminately exist. Although in some cases it is indeterminate whether some object exists, it is never the case that an object is such that it is indeterminate whether *it* exists.

One can make use of van Inwagen's remarks in formulating a thesis of ontic vagueness. The thesis

(V) There is vagueness in the world if, for some F, although the sentence "$\nabla\exists x\ Fx$" is true, the sentence "$\exists x\nabla\ Fx$" is not true; where positive and borderline cases of F are excluded from the range of x;

seems to satisfy the requirements imposed on any substantive thesis of ontic vagueness. If we suitably restrict the range of x, the sentence "$\nabla\exists x\ Fx$" can be true and the sentence "$\exists x\nabla\ Fx$" can be not true only if it is indeterminate whether x exists. And it being indeterminate whether something exists amounts to there being vagueness in the world.

Vagueness in existence as well as vagueness in identity is a consequence of vagueness in composition.[76] As I have tried to argue compositional vagueness is not as anodyne as it has been argued by some theorists. It is quite 'serious' kind of vagueness with very grave consequences for the criteria of identity and individuation of objects. It has been stressed that a particularly striking feature of compositional vagueness is that it may lead to individuative vagueness. Now, we have to resign ourselves to the fact that it may also lead to vagueness in existence.

[76] Vagueness in identity may also result from temporal vagueness. Cf. chapter II, section 3.1.

Chapter V

A QUANTUM MECHANICS EXAMPLE

1. QUANTUM MECHANICS AND INDIVIDUALITY

1.1. Introduction

In this chapter we will examine an example of indeterminate identity given by E. J. Lowe.[1] Lowe thinks that Evans's argument[2] is invalid, because it makes some illegitimate moves. According to him, anyone who thinks that Evans's proof does not work gets some support from quantum mechanics. Lowe claims that quantum theory provides examples of identity statements which are indeterminate in truth value despite having two precise designators as their components. If Lowe is right, then quantum particles are vague objects, in a sense that they can be indeterminately identical with each other.[3] The existence of such examples suggests that Evans's argument must have gone wrong at some place.

As is well-known, quite generally identity and individuation pose problems for quantum particles - especially for those in entangled states. The fundamental question is whether quanta can consistently be regarded as individuals. Thus, before investigating Lowe's example and examining whether the quantum particles are vague objects, we shall have a look at the nature of the entangled state and the individuation of the particles.

---

[1] See Lowe (1994).
[2] See chapter I.
[3] On the relation between vague objects and indeterminate identity see chapter II.

1.2. What does individuality consist in?

A **physical individual** is usually taken to be an object which exists in the physical world, is distinct from other physical objects and is a continuant; i.e. persists through time.[4] There are at least three theories explaining what it is that individuates physical objects (i.e. what makes each object distinct from every other):[5]

(T1) a substratum;

(T2) a spatio-temporal location;

(T3) a bundle of properties.

There are problems connected with each of these theories. The first one is the most mysterious. The substratum theory is a sort of 'metaphysical chimera',[6] for it commits us to the existence of enigmatic substrata. In this theory individuality becomes in fact 'transcendental individuality',[7] i.e. something that transcends observable properties and describable histories of objects.

On theory (T2) to individuate an object it suffices to define its spatio-temporal location.[8] Thus, for continuants, the re-identification of an individual a at a time t_1

---

[4] Thus, e.g. events are not individuals in this sense. Compare also the discussion of continuants in chapter III and a weak notion of individuality below. *NB* The following considerations are conducted from the endurantists' point of view, but they can be quite easily translated into perdurantists' language.

[5] French (1987), p. 5.

[6] French (1989), p. 142.

[7] Terminology of Heinz Post. See below [section 1.4.1].

[8] Someone who accepts this theory has two options: he may accept either the relative or the absolute account of space and time. The former option leads to circularity (for the individuation of a given object involves specifying its location in space, and this location involves its relation with other objects), the latter option lacks the explanation what confers individuality on points of space and instances of time. French, Redhead (1988), p. 235.

with an individual b at a time t_2 requires the spatio-temporal continuity of the trajectory between the location of a at t_1 with that of b at t_2. (T2) assumes impenetrability - i.e. it holds that no two individuals can be in the same place at the same time.

In theory (T3) if bundles of properties are to be capable of individuating, the possibility of there existing indistinguishable but nevertheless distinct objects must be eliminated. It must be guaranteed that indistinguishable objects (i.e. objects having all their properties in common) are identical (i.e. are one and the same individual). Leibniz's law, the so-called **Principle of the Identity of Indiscernibles (PII)**:

$$\forall x \forall y\, [\forall F\, (Fx \leftrightarrow Fy) \rightarrow x = y]$$

is supposed to do the job. Two versions of PII may be distinguished depending on the kind of properties included into the range of F.[9] The weaker PII(1) says that there cannot be two distinct individuals having *all* their non-relational and relational properties in common. This is a weaker version in a sense that it allows the relational properties of x and y - including spatio-temporal properties - into the range of F. Hence it says in fact that if two objects have all their non-spatiotemporal properties in common and are at the same time at the same place, then they are numerically identical. PII(2) is a stronger version and it does not quantify over spatio-temporal properties of x and y. It excludes the possibility of there being two distinct individuals sharing all their non-spatiotemporal properties and relations.

I will not go here into the issue of whether the weak version of PII is sufficient for the bundle theorist. As we shall see neither version is necessarily true, moreover it

[9] French distinguishes three versions of PII. The strongest PII(3) quantifies over monadic properties of particles only. However, the distinction between monadic and relational properties is unclear. See French (1989), pp. 144 and 151.

seems that - at least for a certain interpretation of quantum particles - neither version is even contingently true. Let us just point out that if the stronger PII(2) were true, then we would only need to consider bundles of intrinsic properties in order to individuate an object. On the other hand, if it were only the weaker version PII(1) that held, then we would have to include spatio-temporal properties into the bundles and treat differences in spatio-temporal locations as differences in properties, which may seem controversial.[10]

1.3. Classical physics and PII

In classical physics it is only the weaker version of PII that holds. In general, the properties of classical particles are divided into intrinsic and state-dependent ones. The notion of *intrinsic property* as used by classical physicists is not a standard notion, for the intrinsic properties (e.g. rest mass, charge) are those that do not depend upon the location or the state of motion that the particles are in and *a fortiori* are not spatio-temporal. The *extrinsic* properties, such as position or momentum, depend on the state a particle is in.[11] All particles of the same kind always have the same intrinsic properties. Hence, PII(2) is not valid because two particles having all their intrinsic properties in common may still have different spatio-temporal properties and so be distinct individuals. Therefore, PII(2) is of no use in individuating.

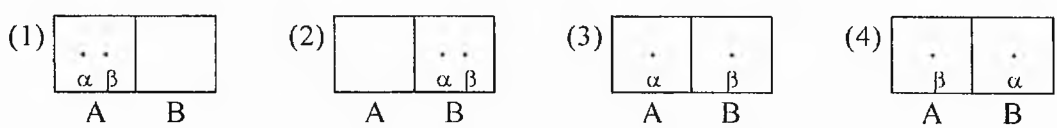
---

[10] Cf. Armstrong (1989), p. 65.

[11] Whether or not properties which are intrinsic in the sense given above are non-relational depends on the accepted physical theory. See French (1989), p. 151nn. This issue is not essential from our point of view, because our versions of PII differ by spatio-temporal properties (not by all relational properties).

The Impenetrability Assumption to the effect that no two distinct atoms can exist in the same place, is a fundamental assumption of classical physics.[12] Thus, PII(1) is valid, for if two particles have the same spatio-temporal characteristics they are in fact one and the same particle. Hence, what allows us in classical physics to individuate two otherwise indistinguishable particles is their spatio-temporal characteristics. So it seems that the two theories (T2) and (T3) boil down to the same thing. Starting off with theory (T2) one has to assume the Impenetrability Assumption. If one wants to individuate in theory (T3) one has to appeal to PII(1) which also presupposes the Impenetrability Assumption. Spatio-temporal trajectory together with the Impenetrability Assumption does the job of individuating.

So if we were to distribute two particles having all their intrinsic properties in common among two distinct states we would get the following four possibilities:



where the boxes represent the two states and labels "α" and "β" refer to the two particles. It is an assumption employed in Maxwell-Bolzman statistics used in classical physics that each of the above arrangements is assigned an equal probability.

Although α and β share all their intrinsic properties, the arrangements (3) and (4) count as distinct. α and β are different individuals (we can distinguish α from β by appealing to their spatio-temporal properties and their histories) and so the arrangement in which α is in the state A and β is in the state B is different from the arrangement in which α is in the state B and β is in the state A.

[12] See e.g. French, Redhead (1988), p. 235; French (1987), p. 5.

1.4. Quantum physics and PII

1.4.1. Indistinguishability Postulate and Transcendental Individuality

In quantum physics the situation is different. In quantum theory not only do distinct particles having all their intrinsic properties in common exist - in fact all particles of the same kind share their intrinsic properties, but moreover there are no individuating spatio-temporal trajectories, and the Impenetrability Assumption is not true. Trajectories are not well-defined and moreover they may overlap,[13] hence different objects can be in the same place at the same time. Since quanta may share all their qualitative (i.e. non-relational), relational and spatio-temporal properties, none of these properties can do the individuating.[14] Thus, neither theory (T2) [spatio-temporal location] nor theory (T3) [bundles of properties] is of any use here.

It might seem at first glance that for two quantum particles of the same kind distributed among two pure quantum states we still have the four possibilities (denoting the quantum states in the traditional manner by vectors |...>):

[13] "...if there are two particles with fairly spread out wave packets, φ_1 and φ_2 respectively, we can consider the case in which the packets move through each other as two waves in the ocean. As they pass they cannot be distinguished spatially, and there are no distinct trajectories by which to track either particle through time." Huggett (1997), p. 119. On the other hand, French and Krause claim that it is not the lack of distinct trajectories which results in non-individuality of quantum particles, but rather the Indistinguishability Postulate (see below). See Krause, French (1995), pp. 198-199.

[14] There is an interpretation of QM which treats particles as individuals differing in their *state-dependent* properties. Bohm claims that every particle has a classical location as its hidden state. On this interpretation individual particles have classical trajectories and hence can be distinguished. The non-locality is provided for by a holistic dynamics. See Huggett (1997), p. 127. Hence, in such a hidden-variable interpretation of QM individuality is conferred by spatio-temporal location. This interpretation is a non-starter for ontic vagueness theorists, however. The claim that particles have sharp trajectories and that we can follow their history, excludes the possibility of vague diachronic identity between particles. Since each particle has a precise individual location, the identity between two particles is always a determinate matter.

(1) Both particles are in the state |r>

(2) Both particles are in the state |s>

(3) Particle α is in the state |r> and particle β is in the state |s>

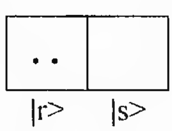
(4) Particle α is in the state |s> and particle β is in the state |r>.

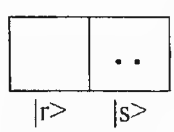
However, one of the fundamental assumptions of quantum physics is the **Indistinguishability Postulate**, according to which it is not possible by measuring the expectation value of any observable to distinguish between two physical states when one is represented by a vector |φ> and the other by any permutation with respect to particles |Pφ>, of |φ>.[15] In our case the Indistinguishability Postulate says that two states that differ only by permutation of the two indistinguishable particles of which they consist, cannot be distinguished. In general the Indistinguishability Postulate entails that quantum statistics must count states which differ solely by permutation of indistinguishable particles as one and the same state. Hence, it forbids counting (3) and (4) as distinct and there are only three distinguishable arrangements:

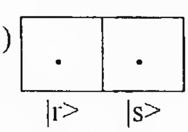
(1') Both particles are in the state |r>,

(2') Both particles are in the state |s>,

(3') One particle is in the state |r> and the other is in the state |s>.

(1')


(2')


(3')


[15] Redhead and Teller claim that Indistinguishability Postulate [IP] should be formulated in terms of vectors and not in terms of states those vectors represent. The reason is that a formulation of IP such as the above implies that the only states that satisfy IP are symmetric and anti-symmetric states, whereas the group theoretic considerations show that there can be many-particle (i.e. more than two particles) states with higher symmetry properties (states of so called 'paraparticles'), which are particle-permutation invariant. Redhead, Teller (1992), pp. 343n.

This has been taken to show that particles α and β cannot be regarded as individuals. For if they were individuals, they would have labels and arrangements (3) and (4) would have to be counted as distinct (for the arrangement of labelled individuals after the permutation is always different from that arrangement before the permutation). Since quantum statistics count them as one and the same arrangement it seems to follow that labels "α" and "β" can no longer be used.

In quantum physics different physical assumptions generate different statistics for bosons (such as photons) and for fermions (such as electrons). According to the Bose-Einstein statistics there are three possible arrangements for bosons:

(1") $|r\rangle \otimes |r\rangle$, corresponding to diagram (1'),

(2") $|s\rangle \otimes |s\rangle$, corresponding to diagram (2'),

(3") $1/\sqrt{2}\,(|r\rangle \otimes |s\rangle + |s\rangle \otimes |r\rangle)$, corresponding to diagram (3').

According to the Fermi-Dirac statistics there is only one state available for two fermions since fermions obey the Pauli Exclusion Principle, according to which two fermions of the same kind cannot be in the same state:

(4") $1/\sqrt{2}\,(|r\rangle \otimes |s\rangle - |s\rangle \otimes |r\rangle)$, corresponding only to (3').

(3") and (4") represent so called 'entangled' or 'superposed' states. (3") is a permutation-symmetric state, whereas (4") is anti-symmetric,[16] but they both represent the arrangement pictured by the rightmost boxes; i.e. they do not distinguish between (3) and (4). The Indistinguishability Postulate says that states like (3) and (4) can be represented as either symmetric or anti-symmetric states, and neither of those can distinguish between permutations of indistinguishable particles. On the other

[16] For two particles there is only one non-trivial permutation which replaces $|r\rangle \otimes |s\rangle$ with $|s\rangle \otimes |r\rangle$. Let ϕ be the original vector and ϕ' its replacement by this non-trivial permutation. Then ϕ is a symmetric vector iff $\phi' = \phi$, while ϕ is an anti-symmetric vector iff $\phi' = -\phi$. See van Fraassen (1991), p. 383.

hand, if one accepts that particles are individuals and can bear labels, then one must also accept that redistributing properties among two labelable entities constitutes a change in the actual state of affairs. Accepting this claim commits one to the existence of two-particle states specified by vectors which are non-symmetric (i.e. neither symmetric nor anti-symmetric). So, in the case of the superposition states there seems to be a clear tension between individuality (which requires non-symmetric states) and the Indistinguishability Postulate (which allows only symmetric and anti-symmetric states).

It has been argued that if one wants to claim that quantum particles are nevertheless individuals, theory (T1) becomes the last resort.[17] On this theory individuality is conferred by a transcendental substratum. This might seem to be a "dark piece of metaphysics",[18] but it appears to be the only sense in which one can retain individuality (in the sense given above) for quantum particles.

The notion of **transcendental individuality** was first introduced to this debate by H. Post. He writes [1963, p. 534]:

"[W]e mean by individuality something that transcends observable differences - what I will call 'transcendental individuality'. If somebody took away my umbrella from my umbrella-stand, and substituted his own [...] indistinguishable from mine, we would hardly claim that there had been no change...".

---

[17] There is also another view which claims that although particles are absolutely indistinguishable, they are nevertheless individuals. Teller tries to save individuality by appealing to inherent non-supervenient relations. According to his **relational holism** objects which in at least some circumstances can be identified as distinct individuals in superposition states have inherent relations, i.e. relations that do not supervene on the intrinsic and non-intrinsic properties of those objects. Due to the existence of non-supervenient relations two individuals may be indistinguishable. Recall that distinguishability requirement is essential for individuality. On Teller's view individuality is saved by new entities which one has to introduce into one's ontology. It is inherent non-supervenient relations that make it impossible to distinguish between particles in superposed states. So, particles are individuals for if it were not for such relations, they would be distinguishable. Thus, one keeps 'ordinary' individual particles in one's ontology at the price of introducing some additional and much less 'ordinary' entities to this ontology as well. Cf. Teller (1986), p. 77. I ignore this possibility in my work.

[18] Copeland (1994), p. 83. He uses this phrase in a different context.

It is worth noticing that from this quote alone it does not follow that transcendental identity is a 'metaphysical' identity, i.e. identity based on some non-qualitative and non-relational properties. It could equally well be identity based on the histories of objects.

However, after defining transcendental individuality, Post goes on to claim that quantum particles do not have any individuality and in particular they do not have transcendental individuality. He argues that the way the quantum statistics works demonstrates that modern physics does not allow transcendental individuality.

It is probably an argument like the one described above which drove Post to claim that individuality is inconsistent with modern quantum physics. Redhead, Teller and French have picked up Post's terminology, but they have arrived at a completely different conclusion. They claim that transcendental individuality is consistent with QM and there is nothing wrong with treating particles as transcendental individuals - in fact this is the only way to retain individuality for quantum particles.

French & Redhead and Redhead & Teller claim that if one does not want to reduce individuals to bundles of properties, one may argue that individuals involve something over and above their properties - "Lockean substratum, the unknowable 'something' that attributes 'attach' to".[19] They make the following terminological proposal: "if an individual acquires its individuality by something that transcends its attributes we shall say that it exhibits *transcendental individuality*".[20] Redhead and Teller add that transcendental individuality is not another property of an object, but

[19] Armstrong claims that this Lockean version of substratum theory has "a rather unlovely form" and argues that a substratum theorist need not take a Lockean line. He claims that one may take substratum to be actually given in experience and proposes to individuate it with a spatio-temporal position of an object. Cf. Armstrong (1989), p. 61. This is a substratum-version of our theory (2) (for one can hold a bundle-version of this theory as well) and we have already seen that it will not work: positions do not individuate quantum particles.

[20] French, Redhead (1988), p. 235.

"that by which an entity allegedly acquires its identity; that is its capacity to bear an in principle individuating label; and that to which its properties attach, or ... in virtue of which it is an object of predication".[21] They distinguish within the notion of transcendental individuality two more specific notions: label transcendental individuality and property transcendental individuality[22] and claim that only label transcendental individuality concerns them. They argue explicitly: "The whole point of label transcendental individuality is that redistributing properties among labelable entities counts as a change in the actual state of affairs"[23]. At first glance such a claim contradicts the Indistinguishability Postulate.

However, as Redhead and Teller point out, two readings of the Indistinguishability Postulate are possible. On the strong reading non-symmetric vectors do not represent physically *meaningful* states and non-symmetric self-adjoint[24] operators (observables) do not represent any physical properties.[25] This view is straightforwardly inconsistent with particles being individuals.

---

[21] Redhead, Teller (1992), p. 341.

[22] In virtue of having label transcendental individuality (LTI) an object can bear a label, can be thought of as persisting through time as one individual. Property transcendental individuality (PTI) supports individual's properties; it is in virtue of it that an individual can be an object of predication. The connection between LTI and PTI seems not entirely clear. It seems that there can be objects (such as, for instance events) that have PTI without having LTI, whereas there cannot be objects having LTI without having PTI. In what follows by "transcendental individuality" I will mean both LTI and PTI.
Loux in his 1998 introduces an analogous distinction. 'Bare substrata' play two different roles according to him: first makes them the underlying substances of attributes, the second makes them the principles of the numerical diversity of concrete objects (p. 113).

[23] Redhead, Teller (1992), p. 342.

[24] An operator M with the following property: $(x \cdot My) = (Mx \cdot y)$ is self-adjoint. See van Fraassen (1991), p. 147.

[25] A restriction on states and observables is always correlative. Cf. Redhead, Teller (1992), p. 206. Van Fraassen gives the following formulation of the Indistinguishability Postulate, which he calls Permutation Invariance (PI): If ϕ is the state of a composite system whose components are identical particles, then the expectation value of any observable A is the same for all permutations of ϕ. Next he claims that it has two aspects: PI 1 which says that if some observable A does not have the same expectation value in ϕ and its permutation ϕ', then ϕ does not represent a (physically possible) pure state of an aggregate of identical particles; and PI 2 which says that if some state ϕ is such that [self-adjoint] operator A does not have the same expectation value in state ϕ as in its permutation ϕ', then A does not represent a (real, measurable) observable. van Fraassen (1991), pp. 381-382. This

Nevertheless, there is a weak reading of the Indistinguishability Postulate which is consistent with particles being individuals. In order to treat particles as having label transcendental individuality we need to regard the Indistinguishability Postulate as imposing a restriction on *actual* states and observables: the Indistinguishability Postulate implies that all physical states must be represented by symmetric or anti-symmetric vectors, but on the weak reading it says merely that non-symmetric vectors do not represent states which *ever physically occur* and that non-symmetric self-adjoint operators do not represent observable properties. On this reading particles are subject to dynamical restrictions as to the set of possible states they can occupy. Thus, on the weak reading of the Indistinguishability Postulate there are states such as (3) and (4), but they never occur.[26] Individuality is saved at the price of postulating states which are never actualised.

The way in which quantum statistics work can be explained now. In order to remove the tension between label transcendental individuality and the Indistinguishability Postulate, it has to be assumed that non-symmetric states are not available to particles. We have to assume that particles never start in a state with the 'wrong' symmetry. The only states which are available for two particles are symmetric and anti-symmetric. Temporal evolution is governed by the Hamiltonian which is the operator for the energy observable. Since it is the observable for energy, it itself is subject to restriction imposed by the Indistinguishability Postulate and hence, has to be symmetric in particle permutations.[27] The particle-permutation symmetric operator

formulation makes the correlative character of the restriction explicit. We get Redhead & Teller's strong reading of IP if we ignore what is written in parentheses.

[26] Hence non-symmetric vectors represent meaningful - though never actualised states. Therefore, the correlative non-symmetric self-adjoint operators represent meaningful physical states. Redhead, Teller (1992), p. 209.

[27] Redhead, Teller (1992), p. 207.

preserves symmetry, i.e. under temporal evolution a symmetric bosonic state must remain symmetric and an anti-symmetric fermionic state must remain anti-symmetric. This is the reason why quantum statistics distinguish three arrangements only: "states with the wrong symmetry get eliminated because they are not *accessible* to the joint quantum system",[28] not because there are no such states. For bosons, states are restricted to symmetric ones and that is why (4") does not count. For fermions in turn, only anti-symmetric states are accessible and that is why (1"), (2") and (3") get eliminated.

Hence, label transcendental individuality can be retained: it is consistent with a weak reading of the Indistinguishability Postulate and so with quantum statistics. Label transcendental individuality implies that there are distinct states such as (3) and (4). Such states have to be identified with each other to get the quantum statistics right. The problem is solved by the weak Indistinguishability Postulate which says that states such as (3) and (4), i.e. states with the wrong symmetry, are possible but never actually occur; they are not accessible for quantum particles.[29]

It seems to me that once one ascribes transcendental individuality to particles one may also claim that they have some other distinguishing properties. For if one claims that there are two distinct physically indistinguishable particles which possess transcendental individuality then one may ascribe them different histories.[30] If a given particle has transcendental individuality then there is no reason why it should not have a distinguishing history. We do not and cannot know which particle is which but, as Redhead puts it, "only an extreme positivism would hold that because we cannot tell

[28] French, Redhead (1988), p. 237.
[29] Redhead, Teller (1992), p. 206.
[30] See the discussion between Cortes, Barnette and Ginsberg in connection with the Principle of Identity of Indiscernibles. Barnette (1978); Cortes (1976); Ginsberg (1981).

which label attaches to which particle, therefore we are *compelled* to give up a description which does ascribe labels to particles".[31]

1.4.2. Huggett's attack on haecceitism

N. Huggett agrees that quantum particles can count as individuals but he is strongly opposed to regarding particles as transcendental individuals in a sense given to this term by French, Redhead and Teller. He takes transcendental individuality to either entail haecceitism or be synonymous with it.[32] Haecceitism is the view that there are at least some cases of haecceistic difference between worlds, where the difference between two worlds is haecceistic if they "differ in what they represent *de re* concerning some individual, but do not differ qualitatively in any way."[33] Hence, according to haecceitism, it is possible that there is a world which is qualitatively identical to the world in which particle α is in a state ϕ and particle β in a state φ and in which the particles have swap their states: i.e. particle α is in a state φ and particle β is in a state ϕ. Huggett's attack on transcendental individuality is an attack on haecceitism.

The main argument against any theory which posits the existence of transcendental substrata is a thesis that one should not postulate any entities which transcend experience. This argument seems quite powerful: any successful account of individuals which does not refer to undetectable entities intuitively seems better than any one which does. The proponents of substratum theories reply to this argument by

[31] Redhead (1982), p. 85, his emphasis.
[32] Huggett (1994), p. 70.
[33] Lewis (1986), p. 221.

pointing out that there is no theory of individuals whose success would be something that all philosophers agree upon. As a positive argument for the *bare* substratum theory[34] they give an argument which relates to the falsity of PII(2).[35] They take for granted the existence of qualitatively identical but numerically different objects - and hence the falsity of PII(2) - and claim that, unlike, for instance, the bundle theorists, they are able to account for this fact. The bundle theorists who do not acknowledge anything but qualitative properties cannot explain how it is that two absolutely identical bundles (in the sense of PII(2)) are not identical numerically.[36] In contrast, the substratum theorists argue that qualitatively identical objects may be numerically different, because they may have different substrata as their constituents. The bare-substrata theorists do not count having a certain substratum as a qualitative property, so the fact that absolutely indiscernible objects possess different bare substrata does not make PII true. PII says roughly that two substrata to which the same attributes are attached are in fact the same substratum, which of course may be false. Since having a substratum does not count as a property which would falsify the antecedent: $\forall F\ (Fa \leftrightarrow Fb)$, the principle $\forall F\ (Fa \leftrightarrow Fb) \rightarrow a = b$, may have a true antecedent and a false consequent. Huggett seems to have missed this, for he writes that in quantum mechanics in which single particle states are taken to be reduced states "[P]II is maximally violated, so... haecceitism is trivially false".[37] To repeat: haecceitism does not guarantee the truth of PII, hence conversely from the falsity of

---

[34] A bare substratum has no attributes in itself; none of the attributes which are attached to substratum is essential to it. Cf. Loux (1998), pp. 115-116.

[35] Loux (1998), pp. 111-113.

[36] They cannot appeal to properties such as x's property of *being identical with x*, because such properties already presuppose the notion of an individual. And bundle theorists treat the concept of individual as built from more basic entities, namely from attributes. See Loux (1998), pp. 109-110. *NB* substrata theorists, who want to claim that PII is false have to deny that substrata could be regarded as some such strange properties. Cf. below. As has been mentioned Redhead and Teller explicitly deny that transcendental individuality is a kind of property.

PII it does not follow that haecceitism is false. So, it is clear that the commitment to the existence of transcendental substrata need not be a commitment to the truth of any version of PII.[38]

Huggett claims that haecceitism has no support from either classical or quantum physics. He writes that in classical physics there is a generalisation of the four state atom state space [the full phase space] (atom 1 is in a state ϕ; atom 2 is in a state φ; atom 1 is in a state φ; atom 2 is in a state ϕ) and a generalisation of the three state atom state space [which is called "the reduced phase space"] (one atom in a state ϕ and one in a state φ; both in a state φ; both in a state ϕ). The former does distinguish between states which differ solely in the way the properties are distributed over atoms, and hence can be seen as supporting haecceitism; whereas the latter generalisation does not distinguish states differing merely by a rearrangement of properties among the atoms, and thus gives no support to haecceitism.[39] Huggett shows further that these two spaces are empirically equivalent: there are no physical properties which depend on the arrangement of properties over particular atoms.[40] Hence, in particular, there are no empirical differences which would show up in statistics ("one obtains the same statistics whether one counts permutations as distinct

---

[37] Huggett (1997), p. 125.

[38] Incidentally, it seems that Huggett is right in thinking that the commitment to substrata does amount to the commitment to haecceitism. Let's assume again that in our world the particle α is in a state ϕ and the particle β is in a state φ. Granting that particles have substrata, a possible world qualitatively identical with ours in which the particles swap their states will be a different world form ours. It does not differ in any quality, but it does differ in its 'transcendental' or 'metaphysical' features. In our world the particle α, which possesses a substratum Γ unique to it, is in a state ϕ, while in the possible world the very same particle (i.e. the particle possessing unique substratum Γ) is in a state φ.

[39] Huggett (1994), p. 70.

[40] Ibid., p. 71. Huggett assumes that in classical gases all atoms are in distinct individual states and shows that the frequency of a given distribution in the two representations is the same.

or not"[41]). Thus, "statistical physics is ... captured by either space".[42] Huggett concludes that classical physics does not support haecceitism.

And we have already seen that there are such interpretations of quantum mechanics which speak against haecceitism.[43] Hence, according to Huggett we would be much better off if we reject haecceitism. He does not advise us to discard the individuality of quantum particles, however. Roughly, his argument is this: in classical gas particles have distinct continuous trajectories and yet haecceitism is not true for them. They are individuals without being haecceistic. Hence, it should be also possible to treat quantum particles as individuals without being thereby committed to haecceitism. In his own words (1997, p. 121):

"[I]n a classical gas we do have particles with distinct, continuous trajectories, and hence particles which are distinct from one another, and which common sense says persist through time. ... [H]aecceitism is not entailed by these aspects of identity. *This means of course*, that neither the lack of sharp trajectories, nor the failure of haecceitism in QM entail that quantum particles aren't individuals in the robust sense of being distinct and persistent" [my emphasis].

So, the reasoning can be re-stated explicitly as follows:

1. Classical gas particles have distinct trajectories and are distinct and persist through time. (premise)
2. Classical physics does not support haecceitism. (premise)
3. Haecceitism is not entailed by distinctness and persistence. 1, 2

∴ 4. Neither the lack of sharp trajectories nor the failure of haecceitism entails that particles are not distinct and persistent. 3

It seems to me that this argument does not work, however. All we can have is:

1. as above
2. as above

[41] Huggett (1997), p. 121.
[42] Huggett (1994), p. 72.
[43] Cf. the strong reading of the Indistinguishability Postulate.

5. Haecceitism is not entailed by the distinctness and persistence of objects having sharp trajectories. 1,2

∴ 6. The failure of haecceitism does not entail that particles having sharp trajectories are not distinct and persistent. 5

Even if we agree that haecceitism fails for classical gas particles, then the conclusion we are entitled to derive is the following: The failure of haecceitism does not entail that objects which have continuous trajectories are not individuals. In other words, the failure of haecceitism is consistent with particles being distinct and persistent, where this distinctness and persistence is grounded in the spatio-temporal trajectories. It seems to me that we are not entitled to draw any conclusions about the individuality of objects which have no distinct trajectories or about objects which have no trajectories *and* for which haecceitism does not hold. Whereas conclusion 4. says in fact that we can have distinct and persistent objects which do not have distinct trajectories and for which haecceitism does not hold (in particular it has not been argued at all that objects lacking continuous trajectories can be distinct and persistent). This is a very strong claim and it certainly does not follow from what has been said before. The most important point to notice, however, is that although Huggett's argument shows that classical physics does not support haecceitism, it does not show that haecceitism fails.[44] And failure and lack of support are two different things. Huggett himself claims that whether or not we count permutations as distinct we get the same statistics. He concludes that this means that there is no support for haecceitism. But one can equally well derive a different conclusion: haecceitism is at least consistent with classical physics. And that is just what the transcendental

[44] Later on in the paper Huggett seems to acknowledge this himself, for he writes that Bohmian mechanics, just like ordinary classical mechanics, "carries no commitment either way to the metaphysics of haecceitism".

individuality theorist needs. All he has to maintain is that transcendental individuality (and so haecceitism) is not inconsistent with classical physics and QM. And it seems to me that Huggett's argument does nothing which would force one to reject that claim. At most Huggett weakens the motivation to endorse haecceitism.

Having dismissed haecceitism, Huggett goes on to claim that "[a]nyone who believes in metaphysically persistent and diverse classical atoms is quite free to carry her beliefs over to QM, for they are logically independent of qualitative behaviour".[45] Furthermore he argues that the ontology of individuals is consistent with QM, for one might maintain that diversity and persistence are "non-qualitative metaphysical properties"[46] which confer individuality.

Now, the kind of properties he seems to have in mind might at first blush seem similar to what Lewis calls *haecceities*[47]. Lewis claims that the existence of haecceities does not follow from haecceitism (one can be a property-nominalist, for instance). He also claims that believing in haecceities does not commit one to haecceitism. He himself is not a haecceitist (i.e. does not support haecceitism), but nonetheless believes in haecceities. He holds that there is a non-qualitative property for any set whatever of possible individuals - namely the set itself. This is not the kind

---

[45] Huggett (1997), p. 128.
[46] Huggett (1997), p. 127. It seems that Huggett understands "qualities" more broadly that it is usually done. For instance, on the one hand he claims that haecceitism is a view described by Lewis in the quote given above, while on the other hand he characterises haecceitism as a position according to which identity of objects goes beyond their qualitative characters (cf. (1997), p. 120). However, if only non-relational properties count as qualities, then the latter characterisation is insufficient. For it is not the case that any view which uses relational, spatio-temporal properties for the purpose of individuation is committed to haecceitism. In particular, if Huggett really meant haecceitism to be any view according to which identity of objects goes beyond their non-relational characteristics, straightforwardly his own view would be an example of haecceitism and clearly this is just what he wants to avoid. Thus, it seems to me that by "qualitative properties" Huggett must mean both non-relational and relational properties. Such an understanding is suggested even more strongly by his taking persistence of quantum particles to be a particular "non-qualitative" property. If qualities are understood narrowly - i.e. as non-relational properties - then persistence is always a "non-qualitative" property. We do not appeal merely to such qualities in order to establish whether an object persists or not - we do that by checking the continuity of its spatio-temporal trajectory.
[47] Lewis (1986), p. 225.

of property with which we are concerned, however. It is not 'metaphysical' (i.e. transcendental) in our sense - it cannot do the individuating for us. It will not do to say that quantum particles are individuals *because* they have a property: 'the unit set of individual'[48]. Such a set cannot *make* a particle an individual. One might agree that if a particle is an individual then it has this property, but it is not the case that because of having this property it is an individual.[49] Whereas in our case non-qualitative diversity and persistence are to *confer* individuality.

So, it seems to me that although we can have 'Lewis's' haecceities without haecceitism, there is no way of having *metaphysical* haecceities without haecceitism. What makes a particle's diversity and persistence non-qualitative and metaphysical properties must surely be the fact that they are the diversity and persistence of that very particle (i.e. of the individual having a certain substratum Γ).

Besides, French & Redhead and Redhead & Teller would probably agree that it does not have to be a substratum which confers individuality. Any transcendental characteristics would do.[50] Thus, they would probably be quite content with non-qualitative, metaphysical diversity and persistence as the individuating principles. For a theorist who wants to regard particles as individuals the crucial point is this: it has to make sense to say that permutations are distinct, since it is embedded in our notion of labelable individual. It does not matter then whether it is a transcendental substratum or a metaphysical property as long as by means of it we can conceptually distinguish relevant permutations. And the idea of having non-qualitative metaphysical

---

48 ibid.

49 ibid. Lewis writes further: "Also, for any individual and any counterpart relation, there is the set of that individual together with all its counterparts". It is clear that it is not the existence of such set that *makes* certain objects individuals and counterparts.

50"To deny that thisnesses are purely qualitative is not necessarily to postulate 'bare particulars', substrata without qualities of their own...". Adams (1979), p. 7.

properties which nevertheless do not distinguish between permutations is a strange and hardly intelligible one.

Thus, the upshot is this. Huggett takes quantum particles to be individuals, but he does not want to endorse haecceitism, since he claims that although classical particles are individuals, i.e. are persistent and diverse, haecceitism is not true for them. Classical particles are persistent and diverse thanks to their well-defined spatio-temporal trajectories. Since there are no such trajectories for quantum particles, someone who wants to argue that in spite of that fact they are persistent and diverse, may appeal to persistence and diversity understood as non-qualitative metaphysical properties. So, according to Huggett, one may have distinct and persistent quantum particles, without being thereby committed to haecceitism.

What I have tried to argue is - firstly - that by Huggett's own lights haecceitism is consistent with classical physics, and - secondly - that from the fact that one can claim that objects which have distinct well-defined spatio-temporal trajectories are distinct and persistent without being thereby committed to haecceitism, it does not follow that the same is the case for objects which do not have such trajectories. Moreover, it seems to me that it is hard to understand what non-qualitative metaphysical diversity and persistence are, unless one takes them to entail haecceitism. It would be a rather strange view which would have it that notwithstanding the fact that particles are individuals in virtue of having 'non-qualitative metaphysical' properties of diversity and persistence, their permutation does not amount to any change at all.

So, if I am right, there is no essential difference between the view which Huggett represents and the view supported by French, Redhead and Teller. The main difference is that French, Redhead and Teller postulate the existence of transcendental substrata, whereas Huggett talks in terms of transcendental properties. Although metaphysically this difference may well be very significant, it is not important from our point of view.

1.4.3. Interpretations of state-dependent properties

As we have seen, the transcendental-identity view allows us to regard particles as individuals. Since distinct particles of the same kind have all their intrinsic properties in common, PII(1) is false. In order to check the validity of PII(2) we must consider the extrinsic, state-dependent, properties of particles in the entangled states, for it is intuitively plausible that such states involve particles which share all their properties - i.e. both intrinsic and extrinsic ones. There seem to be two general options:

(*) The state-dependent properties of particles in entangled states may be identified with the specification of the pure quantum mechanical state in which the particle is; or

(**) The state-dependent properties of particles in entangled states may be identified with something else in the formalism that is taken to be 'the state' of an individual particle.

(*) The problem with this identification is that for an entangled state there are no pure states that can be ascribed to the individual particles. A given state is pure if it is not a mixture of other states. The information about the quantum mechanical state which the particle is in is given in terms of state vectors. State vectors are linked to observational results in terms of probabilities: a system characterised by a given state vector will reveal a given observational characteristic with a given probability provided by the state, observable algorithm of quantum mechanics. In special cases these probabilities equal 1. One state vector will give an object a probability 1 for having exact position x_1, a second state vector will give an object a probability 1 for having exact position x_2, a third state vector will give an object a probability 1 for having exact momentum p_1 and so on. These special state vectors are called eigenvectors for the properties assigned the probability 1. The key assumption is that a system has a given property if and only if it is in a relevant eigenstate, i.e. in the state described by a relevant eigenvector.[51]

If there were pure states that could be ascribed to the component particles, then the state for the combined system would be the tensor product of these states, such as (1") or (2"). But neither (3") nor (4") are tensor products; they are superpositions of tensor products. Thus, the component particles cannot be ascribed any pure states and so cannot be ascribed any state-dependent properties either.

It follows that if one identifies the state-dependent properties of particles with the pure states they are in, then in the entangled states there are no state-dependent properties which particles that are in those states have individually. Hence, the only properties that we can ascribe them are intrinsic properties and those they have in common, so PII is violated.

This interpretation leads to *holism*. According to the holistic theory some individuals have features that cannot be reduced to features of their component parts

[51] Teller (1986), p. 77-8. This is a strong assumption and rules out e.g. Bohm's theory of quantum mechanics.

and relations holding between those parts. The whole may have properties that do not supervene upon the intrinsic physical properties and relations of their basic physical parts.

(**) Nick Huggett[52] lists different objects with which one may identify states of individual properties. Let us mention by way of an example two of the possibilities.

(a) French & Redhead[53] mention the proposal according to which one can identify the states of the separate particles with the 'joint states'. In an entangled state each particle partakes of both states in the superposition of product states. Thus, two particles in the superposition state have the same both intrinsic and state-dependent properties. Thus, again both versions of PII are violated.

(b) French & Redhead[54] and Redhead & Teller[55] propose to identify the states of the separate particles with the 'mixed states'. The state of a particle in the superposition state is a 'reduced' state corresponding to an 'improper'[56] 'mixture' of the particles. The relevant (improper) mixed states are the same for the two particles - they are equiprobable mixtures of the states |s> and |r>. So, also on this interpretation one ends up with particles having the same intrinsic *and* state-dependent properties. PII is violated in the same way as on the previous interpretation of the state-dependent properties.

Huggett claims that in both those cases, (a) and (b), "haecceitism is trivially false". His reason for such a conclusion is that both particles are in the same joint (or mixed respectively) state and hence the permutation of particles does not change

---

[52] Huggett (1997), p. 125nn.
[53] French, Redhead (1988), p. 240.
[54] French, Redhead (1988), p. 241.
[55] Redhead, Teller (1992), p. 216.
[56] Redhead, Teller (1992), p. 216.

anything; or as he puts it "'swapping states' in [these] case[s] leaves everything just as it was". This conclusion is simply unjustified. "Leaves everything just at it was" in this context may only mean "makes no qualitative difference". However, haecceitism is a metaphysical standpoint and whether 'swapping states' makes any qualitative difference, or not, has no bearing on its being a correct or incorrect view. The states of the transcendental individuals have been swapped, and although there is no qualitative difference, there is a metaphysical one. One cannot argue from the failure of PII to the failure of haecceitism.[57]

1.5. Quantum individuality revisited

One may distinguish two senses of the term "individual". We started off with a definition according to which a spatio-temporal object to be an individual has to be individuatable and reidentifiable. The former condition amounts to the requirement that an individual at any given time must be distinguishable from every other spatio-temporal object. The latter is tantamount to the claim that individual must be a continuant; it must persist through time. Let us call an object that satisfies both conditions an individual in the *strong sense*. For *weak individuality* only the first condition must be fulfilled. So an object need not be a continuant in order to be an individual in the weak sense. In this sense PII states that every object is an individual, for if two objects are indistinguishable then they are in fact one and the same object.[58]

[57] Other possibilities listed by Huggett are: "expectation values" (Lavine; Redhead & Teller), wave-packets with (approximately) disjoint support from any other individual state (Dicks), a modally assigned set of definite properties (van Fraassen), hidden variables and the joint state (Butterfield; French & Redhead). On the last two proposals PII may not be violated. Here again Huggett makes a faulty connection between PII and haecceitism. See (1997), p. 127.

[58] Cortes (1976), p. 493.

Hence, every 'genuine' object is distinguishable from every other object and so is an individual in a weak sense. So, on this account the violation of PII amounts to the claim that there are objects which are not individuals.[59]

We have just seen that PII is violated by quantum particles. The obvious conclusion is that they are not individuals. One can avoid this conclusion by bringing in metaphysical substrata and ascribing transcendental individuality to particles.[60] Transcendental individuality is individuality in the strong sense. It is consistent with quantum mechanics, but does not vindicate PII. Thus, PII must be rejected as not even contingently true. One ends up with indistinguishable individuals whose individuality is conferred by mysterious transcendental substrata. I will call individuals for which PII is not valid *transcendental individuals*.

It can be argued that the price of saving individuality of quantum particles is too high. It is true that one *can* hold on to the view that particles are individuals but in order to do this one must accept transcendental individuality. Moreover, the claim that particles are transcendental individuals is consistent with quantum statistics only if one admits also the existence of never-occurring non-symmetric states and properties. The alternative is to introduce non-individuality "right at the start".[61] It is done by most formulations of quantum mechanics. They do not talk in terms of individuals at all and do not introduce labels and transcendental individuality. They refer to distinguishable fields and non-individual 'particles'. In such theories the problems with getting statistics right do not arise. However, the question then is what exactly this 'non-individuality' of the 'particles' amounts to.

[59] Of course objects which do not obey the weak individuality constraint are not individuals in the strong sense, either.
[60] See however footnotes 14 and 17 for other options.
[61] Post (1963), p. 536.

There is also an intermediate view. Redhead proposes to give up particles in favour of "ephemerals".[62] Ephemerals constitute a new category of entities. The key assumption is that the collection of ephemerals is itself a single ephemeral. Ephemerals can be distinguished from one another at any given time, but they do not possess label transcendental individuality and hence cannot be reidentified. Redhead does not want his ephemerals to be just waves. Teller pushes Redhead's idea a bit further.[63] He claims that they are waves with certain very unexpected features, but nevertheless waves. He takes the notion of transcendental identity to be essential for our concept of a particle and the notion of superposition to be central for waves. Ephemerals are not continuants, they cannot be reindividuated and moreover they obey some kind of superposition principle: if we add two ephemerals we will obtain a new single one.

French claims that ephemerals do not possess self-identity, because in the 'entangled' state "the self-identity of particles becomes submerged in that of the global collective".[64] This seems to be too strong a claim, however. The claim that ephemerals are not continuants, that they "pop in and out of existence" is different from the claim that ephemerals are not identical with themselves. It seems that as long as we can speak of two ephemerals we can speak of two self-identical ephemerals. And when one deals with superposition one deals with one (for the explicit assumption has it that a collection of ephemerals is itself a *single* ephemeral), again self-identical, ephemeral. It appears that as long as we are able to refer determinately to something or count it, that something must possess self-identity. No object can

[62] Redhead (1982), p. 88-89.
[63] Teller, p. 106-108.
[64] French, Krause (1995), p. 200.

possess criteria of identity without being self-identical in the first place. So, as long as the claim is that we know the number of the objects involved, these objects have to be self-identical entities.

Since ephemerals are not continuants, they are not individuals in our strong sense but they can be regarded as individuals in the weak sense.

Let us now have a look at the alleged example of vague identity offered by E. J. Lowe and see whether our general considerations concerning individuality of quantum particles will allow us to determine whether the situation described in the example is one of 'genuine' ontic indeterminacy.

2. E. J. LOWE'S EXAMPLE

2.1. The construction of the example

2.1.1. Evans's argument and the identity-involving properties

Recall that the radical standpoint has it that the sentence "$a = b$", where "a" and "b" are precise designators, is indeterminate in truth value iff:

(i) there is no property which b (definitely) possesses and a (definitely) does not possess; and

(ii) there is a property which b (definitely) possesses, but it is indeterminate whether a possesses this property.[65]

[65] Cf. chapter II, section 3.3. The intermediate standpoint has it that the sentence "$a = b$", where "a" and "b" are precise designators, is indeterminate in truth value iff: (i) there is no identity-free property which b (definitely) possesses and a (definitely) does not possess; and (ii) there is a property which b (definitely) possesses, but it is indeterminate whether a possesses it.; whereas the liberal standpoint says that that sentence is indeterminate in truth value iff: (i) there is no indeterminacy-free property which b (definitely) possesses and a (definitely) does not possess; and (ii) there is a property which b (definitely) possesses, but it is indeterminate whether a possesses it.

Evans's argument can be regarded as an attempt at refuting the possibility of the existence of such statements. It purports to demonstrate that this definition itself rules out the possibility of the indeterminate identity statements containing only precise designators. The conditions (i) and (ii) are never jointly satisfied, for if "$a = b$" is indeterminate, there will be a property which b possesses and which a definitely does not possess; namely the property of being such that it is indeterminate whether it is identical to a. For it seems that if $\nabla (a = b)$ and "a" and "b" are precise, then we are entitled to predicate *of b* that it is such that it is indeterminate whether it is identical to a ($\lambda x [\nabla (x = a)]b$). Such ascription is not justified if "a" or "b" is imprecise. Hence, the only indeterminate identity statements, if any, are those that contain imprecise designators.

Lowe claims that quantum theory provides counterexamples to Evans's conclusion.[66] According to him there exist identity statements which are indeterminate despite having two precise designators as their components. He considers identity over time and claims that there are identity statements whose indeterminacy is due solely to the existence of vague objects. His example goes as follows: Suppose that in an ionisation chamber a free electron a is captured by an atom to form a negative ion. The electron a and other electrons in the outer shell of the atom enter a superposition state. Later on the atom releases an electron b and reverts to its previous state. It is claimed that - because of the nature of superposed states - there is no objective fact of the matter as to whether or not the captured electron a is identical with the released electron b. According to Lowe this example counts as an example of indeterminate

[66] See Lowe (1994).

identity. The property *is such that it is emitted from the atom* is true of b but it is indeterminate whether it is true of a.

The existence of indeterminate identity statements "$a = b$" containing only precise singular terms shows that Evans's proof must be incorrect; that it must commit a fallacy. As we have seen in the first chapter, according to Lowe the most compelling explanation[67] of what has gone wrong in the proof is the one which says that the inference from

(3) $\neg\nabla\ (a = a)$

to

(4) $\neg\lambda x\ [\nabla\ (x = a)]a$

is invalid. If there is no objective fact of the matter as to whether or not a is identical with b then the property "$\lambda x\ [\nabla(x = a)]$" that b possesses is not determinately different from the property "$\lambda x\ [\nabla(x = b)]$" that a possesses, because these properties differ only by permutation of "a" and "b". Since $\lambda x\ [\nabla(x = b)]$ and $\lambda x\ [\nabla(x = a)]$ are not determinately different, one cannot (determinately) deny that a possesses the property $\lambda x\ [\nabla(x = a)]$. Hence, to claim that (3) entails (4) is to make a formal error. A formal restriction must be placed on the property abstraction so that from "$\neg\nabla(a = a)$" only "$\neg\lambda x\ [\nabla(x = x)]a$" could be derived.

Thus, conditions (i) and (ii) are satisfied. There is no property which b possesses and a does not possess (for - as we have just seen - we cannot say that b possesses and a does not possess the property of being indeterminately identical to a), and yet there is a property which b possesses, but it is indeterminate whether a possesses this property (namely the property of being emitted from the atom).[68]

---

[67] He considers five different explanations altogether. See Lowe (1994), p. 112. See also chapter 1.
[68] Thus, Lowe argues in fact that the radical standpoint on intermediate identity should be replaced

Noonan points out that Lowe is assuming that Evans's argument essentially requires an appeal to properties only expressible using the concept of identity.[69] One may accept that properties which involve identity are suspect in the cases concerning indeterminate identity, but it seems that they are not the only properties to which one may appeal in such cases. In order to disarm Lowe's argument one must ban identity-involving properties from consideration and focus on identity-free ones instead. Evans's argument will still work provided that the objects which the indeterminate-identity statement is about have some properties which are not based on identity and which (determinately) differentiate these objects.

2.1.2. Identity-free properties

Noonan reconstructs Evans's argument for the case of Brown and Brownson, in which Brown's brain is transplanted into Robinson's body (where "Brownson" is a name introduced to name a person consisting of Brown's brain and Robinson's body) and it is apparently indeterminate whether Brown = Brownson.[70] It seems that we may apply Evans's argument here and - on the basis that Brownson is such that it is indeterminate whether he is identical with Brown, whereas Brown is not such that it is indeterminate whether he is identical with Brown - we can conclude that either Brown and Brownson are not indeterminate after all or else "Brown" or "Brownson" is an imprecise designator. Lowe, however, can reply that in deriving

(4) $\neg\lambda x\, [\nabla\, (x = \text{Brown})]\text{Brown}$

with what we have called the intermediate standpoint.

[69] Noonan (1995), p. 16.

[70] Noonan (1995), p. 16. This example is a version of the example of Brown and Smith from chapter III.

from

(3) $\neg\nabla$ (Brown = Brown)

we have illegitimately assumed that being such that it is indeterminate whether he is identical with Brown is distinct from being such that it is indeterminate whether he is identical with Brownson. Such a supposition simply begs the question against the proponent of vague identity. If Brown and Brownson are vague objects, then the properties based on their identity (namely being such that it is indeterminate whether he is identical with Brown (or Brownson)) are not determinately distinct and hence they cannot differentiate between Brown and Brownson.

Brown and Brownson may have other distinguishing properties that do not involve any appeal to their identity, however.[71] Suppose that before the transplant Brown was fat and Robinson thin. Brownson, who has Robinson's body, is thin. Yet it is indeterminate whether Brown is thin after the transplant, for it is indeterminate whether he is Brownson or not. Thus, Brown possesses the property that it is indeterminate whether he is thin, but Brownson does not possess this property. Hence, by the contrapositive of Leibniz's Law, $\neg$(Brown = Brownson) which apparently contradicts the initial assumption that "Brown = Brownson" is indeterminate. Lowe's reasoning cannot be applied here, because being such that it is indeterminate whether he is thin after the transplant is a property that does not involve identity. Moreover, it seems plausible that such differentiating identity-free properties exist for any pair of supposedly vague objects.[72]

---

[71] Noonan (1995), p. 16.

[72] Recall our considerations concerning the watches and the property of being worn last year (cf. chapter II). Noonan remarks that one could argue that electrons do not have any identity-free properties which would determinately distinguish them. But since Lowe stresses that outside superposition states electrons do have determinate identity, it is unlikely that he will use this argument. If one is to give an informative answer to the question whether or not the electrons *a* and *b*, which are not in a superposition state, are determinately distinct, one cannot refer merely to

So, to sum up: Lowe's argument, if accepted, shows that Evans's argument fails, because it assumes what it was supposed to prove. It uses as distinguishing, properties which essentially involve identity and as such are suspect and should not be used in the proof. Noonan rejoins that Evans's reasoning can be conducted without the use of identity-involving properties. For every pair of objects a distinguishing identity-free property can be found.[73] Hence the indeterminacy in question should not be explained by an appeal to indeterminately identical objects (for they are determinately non-identical in fact), but rather - by an appeal to the imprecision of the names of these objects. He claims that every alleged case of ontic vagueness, as a matter of fact, is a case of semantic vagueness.[74]

According to Noonan the Brown/Brownson case is analogous to the electron *a*/electron *b* case. Both are cases of identity over time and the character of indeterminacy involved seems similar. In the former case the indeterminacy of the statement "Brown = Brownson" can be explained by an appeal to the imprecision of (at least) one of the flanking names; for instance "Brown". It is indeterminate whether "Brown = Brownson", but it *is not the case* that there is an object which is Brown and is such that it is indeterminate whether or not it is identical with Brownson. Hence, in order to regard the electron case as an example of ontic vagueness, one should establish first that neither "*a*" nor "*b*" are imprecise designators (unlike "Brown").[75]

---

identity-involving properties such as "is identical to *a*" and "is identical to *b*".

[73] Thus, even if the intermediate characteristic of indeterminate identity is accepted, one can prove that the alleged indeterminate identity is in fact non-identity.

[74] Incidentally, as we have seen in chapter III the above solution is easily available to perdurantists. However, endurantists may also argue that such terms are imprecise, but only if they admit that the objects themselves are vague as well. For endurantists who do not believe in vague objects, but still want to apply this solution, are forced to accept the spatio-temporal coincidence. Thus, we do not agree with Noonan that if terms are imprecise, then the whole vagueness is semantic. On the endurantist view both terms and objects are vague.

[75] Noonan (1995), p. 19.

2.1.3. Tense-involving properties

In his "Reply to Noonan on vague identity" Lowe, after adjusting the reasoning which Noonan used in the Brown/Brownson case to his electrons example, goes on to argue that electrons are vague objects and the indeterminacy under discussion is ontic after all. He admits that in the Brown/Brownson example ontologically indeterminate identity is not at issue,[76] but claims that this is not so in the case of the electrons.

Noonan's argument applied to electrons is as follows: Let's assume that it is indeterminate whether *a* is identical with *b*. *b* is the electron that was emitted from the atom. Therefore, *b* possesses the property of being emitted from the atom. Now, if it is indeterminate whether *a* is identical with *b*, then it is also indeterminate whether *a* was emitted from the atom, and *a* possesses the property that it is such that it is indeterminate whether it was emitted from the atom. So, there is a property (*viz*. the property of being such that it is indeterminate whether it was emitted from the atom) which *a* possesses but *b* does not possess. Hence, *a* is not identical with *b*, which contradicts the initial assumption. Moreover, the distinguishing property appealed to is an identity-free property, so Lowe's reasoning from (1994) cannot be applied to it.

However, Lowe replies that the property of being such that it is indeterminate whether it was emitted from the atom cannot distinguish between particles. The reason is that "we cannot legitimately ignore [tenses] where predications are concerned".[77] Let t_1 be the time of entanglement and t_2 the time after electron *b* was

[76] Since Lowe does not believe in temporal-parts it is not clear what his solution is to this case.

[77] Lowe (1997), p. 90. It is clear that Lowe does not want to give up the intermediate standpoint on indeterminate identity and replace it with the liberal one. According to this latter view the property of being indeterminately emitted from the atom, which *a* possesses and *b* does not, cannot be used as a proof that *a* and *b* are not indeterminately distinct. A liberal theorist can hold on to the view that *a*

emitted. Now, at t_2 a possesses the property that it is indeterminate whether it is such that it was emitted from the atom. However, Lowe claims that b possesses the symmetrical property that it is such that at t_1 it was indeterminate whether it was going to be emitted. And there is no reason to suppose that the property that is assignable to a in virtue of the fact that at t_2 it was indeterminate whether it had been emitted is determinately distinct from the property that is assignable to b in virtue of the fact that at t_1 it was indeterminate whether b was going to be emitted. Lowe concludes that "the coherence of ontically indeterminate identity has not been successfully challenged".[78]

2.1.4. The analysis of the electrons example

Lowe wants to argue that although the predicate "it was emitted from the atom" is true of b, and it is indeterminate of a, and consequently another predicate "it is indeterminate whether it was emitted from the atom" is true of a, it does not follow that "it is indeterminate whether it was emitted from the atom" is false of b. He claims that at t_2 it was indeterminate whether a *was* emitted, and at t_1 it was indeterminate whether b *was going* to be emitted, so the properties which a and b have in virtue of those facts are not determinately distinct.

The way in which Lowe intends his example to work is not entirely clear. There are two interpretations which seem to be equally justified:

and b are indeterminately identical as long as the only properties that determinately distinguish the objects in question are indeterminacy-involving. A separate problem is that he should provide us with reasons for thinking that $\nabla (a= b)$.

[78] Lowe (1997), p. 90.

(IntA) He writes that *a* has been introduced as the captured electron and *b* as the emitted electron. This suggest the following interpretation: There is an electron approaching an atom; we call this electron "*a*"; *a* is captured and becomes a part of the entangled state with another electron; later on an electron is emitted; we call the electron which was emitted "*b*". The question is whether *b* is such that it is indeterminate whether it is identical with *a*.

(?)∇	(*a*	=	*b*)
	at t_1, captured		at t_2,emitted
	at t_2,∇emitted		at t_1,∇emitted

On the other hand,

(IntB) Lowe claims that what (among other features) makes the electrons case different from the Brown/Brownson case is the fact that "*two electrons, a and b,* both exist throughout a period of time which begins before the capture of one of them and ends after the emission of one of them".[79] So, here we have one electron approaching an atom; we call it "*a*"; and another electron within the atom's outer shell; we call it "*b*". It should be noticed that the electron within the atom had to be called "*b*" not later than *a* was captured, because it is claimed that (i) both electrons *a* and *b* exist throughout the period in question; and (ii) "these two electrons exist in an 'entangled' state". So, *a* is captured and becomes a part of the entangled state. Later on an electron is emitted and "there is no fact of the matter as to which of them is emitted".[80]

It seems that in this case calling the emitted electron "*b*" begs the question. For we have no more reasons to identify the emitted electron with *b*, then we have to

[79] Lowe (1997), p. 90 (my emphasis).
[80] ibid.

identify it with a. So, in this case the emitted electron could be called, for instance, "c". Now we have got two questions concerning indeterminate identity: whether c is such that it is indeterminate whether it is identical with a

(?)∇	(a	=	c)
	at t_1,captured		at t_2, emitted
	at t_2,∇emitted		at t_1,∇emitted

and whether c is such that it is indeterminate whether it is identical with b.

At first glance it seems that (IntB) is more complex than (IntA), because it refers to two indeterminate-identity questions, whereas only one such question is mentioned in (IntA). However, in (IntA) we may ask whether b is indeterminately identical with the electron which was in the atom from the beginning as well as whether b is indeterminately identical with a. It is not the complexity which is important here. Neither are the two interpretations essentially different. What is important is the fact that they bring out that the way the example has been described is incoherent. Two cases can be distinguished here and those cases are incompatible. In the first case the question whether a and b are indeterminately identical is entirely justified, but we have no right to claim that *two* electrons, a and b, exist through the whole period of superposition. We perform the act of giving a name "b" to the emitted particle at some time after it was emitted and we have no guarantee at all that we are not naming a, i.e. the electron which had been captured. If this were the case, then a and b would be one and the same electron - not two. In the second case the question of indeterminate identity of a and b does not arise at all. This interpretation gives priority to that of Lowe's claims which the previous interpretation discarded. Since the claim that *two* electrons, a and b, exist through the whole period of superposition is taken at face value, the identity of a and b is not an issue: they are two, hence obviously they are not identical. One can still ask whether the emitted electron is identical with the captured one, but saying that the emitted one is b is completely *ad hoc* and arbitrarily answers the question of a and b's indeterminate identity in the negative. Thus, if one wants that question to be an interesting one, one has to find a new name for the emitted electron.

So there are two alternatives here. Either we stick to the claim saying that a and b are two electrons existing through superposition, or else we ignore it. In the former case the statement "$\nabla(a = b)$" is simply false (although another statement, namely, "$\nabla(a = c)$" (as well as "$\nabla(b = c)$"), where c is the emitted electron, becomes a puzzle), whereas in the latter case it may indeed turn out that its truth value is indeterminate.

In what follows I will concentrate on the interpretation (IntA) since it allows us to retain Lowe's original claim that the truth value of "$\nabla(a = b)$" is indeterminate.

2.1.5. Number and identity

Lowe argues that although in a superposed state the number of the electrons is determinate, there is no determinate fact of the matter as to the identity of the electrons in such state. He claims that a statement of the form "*x* is the same electron as *y*" may not have a determinate truth value if *x* and *y* are in the entangled state. It is hard to imagine, however, how this could be so. Suppose that two electrons, *x* and *y*, enter a superposed state. In such a state they are absolutely indiscernible; we cannot tell them apart. Moreover, the claim is that not only *we* cannot tell them apart, but they cannot be told apart *in principle*. Remember, however, that Lowe assumes that the number of electrons in the entangled state is determinate. Hence, there are *two* electrons in this state and they do not penetrate each other nor do they exchange their properties in any other way.[81] Because there are no means of distinguishing them, we cannot tell which one is *x* and which one is *y*.

It seems to follow that, despite the fact that we do not know which of the electrons in the entangled state is *x*, and which is *y*, we do know that there are two electrons in this state, each of which is identical with itself and different from the other. Moreover, before the entanglement they must have been either different or identical. If *x* were not identical with *y* before the entanglement, then it could not became identical with it in the entanglement. Similarly, if they were identical, they could not cease to be identical. Hence, in each case "*x* is the same electron as *y*" has a determinate truth value (which may be unknown to us).

[81] As it has been mentioned on the particle-interpretation of QM the particles in entangled states are described symmetrically; they have the same monadic properties and the same relational properties one to another, but they do not interfere with one another.

On the other hand, if electrons are not named before the entanglement and we know nothing about their histories, then we cannot begin referring (determinately) to them by "x" or "y" in the entanglement. We cannot point to one of the particles in the entangled state first and name it "x", and point to another particle next and name it "y", the reason being that we are not able to distinguish this situation from another situation in which we name the same particle twice. In order to name something effectively we must be able to distinguish that something from other candidates to this name; i.e. we must be able - if requested - to tell or show which object we purport to name. In the entangled state this is impossible. And if there is no information concerning the histories of the particles prior to entanglement available, then we have no means of choosing one of the two absolutely indiscernible particles. So, it seems to me that we cannot refer to either of them separately. Hence, the claim that the statement "x is the same electron as y" has no determinate truth value is a plausible claim in this case, but the justification for it has nothing to do with ontic indeterminacy. This statement has no determinate truth value because "x" and "y" have no determinate reference. It is indeterminate whether we have succeeded in naming two different particles or one particle has been named twice.[82]

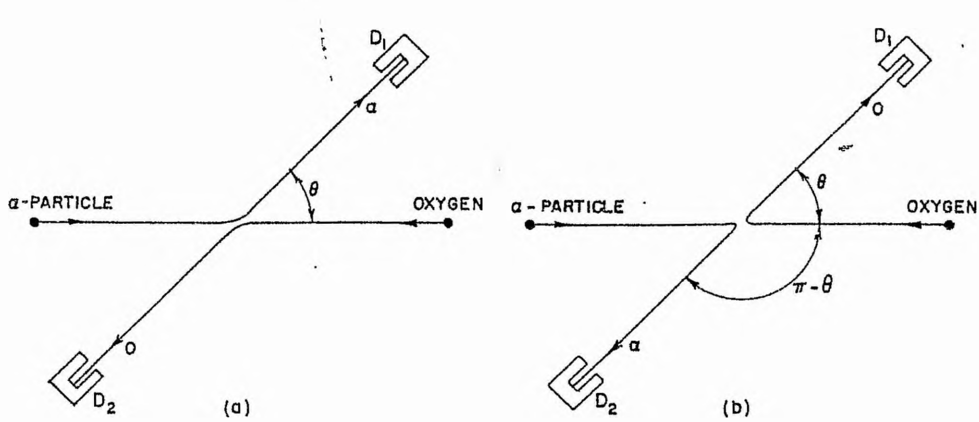
2.2. The scattering of α-particles

What is important in Lowe's example is that it easily generalises. We need not consider absorption and emission of electrons. Every situation in which we have two indiscernible particles which enter a superposed state poses the same problem.

[82] One might argue however that semantic indeterminacy in this case has an ontic source. But see below section 3.3.2.

consider absorption and emission of electrons. Every situation in which we have two indiscernible particles which enter a superposed state poses the same problem.

For instance, Feynman in his *Lectures on Physics* describes the following experiment.[83] Let us consider the scattering of nuclei on other nuclei and let us start with α-particles (i.e. helium nuclei, He^4) bombarding oxygen nuclei. We assume that the α-particle and the oxygen nucleus have their velocities in opposite directions both before and after the collision. Suppose moreover that there is conservation of energy and that the collision energy is so low that neither particle is broken up or left in an excited state. Since both particles carry a positive charge they will deflect each other. The scatterings will happen at different angles with different probabilities and the experiment consists in measuring the probability of scattering in various directions. This can be done by means of two detectors, one of which is situated at the angle θ to the line along which the particles move, while the other is situated at the opposite side at the angle $(\pi - \theta)$.



[83] Feynman (1965), p. 3-9, 3-10, 3-11.

Now, assume that the detectors do not distinguish the particles - they just count the presence of *some* particle. If there is to be an oxygen in the position θ, there must be an α-particle in the position $(\pi - \theta)$. Thus, if $f(\theta)$ is the amplitude for α-scattering through the angle θ, then $f(\pi - \theta)$ is the amplitude for oxygen scattering through the angle θ. So, the probability of getting some particle in the detector D_1 at position 1 is $|f(\theta)|^2 + |f(\pi - \theta)|^2$. However, the state in which it is the α-particle which is in the position 1 and the state in which it is the oxygen particle which is in that position are *distinguishable in principle*. We may not want to distinguish them, but we could. "Nature knows" as Feynman puts it. The result: $|f(\theta)|^2 + |f(\pi - \theta)|^2$ is correct for all cases in which we deal with distinguishable particles. It is not correct, however, for the case in which an α-particle bombards an α-particle. The reason is that there are two ways to get an α-particle into the detector: either by scattering the bombarding particle at an angle θ or by scattering it at an angle $\pi - \theta$. There is no way we could tell which particle entered the detector. The state in which it is the bombarding α-particle which entered into the counter and the state in which it is a target particle which did so are *indistinguishable in principle*. In fact, the probability of an α-particle at D_1 is $|f(\theta) + f(\pi - \theta)|^2$. If we could, even in principle, distinguish which particle went which way then the probability would be as previously: $|f(\theta)|^2 + |f(\pi - \theta)|^2$. The fact that the probability result is quite different shows that the two alternatives involving indistinguishable particles cannot, *even in principle*, be distinguished. We could adapt Feynman: "nature does not know".

This presumably can be taken to show that there is *no fact of the matter* whether the bombarding α-particle entered D_1. There cannot be a fact of the matter that the particle entered D_1 and there cannot be a fact of the matter that it did not enter D_1, for if there were any such fact, we would get the wrong probability result. In other words, the assumption that the two states can in principle be distinguished - i.e. the assumption that there is a fact of the matter which particle entered the detector - results in an incorrect probability measurement, which is inconsistent with the empirical data.

3. ARE QUANTUM PARTICLES VAGUE OBJECTS?

3.1. The three metaphysical alternatives

In the first part of this chapter we investigated three metaphysical alternatives for quantum particles: they can be regarded either as transcendental individuals or as ephemerals or else as non-individuals. Lowe clearly intended his example to work for particles regarded as individuals. The example can be constructed neither for non-individuals nor for ephemerals. For non-individuals the question of vague identity does not arise at all.[84] The situation described in Lowe's example does not arise for entities which cannot bear labels, for in such a case there is nothing for the names "*a*" and "*b*" to refer to.

The example is a case of identity over time. However, if quantum particles are some kind of ephemerals, then they are not continuants and cannot be re-individuated. As we have seen two ephemerals that enter a superposed state become one

[84] One theory which deals with "non-individual" objects is "quasi-set theory". This theory allows for the existence of certain kind of Urelements to which the concept of self-identity does not apply. See French, Krause (1995), pp. 23nn.

ephemeral. So, although we can distinguish between two particles before they enter the superposition state, as soon as they enter such a state they cease to exist. A new partless entity is created and is determinately different from both previous ones. At the very moment at which the entangled state ceases to exist two completely new entities begin to exist. Thus, there are no ephemerals that would satisfy an indeterminate diachronic-identity statement. It seems also that ephemerals cannot be indeterminately identical at a time. At every time at which they exist they are distinguishable from every other object. Before the entanglement the ephemerals are clearly two, while after the entanglement there is clearly one ephemeral. Hence, it appears that there are no vague ephemerals.

Lowe's example can only be constructed for particles regarded as individuals. As French, Redhead and Teller argue the only way for the particles to be individuals is to be transcendental individuals. The individuality of particles has to transcend all their attributes. It follows that there must be a fact of the matter as to whether $a = b$. If particles are transcendental individuals then two particles may be distinct and yet may be absolutely indistinguishable, have the same intrinsic and state-dependent properties. Surely, on this account it may be indeterminate *epistemically* whether at two different times one has to do with two different particles or with the same particle. The question remains whether the indeterminacy involved is ontic as well as epistemic.

Transcendental individuals have label transcendental individuality; their number is determinate. In virtue of having label transcendental individuality they also may have histories. So, it follows that throughout the whole period there are two distinct particles: one which has been captured and one which has been within the atom from the beginning. One of those particles has been emitted and one of them remained in the atom. There are no means to ascertain which particle suffered which fate, but label transcendental individuality, obscure as it is, has to amount to something. If particles have label transcendental individuality then there must be 'a fact of the matter' concerning their identity, even though it is a 'deep, metaphysical fact' due to 'something known not what'.[85]

The problem arises of course how to reconcile transcendental identity with empirical results concerning superposed states or the scatterings of α-particles. As we have seen the weak reading of the Indistinguishability Postulate, which says that non-symmetric vectors do not represent states which ever physically occur, can get transcendental individuality 'off the hook'. On the weak reading particles are subject to restrictions as to the set of possible states they can occupy. Thus, on this reading of the Indistinguishability Postulate there is a conceptual possibility of the occurrence of the states

(3) Particle α is in the state $|r\rangle$ and particle β is in the state $|s\rangle$ and

(4) Particle α is in the state $|s\rangle$ and particle β is in the state $|r\rangle$,

but such states are not physically possible. Fermions can only be in the anti-symmetric states and bosons - only in the symmetric states. The states such as (3) and (4) have the wrong symmetry - they are non-symmetrical, and hence are not accessible for quantum particles. However, the conceptual possibility of the occurrence of such states is enough to ensure the individuality of the quantum particles. Thus, provided one adopts the weak reading of the Indistinguishability Postulate, label transcendental individuality can be made consistent with quantum statistics.

---

[85] Locke famously called the substratum "something I know not what".

So, the conceptual possibility is enough to allow us to claim that the state in which $a = b$ could be distinguished from the state in which it is not the case that $a = b$. Thus, there is a fact of the matter as to their identity, but it is not a 'physical fact' Nothing that could ever occur in our world can allow us to ascertain whether the identity between the captured particle and the emitted particle holds or not.

What about Feynman's scattering experiment? Can one say that it is determinately the bombarding α-particle or the target α-particle which entered the detector D_1? It seems that the positive answer to this question would contradict empirical data. As has been said if one could distinguish which particle went which way, then one would obtain the wrong probability result. However, it seems that if α-particles are transcendental individuals and have substrata, and French, Redhead and Teller are right about the weak reading of the Indistinguishability Postulate, then one might argue that there is a conceptual possibility of distinguishing the α-particles. Although in our world there is no possibility to distinguish them, they are *conceptually* distinguishable. There are certain states which are not accessible for quantum particles, but the mere (unrealised and unrealisable) possibility of the existence of such states means that they can be regarded as individuals. In other words, if the particles entered such states we would see the difference. Unfortunately they cannot enter them, because the states in question have the wrong symmetry. Thus, we will never see the difference; we will never be able to distinguish the particles. Therefore, one can still maintain that "nature does not know", because the principle of individuality - the substratum - is of a 'transcendental order'.

Hence, regarding the relevant 'fact of the matter' about the identity of quantum particles as a 'deep, metaphysical fact' concerning their substrata allows to avoid the charge of contradicting the results of quantum statistics. The substrata, the underlying individuality of the particles, do not show up in the statistics, so to speak.

Thus on this interpretation it ceases to be the case that there is *no fact of the matter* whether the captured electron is identical with the emitted one and it ceases to be the case that there is no fact of the matter whether the bombarding α-particle entered the detector D_1. Although there is still no 'physical fact of the matter', there are relevant 'deep, metaphysical facts' concerning the relevant substrata of the particles. Particles have names in virtue of having substrata. In fact, one could think of names "*a*" and "*b*" as attached to substrata rather than particles themselves. Thus, if one had the means to follow the fate of a given substratum, one would know the answer. But one cannot do such a thing, of course. Thus, in either case it is *unknowable in principle* which of the two alternatives has been realised. It is unknowable in principle whether or not *a* is identical with *b* and it is unknowable in principle whether the bombarding α-particle entered the detector D_1. However, it is not metaphysically or ontically indeterminate whether the relevant facts occur. Hence, one might argue that while regarding particles as transcendental individuals commits one to epistemic vagueness, it does not commit one to ontic indeterminacy.

3.2. Further objections to Lowe's example

It is worth pointing out that there are other objections against Lowe's argument, which can be raised quite independently from any considerations concerning individuality. In what follows the difficulties concerning individuality of quantum particles are ignored and it is taken for granted that such particles are individuals in the sense of being distinct and persistent. It is argued that even granting all of this the electrons-case does not furnish us with the example of ontic vagueness.

3.2.1. Taking tense seriously

Recall that Noonan argues that there is an identity-free property, *viz.* "the property of being such that it is indeterminate whether it is emitted from the atom at t_2", which is possessed by *a*, but it is not possessed by *b* and so can distinguish between these particles. Lowe replies that the property of being such that it was indeterminate at t_2 whether it had been emitted cannot serve to distinguish between two particles because it is not determinately different from the property of being such that it was indeterminate at t_1 that it was going to be emitted. Lowe concludes that "[c]onsequently, *a*'s possession of that 'first' property can provide no reason for thinking that *a* determinately differs in at least one of its properties from *b*".[86] It seems however that *a* does differ in its properties from *b*, after all. The 'first' property can be ascribed to both *a* and *b*, whereas the former only to one of them. *a* is such that it was indeterminate at t_1 that it was going to be emitted *and* such that it is indeterminate at t_2 whether it was emitted from the atom. *b* is such that it was indeterminate at t_1 that it was going to be emitted *but is not* such that it is indeterminate at t_2 whether it was emitted from the atom.

[86] Lowe (1997), p. 90.

$\neg\nabla$	$(a$	$=$	$b)$
	at t_1, captured		at t_2, emitted
	at t_1,∇emitted		at t_1,∇emitted
	at t_2,∇emitted		at t_2, $\neg\nabla$emitted

And it seems that this picture suggests that the property of being such that it was indeterminate at t_2 whether it had been emitted is determinately different from the property of being such that it was indeterminate at t_1 that it was going to be emitted. After all only one particle, *a*, has both these properties - *b* has only one of them. It seems that if the properties were not determinately distinct we could not argue that one particle has both, while the other has only one. Hence, it appears that identity-free but indeterminacy-involving properties may be used to distinguish between the electrons after all.[87]

3.2.2. Indeterminacy vs. indeterminism

According to another - more radical - objection there is a flaw in the example itself. K. Hawley argues that we cannot ascribe *b* the property of being such that it is indeterminate at t_1 whether it will be emitted from the atom.[88] All that quantum mechanics tells us is that at t_1 it is *undetermined* whether *b* (or *a*) will be emitted; i.e. neither the fact that *b* will be emitted nor the fact that *b* will not be emitted follows from the laws of nature plus a total description of the situation up to the time of capture. This however does not amount to there being *no fact of the matter* whether *b* will be emitted. So there is nothing that would justify the indeterminacy.

[87] *NB* But one can give up such an intermediate standpoint and adopt the liberal one on which the indeterminacy-involving properties do not count. See chapter II, section 3.3.
[88] Hawley (1998), p. 103.

At first glance it does seem that we do not want to say that everything that has not been determined yet, is indeterminate. On the other hand however, it might seem that we do not want to be forced into admitting that *b* has at t_1 the property of being such that at t_1 it is determinate that it will be emitted. It would be rather strange to claim that although *b* is such that it was undetermined at t_1 whether it will be emitted, nevertheless it is such that it was determinate at t_1 that it will be emitted. After all, what its being undetermined at t_1 whether *b* will be emitted amounts to is the fact that "the laws of nature, together with a complete qualitative description of the situation up to time t[$_1$], entail neither that *b* will be emitted nor that *b* will not be emitted."[89] And what its being indeterminate whether *b* will be emitted amounts to is the fact that there is no fact of the matter as to whether *b* will be emitted or not. So, it seems that it can be argued that at t_1 it is both undetermined and indeterminate whether *b* will be emitted.

However, Hawley gives also another argument against the thesis that *b* is not such that at t_1 it is indeterminate whether it will be emitted. Recall that I have distinguished two different interpretations of Lowe's example. On both interpretations there are actually two indeterminate-identity questions which may be justifiably asked. According to the interpretation (IntA) the electron *a* is captured and 'joins' another electron, *c*, which is already in the atom; later on an electron is emitted; we call the emitted one "*b*". Now we are facing two questions: "Is *a* such that it is indeterminate whether it is identical to *b*?" and "Is *c* such that it is indeterminate whether it is identical to *b*?". Hawley - on behalf of the ontic theorist - answers "Yes" to both questions. She claims that if we take ontic indeterminacy seriously, then we should

[89] Hawley (1998), p. 103.

argue that *b* is neither determinately identical to *a* nor determinately identical to *c*. As in the two-slit experiment the particle that is recorded on a screen beyond the barrier having two open slits, has a property which it would not have had it passed determinately through either one slit or the other (namely the property of reaching a certain position *x* which is accessible merely for the particles such that it is indeterminate which slit they pass through), *b* can have (or lack) properties that neither *a* nor *c* have (or both *a* and *c* have). Hence, although both *a* and *c* are such that it is indeterminate at t_1 whether they are emitted at t_2, *b* need not have that property. It can be determinate at t_1 that *b* will be emitted at t_2.[90]

It is clear however that - contrary to what I have promised at the beginning of this section - this argument *does* depend on the metaphysical stance one accepts. First of all, one is explicitly claiming here that objects can be indeterminately identical even though one of them has a property *F* indeterminately while the other has it determinately.[91] Moreover, it seems to me that it is plausible only if one gives up the thesis that particles are distinct and persistent individuals. As we have seen French, Redhead and Teller argue that particles can be regarded as individuals only if we consider them as transcendental individuals. However, the above solution is not an option for a transcendental individuality theorist. On his view it cannot be the case that the emerging particle is indeterminately identical to two other particles.

And indeed Lowe has suggested a new metaphysics for his example.

3.3. The new version of the example

[90] There is also another objection in Hawley's paper. She complains that Lowe's example forces us to accept that the fact that *b* has the property of being emitted is indeterminate at t_1 and "somehow becomes determinate" at t_2. She argues that "we have no reason to believe that a fact about *b* becomes determinate as time passes". Hawley (1998), p 104.

[91] Hence, Hawley must accept a kind of liberal standpoint.

3.3.1. Electrons as quasi-objects

In *The Possibility of Metaphysics* Lowe considers a new version of the electrons example. He claims now that electrons are "quasi-objects": although sometimes they have determinate identity conditions, they do not possess such conditions across states of superposition. This seems to be the fourth metaphysical interpretation of what sort of objects electrons are, the previous three being: non-individuals, ephemerals and transcendental individuals.

Quasi-objects are not non-individuals because they may have determinate identity conditions; they are not ephemerals since they are supposed to survive the states of superposition; finally they are not transcendental individuals since - as I have tried to argue - transcendental individuals possess determinate identity conditions all the time. However, the difference between ephemerals and quasi-objects might be questioned. If quasi-objects do not possess determinate identity conditions across the states of superposition, then it seems they do not determinately survive superposition. And if it is not determinate that they survive superposition, then it is not determinate that they are not ephemerals. But I'll not go into this issue here.[92]

Recall that the manner in which Lowe presented his first version of the example was ambiguous between two ways of naming particles. In *The Possibility of Metaphysics* he is more explicit: "a single free electron, which we could label "*a*", were to be captured [...] and subsequently a single electron which we could label "*b*"

[92] And of course, if quasi-objects are a kind of ephemerals, then they cannot satisfy any indeterminate identity-over time statement.

were to be released".[93] Moreover, similarly as in the previous version "there are precisely and determinately *two* electrons in the shell"[94] of the atom throughout superposition. The claim is that there is no fact of the matter whether *a* is identical to *b*. So, here we are told that *a* is captured and *b* is released and that two electrons exist through superposition, but we are not told that these two electrons are *a* and *b*. So, it is my original interpretation (IntA) which is correct for this version of the example. However, now the claim is that at t_1 neither of *a* and *b* has the property of being such that it is indeterminate whether it is captured (at t_1 one electron is just being captured and the other is already inside the atom), while at t_2 they both have this property (the reason being that "there is no fact of the matter as to which of the two entangled electrons was the one which was captured at t_1").[95]

?∇	(*a*	=	*b*)
	at t_1,¬∇captured		at t_1, ¬∇captured
	at t_2,∇captured		at t_2, ∇captured

Let us notice that the reason why at t_1 *a* does not have the property of being such that it is indeterminate whether it was captured is that it is just being captured at that time.[96] So at t_1, *a* has the property of being captured, while at t_2 it has the property of being such that it is indeterminate whether it was captured.[97] One can

---

[93] On the other hand Lowe writes also "there is no fact of the matter as to which of the two entangled electrons [...] was the one which was captured at t_1 and which was the one already present in the shell at t_1 - and, *ex hypothesi*, *a* was one of those electrons, as was *b*" (Lowe (1998), p. 69). Since *a* was the captured electron, *b* must have been the one already present in the shell. But then we end up with the interpretation (IntB).

[94] Lowe (1998), p. 62.

[95] Lowe (1998), p. 69. *NB* With the new version of the example Lowe departures form our three standpoints on vague identity, for in this version there is no property that one of *a* and *b* possesses determinately, while the other indeterminately.

[96] It is worth noticing that the reason why we ascribe a at t_1 the property ¬∇c [i.e. of not being such that it is indeterminate whether it was captured] is that it has the property c [of being captured]. So we seem to assume that if c then ¬∇c. We do not want to accept the contraposition, however. We do not want ∇c to entail ¬c. Since both particles have the property ∇c at t_2, it would follow that at t_2 they are both such that they were not captured at t_1.

[97] Analogous considerations concerning *b* and the property of being emitted lead us to the conclusion that *b* at t_2 has the property of being emitted whereas at the time t_1 it has the property of being such

claim that a could have changed from not being indeterminately such that it was captured to being indeterminately such that it was captured, just as someone can change from not being indeterminately fat (i.e. being fat) to being indeterminately fat. However we are not talking about a changing merely from $\neg\nabla$captured at t_1 to ∇captured at t_2 (just as we say that Brown changed from being fat at t_1 to being indeterminately fat at t_2); we are talking about a changing from being at t_1 $\neg\nabla$captured at t_1 to being at t_2 ∇captured at t_1 (as if we were to say that Brown at t_1 was fat at t_1, but at t_2 is indeterminately fat at t_1). At first glance it seems absurd. If an object has certain property at a certain time then no matter what happens to that object later, at any time at which it exists it should have the property of having that property at that time.

So, what can be the reason of such a strange state of affairs? What can cause the change from a (determinately) having at the time t_1 the property of being captured at t_1 to a having at some later time the very same property only indeterminately? As I have mentioned, Lowe claims that electrons do not possess determinate identity 'across' states of superposition.[98] He does not mean it as an explanation, however. Nor does he try to justify this claim. He takes it simply as a plausible account of what is going on in the states of superposition.

One way in which one can understand the claim that in our example electrons 'lose' their identity because of superposition is to assimilate this example to the two-slit experiment. We have already seen that K. Hawley uses the two-slit experiment to argue that b need not have the property of being such that it is indeterminate whether

---

that it is indeterminate whether it is going to be emitted.

[98] Lowe (1998), p. 62. Note that this claim cannot simply amount to the statement that electrons do not survive superpositions, for then this view would not be different from the one that treats electrons as ephemerals and indeterminate identity over time would not come into the picture at all.

it will be emitted. Recall that her claim has been that since b is not determinately identical to a and is not determinately identical to c (i.e. the other electron within the outer shell of the atom), it can have properties that neither a nor c has. Similar argument can be made here. As I have argued for all we know the situation is like this: at t_1, a is captured and c is in the atom; at t_2, one electron which we label "b" is released. Hence, instead of one indeterminate-identity statement we have the following:

$\neg (a = c)$

$\nabla (a = b)$, $\nabla (c = b)$

On the other hand, it seems that we also have the following:

$a = b \vee c = b$.

Since there are only two electrons for b to be, b has to be either a or c. However, because the claim is that the situation here is analogous to that in the two-slit experiment, the "either ... or..." may not be a classical connective. In the experiment the statement "the fired electron either went through the lower slit or it went through the higher slit" cannot be taken to mean that the electron determinately went through one slit or the other. Rather it is indeterminate which slit it went through. So similarly here: although b is either c or a, it is neither determinately c nor determinately a. The claim that electrons do not possess determinate identity across superposition can be understood as saying that both "$\nabla(a = b)$" and "$\nabla (c = b)$" are true. Neither a nor c determinately 'carries' its identity through superposition and as a consequence neither is determinately identical to the emerging particle.

Admittedly such a picture is quite compelling. The formulation of the example involving a, b, and c has one crucial feature, however. It demonstrates that in neither case it is ontic indeterminacy that we are talking about. The above indeterminacy statements clearly are not ontic indeterminacy statements, for there is two of them and the assumption was that there are only two electrons. The indeterminacy statements say that it is indeterminate whether b is identical to a and that it is indeterminate whether b is identical to c. We do not have three electrons, a, b, and c, however.

This shows that we are dealing with *semantic* indeterminacy. What the statements $\nabla(a = b)$ and $\nabla(c = b)$ say in fact is that it is indeterminate whether "a" refers to the same object as "b" and it is indeterminate whether "c" refers to the same object as "b". We do not know to which of the particles "a" refers at t_2 and to which of them "b" refers at t_1.

However, if semantic indeterminacy is involved, then we have no right to claim that at t_2, a has the property that it is such that it is indeterminate whether it was captured (and that at t_1, b has the property that it is such that it is not captured). Since the electrons example has been offered as an example of ontic indeterminacy, for this example to work the statements ascribing the properties to electrons should be regarded as ascriptions *de re*. For instance, the claim that a is such that it is indeterminate whether it was captured, should be a claim *de re*, i.e. we purport to claim of the referent of "a" that it is such that it is indeterminate whether it was captured. In our case this property cannot be ascribed *de re*, however. In order to say anything *of a* we must know first what "a" refers to. However, although we do know what "a" refers to at t_1, we do not know whether at t_2 "a" refers to the electron that remained in the atom or to the emitted electron. We cannot ascribe a any property at t_2, because we do not know which of the two electrons we are referring to. We have individuated a at t_1 but it is impossible in principle to know which of the two particles surviving the entanglement it is. Similar remarks apply to ascribing properties to *b* at t_1. Hence, the only properties we are allowed to ascribe of *a* are the properties ascribed at a time t_1, whereas the only properties we are allowed to ascribe of *b* are the properties ascribed at a time t_2. These are the only properties we can ascribe *de re*. In particular we cannot ascribe *de re* the indeterminacy-involving property of being such that it is indeterminate whether it was captured to *a* at t_2, because its indeterminacy stems from the fact that the reference of "*a*" at that time has not been fixed.

Thus, it seems that the example has been wrongly constructed. It illegitimately attributes *de re* properties to the particles at the times at which to these particles no property can be attributed *de re*.

3.3.2. Semantic indeterminacy

In his recent reply to Katherine Hawley, Lowe acknowledges the semantic indeterminacy in the example. He concedes that he "misdescribed the example in supposing that "*b*" determinately designates a unique electron".[99] He argues that since the entangled electrons, *a* and *c*, are not determinately distinct, there is no fact of the matter as to which of them has been emitted, and therefore "*b*" fails to pick out a unique object. Lowe argues that this is not to say that the indeterminacy involved in the example is not ontic, however. On the contrary, the fact that there is no determinate fact of the matter as to which electron is emitted constitutes, according to Lowe, "a perfectly coherent example of ontic indeterminacy of identity ...".[100]

[99] Lowe (1999). p. 329.
[100] Ibid. Lowe's exact words are "... there is no determinate fact of the matter as to whether *a* or [*c*]

Lowe is right to claim that the worry about the incoherence of this example does not arise, because it is not susceptible to Evans's argument. If "b" is an imprecise designator and does not determinately designate a unique electron, the truth of the indeterminate-identity statement "$\nabla(a = b)$" assumed for *reductio* does not allow us to use property abstraction and predicate anything of b. The same applies to the statement featuring the description "the emitted electron" instead of "b". So, Evans's contradiction cannot be derived.

There is a problem concerning the alleged semantic indeterminacy of "b", which - as Lowe argues - does not determinately designate a unique electron. In order to treat "b" (which has been introduced as a name for the emitted electron) as imprecise in this sense there would have to exist at least two candidates for "b" to refer to. There would have to be two electrons emitted from the atom such that "b" refers indeterminately to one of them. But clearly this is not so: only one electron was emitted. Thus, unless one is a temporal-parts theorist, a view that "b" fails to pick out a unique particle, leads to spatio-temporal coincidence (i.e. to the claim that two electrons are at the same spatio-temporal location), which is usually regarded as too absurd to be accepted.

Recall however that we have distinguished two senses of semantic imprecision.[101] According to the standard account a designator is imprecise iff it refers indeterminately to something and does not refer determinately to anything. And

is emitted. Here we seem to have a perfectly coherent example of ontic indeterminacy of identity ...". But using the names "a" and "c" in this context must be a slip on Lowe's part. Lowe himself has argued that since a designator may cease to be precise, designation must be relativised to time: "we must ... relativise designation to times, saying that a name or description which determinately picks out a unique entity with respect to one time may fail to do so with respect to another" (ibid.). And it seems that after the entanglement "a" and "c" – as well as "the absorbed electron" (Cf. (1999), p. 329) – do not determinately pick out a unique entity. So, by using "a" and "c" one can refer determinately only to the electrons at times prior to absorption.

[101] See chapters II and III.

this is the account that Lowe seems to have in mind. But one can define another - non-standard - sense of imprecision. According to such non-standard account a designator is imprecise iff it refers indeterminately to something. This sense allows for the case in which a designator refers determinately to a vague object and indeterminately to an object which is indeterminately identical to that vague object. In order for "*b*" to be imprecise in this sense, there would have to be a vague object *b*, to which "*b*" refers determinately and "another" object indeterminately identical to *b*, to which "*b*" refers indeterminately. It might be argued that this account fits our case. One may claim that if it is indeterminate whether *b* is identical to *a*, then "*b*" refers determinately to the emitted electron, which is a temporally vague object, since it is indeterminate whether it existed before the entanglement, and indeterminately to *a*. Thus, in the non-standard sense "*b*" may indeed be regarded as an imprecise designator. Such imprecision, however, is possible only in cases of indeterminate identity. Thus, in order to argue that "*b*" is vague in this sense, one would have to prove first that there is something to which *b* is indeterminately identical.

Lowe argues that the identity-over-time statement "$a = b$" is indeterminate, because of the ontic relation between the entangled electrons, i.e. between the electrons that before the entanglement bore names "*a*" and "*c*". His reasons for saying that the entangled electrons are ontically indeterminately identical seem to be that (i) they are determinately two and yet (ii) they are not determinately distinct, because in the entanglement "no property can be determinately assigned to one of the electrons rather than to the other".[102] However, the claim (ii) is too weak, for there is no property which could be *indeterminately* assigned to one of the electrons rather than

[102] Lowe (1999), p. 329.

to the other, either. Lowe seems to take it that after the time of entanglement the property of *having been absorbed by the atom* cannot determinately be ascribed to either of the entangled electrons. But if either electron has a property of being such that it is indeterminate whether it was absorbed by the atom, then so does the other electron. If we accept Lowe's picture, there is no property whatsoever – not even an indeterminacy-involving property – which could be ascribed to one electron and not to the other. Not only are the entangled electrons determinately qualitatively distinct – they are determinately qualitatively identical.

Moreover, if (i) is true, then it cannot be ontically indeterminate whether the entangled electrons are identical. For - as has already been argued - what the claim that certain objects are ontically indeterminately identical amounts to is just that the number of those objects is indeterminate: it is indeterminate whether they are one and the same object or two distinct objects. Usually when one claims that certain objects, *a* and *b*, are indeterminately identical, one also maintains that their number is indeterminate: it is not determinate whether they are (determinately) one or two. Moreover, that latter indeterminacy seems to be a straightforward consequence of *a* and *b* being indeterminately identical. If they were determinately identical there would be determinately one of them, and if they were determinately distinct there would be determinately two of them. If it is ontically indeterminate whether certain objects are identical or not, it has to be also indeterminate whether they are one and the same object or two distinct objects. Hence, their number has to be indeterminate. If one were to maintain that they are determinately two, one would have to give up the claim that it is ontic indeterminacy one is talking about. It is only epistemic or semantic indeterminacy which may be involved in such a situation.

Thus, what the claims (i) and (ii) amount to is that there are two determinately indiscernible electrons. Although the adherent of these claims is forced to reject the Principle of the Identity of Indiscernibles, he has no reason whatsoever to believe in the ontic indeterminacy of identity between the entangled electrons. Therefore, Lowe has failed to justify the claim that his is an example of ontic indeterminacy.

So, since it has not been established that the entangled electrons are ontically indeterminately identical, the claim that "*b*" is semantically vague because of ontic reasons is unjustified. To repeat, we are not saying that it is incoherent to suggest that *a* and *b* are vague. All we are arguing is that the claim that they are vague, is unsupported.

4. CONCLUSION

Quantum particles are not good candidates for vague objects. They can be regarded either as individuals, ephemerals, quasi-objects or non-individuals. As Huggett puts it: "[I]t is hard to wring metaphysics out of standard QM by itself".[103] We have several metaphysics to choose from, and quantum mechanics provides no grounds for choosing between these metaphysical alternatives. The particles-as-individuals view is highly problematic. The only way in which one may claim that particles having both intrinsic and extrinsic properties in common are nevertheless two distinct individuals is to insist that they have label transcendental individuality. It is utterly obscure in what label transcendental individuality consists. It seems that it is nothing more than a 'proclamation of faith'; since two particles entered the

[103] Huggett (1997), p. 128.

superposition state and two particles left it then it seems 'reasonable' to insist that they existed all the time. Moreover, it should be noticed that 'entanglement' is never strictly absent - every quantum particle is involved with the state of every other quantum particle of the same kind, in the universe. Our considerations are merely hypothetical, for in fact superposition is always present. It follows that our individuals are capable not only of penetrating each other, but of being in several places at the same time as well.

If such a notion of "individual" is too strange to be accepted then one may regard quantum particles as ephemerals. They are individuals in a much weaker sense: they do not persist in time, hence the question of identity over time does not arise for them. On the other hand, their identity at a time seems to be determined. In a superposition state there is only one ephemeral; the 'original' ephemerals that constituted the new one, ceased to exist.

Yet another option is to treat particles as quasi-objects, i.e. object which are distinct and persistent as long as they do not enter superposition. In a superposition state they 'lose' their (determinate) identity. The particles emerging from such state are not determinately identical to any of the particles existing before the entanglement. Hence, strictly speaking particles are individuals only outside superposition.

It has been argued that the particles-as-non-individuals view agrees well with the Fock space interpretation of quantum field theory, which is considered simple and empirically adequate.[104] On such a view 'particles' are no longer particles: they are not even self-identical.

---

[104] See French, Krause (1995), p. 22; and Redhead, Teller (1992), pp. 217-18.

Although Lowe's example can be stated if particles are regarded as individuals it does not establish vague identity. If *a* and *b* are individuals, the statement "$a = b$" is not indeterminate; it possesses a determinate truth value, which is in principle unknowable for us. The example cannot be formulated for ephemerals, because *a* definitely 'popped out' of existence before *b* 'popped into' existence. On the particles-as-non-individuals view Lowe's example cannot be constructed, either. There are no such things as electrons *a* and *b*. We have no means to refer to single particles there. On the particles-as-quasi-objects view, since particles do not possess determinate identity conditions across the superposed states, the statement "$a = b$" cannot be regarded as determinate in truth value. Putting electrons into the category of quasi-objects precludes the possibility that the captured electron is determinately identical to the emitted electron. However, it seems that the claim that our particles *a* and *b* are quasi-objects is in fact tantamount to the claim that *a* is indeterminately identical to *b*. And if this is so, that claim should be argued for, because it is precisely what is at issue. One cannot just state that quantum particles are quasi-objects, such a claim should be justified. In order to argue that the statement "$a = b$" is indeterminate, one has either to demonstrate that *a* and *b* are vague objects or else opt for a semantic indeterminacy. As I have tried to argue Lowe did not succeed in arguing for the first option. The latter option is a viable option only for the temporal parts theorists. A person who believes in temporal parts has an easy semantic explication ready: he can claim that "$a = b$" is indeterminate in truth value because the name "*b*" refers indeterminately to two four-dimensional objects: the electron whose post-emission stages are outside the atom and whose pre-absorption stages are inside the atom, and the electron whose both pre-absorption and post-emission stages are outside the atom.

One might be puzzled that here I am objecting to electrons being vague objects, while in chapter III we have acknowledged that watches and persons might be vague. However, the watches and persons will be vague only in certain particular cases in which due to some events their identity has become questionable. If such a puzzling case arose for electrons, then one might try to argue that they are vague as well. It will be possible only on the quasi-objects option (as it has been argued on the transcendental identity view indeterminacy of identity is impossible). So, in order to argue that electrons are vague quasi-objects one would have to build up a case in which the identity over time of an electron becomes questionable. As I have tried to argue the example described by Lowe is not such a case.

CONCLUSION

The main focus of this thesis is indeterminate identity and its relations to vague objects and to imprecise designation.

In **chapter 1** Evans's argument concerning indeterminate identity statements was presented and discussed. Evans's paper in which he formulated his argument is one of the most frequently discussed papers concerning identity. As we have seen the only fact upon which all the commentators agree is that Evans's paper is "over-brief, cryptic, and often misunderstood".[1] There are serious doubts concerning what Evans wanted to prove by his argument. Theorists have proposed two competing and incompatible interpretations. According to some, Evans purposefully constructed an invalid argument in order to demonstrate that the vague objects view cannot diagnose the fallacy and is therefore untenable. According to others, Evans wanted to formulate a (valid) argument to the effect that there cannot be vague identity statements whose vagueness is due solely to the existence of vague objects. As I have argued, if it is the former interpretation which is correct, than the argument really is invalid, but it is doubtful whether it achieves its aim. It might be argued that "the vague objects view" it refutes is not the view that most vague objects theorists hold. The main part of the chapter was devoted to the second interpretation and the discussions concerning the validity of the argument on this interpretation. In the first section each step of the proof was considered separately and the doubts concerning it were presented. It

[1] Lewis (1988), p. 128.

appears that the vague objects theorist is in a position to object to the validity of every single step.

There are two well-known arguments similar to Evans's: one was formulated by Nathan Salmons and the other by David Wiggins. These arguments were briefly discussed in the second section.

Chapter II was devoted to issues concerning vague objects, indeterminately identical objects and precise and imprecise designation.

Recall that one of the interpretations of Evans's argument takes it to prove that the idea of indeterminate identity- statements composed exclusively of precise terms is incoherent. I have argued that - quite independently of Evans's argument - terms designating indeterminately identical objects cannot be precise designators. If my argument is correct, then it shows that terms referring to vaguely identical objects have to be imprecise in a sense that they refer to an indeterminate number of objects. I also offered an argument to the effect that terms designating indeterminately identical objects are designators of a special kind, which refer both determinately and indeterminately. The question arises whether such designators could be considered precise. After presenting the arguments for regarding them as precise, I have argued that it seems nevertheless more appropriate to call them imprecise. And, anyway, they are not 'precise enough' to run Evans's argument on them, for the use of property abstraction is not justified in their case.

In the third section various accounts of what indeterminate identity between objects may consist in were discussed. There are at least four accounts of why the identity statement concerning objects a and b may be vague: (i) a and b may be vague objects, (ii) properties of *a* and *b* may be vague, (iii) *a*'s and *b*'s having of properties may be indeterminate and (iv) it may be undetermined what counts as a property relevant for the identity claim. Possibilities (i) and (iv) were investigated in detail.

In particular *re* (i) the relations between vague objects and indeterminate identity were considered. One possible account has it that objects are vague if they are indeterminately identical. I have discussed Mark Sainsbury's attempts to find a substantive thesis of ontic vagueness (namely such thesis that would separate genuinely (i.e. ontically) vague objects form anodyne (i.e. semantically) vague objects) and in particular his argument to the effect that indeterminate identity cannot be a guide to vague objects, since there are no objects which are indeterminately identical. I have argued to the contrary that there are objects whose identity is indeterminate and that such indeterminacy is *ontic* in the sense that it concerns identity, individuation and spatio-temporal boundaries of objects. This kind of vagueness endangers the very "objecthood" of objects and thus seems more ontic than semantic.

The issue of whether vague objects can be indeterminately identical is crucial for Evans's argument. For if they cannot, then even if the argument succeeds in proving that there cannot be indeterminately identical objects, it does not concern vague objects at all. There is no common agreement as to whether identity between vague objects can be vague or not (i.e. whether it can be vague whether or not the identity holds), and various possible standpoints were briefly sketched.

Re (iv) three different standpoints concerning the indeterminate identity of objects were presented: the radical, the intermediate and the liberal. Each of these standpoints makes certain assumptions concerning properties and predicates and in this way circumscribes the application of the Contrapositive of Leibniz's law, and is therefore able to escape Evans's argument. The radical standpoint on indeterminate identity can defend itself against the charge of inconsistency by formulating the definition of indeterminate identity in terms of properties and arguing that although *a* and *b* could be distinguished in terms of predicates, there are *no properties* which could differentiate them. Thus, Evans's argument, which essentially appeals to the properties of *a* and *b*, is invalid. The intermediate standpoint has to argue either that the *indeterminate-identity involving* properties cannot serve to distinguish between objects whose identity allegedly is indeterminate, or else that the indeterminate-identity involving predicates do not correspond to any properties. Again, Evans's argument comes out as invalid. One may object to the intermediate standpoint by pointing out that Evans-type arguments can be constructed without using any indeterminate-identity involving predicates. The last - liberal - standpoint is immune to this objection for it has it that no *indeterminacy-involving* property counts in determining the identity or distinctness of objects.

Chapter III was devoted to problems concerning vagueness and persistence. There are many identity-over-time puzzles concerning the identity between objects *a* at t_1 and *b* at t_2 to which the only intuitive answer is that there is no determinate answer as to whether *a* and *b* are identical. That is, in other words, the only plausible answer seems to be that there is no fact of the matter as to whether *a* and *b* are identical.

After an introductory first section, in the second section of this chapter general problems concerning identity over time were presented. The main challenge for any persistence theorist is to accommodate the phenomenon of change within his framework. There are two main theories of persistence: endurantism and perdurantism. Perdurantists have no problems with fitting change into their theory, but they do have problems with making their view look plausible and consistent with our common 'pre-scientific' intuitions about the world. On the other hand, for endurantists change is a real challenge, because they have to show that an object that changes its intrinsic properties can nevertheless retain its numerical identity; e.g. that a tomato which is green all over at t_1 and a tomato which is red all over at t_2 can in fact be one and the same tomato. As we have seen, endurantists seem able to meet that challenge.

In the third section questions concerning indeterminate identity and the diachronic-identity puzzles were considered. It appears that the indeterminate answer to the questions concerning identity over time in puzzling cases can be regarded as the correct response. The indeterminacy in diachronic identity in those cases is caused by the imprecision and the indeterminacy of persistence conditions. The persistence conditions are not specified sufficiently to completely determine answers to the identity questions. The objects whose persistence conditions are vague are vague objects in the sense that their temporal boundaries are not precisely delimited.

Perdurantists define persistence of objects in terms of relations holding between temporal parts of those objects. The relevant relations are relations of spatio-temporal continuity, similarity and causal connectedness, but they are never relations of identity, for two non-coincident temporal parts can never be identical. Therefore, for perdurantists the whole vagueness of persistence conditions is a conceptual matter. One has to determine which relations are essential if a certain concept is to apply to a given collection of temporal parts. If the identity-over-time question has an indeterminate answer it is because the relations have not been specified sufficiently.

For endurantists persistence is a matter of identity. They read identity-over-time questions as "Is there a single object such that it existed at t_1 and exists at t_2?" and argue that because of the vagueness of persistence conditions that question has no determinate answer. I have tried to argue that endurantists should accept the existence of vague indeterminately identical objects. In every puzzle of identity over time a question is asked of whether a certain object *a* is identical with a certain object *b*. And if one wants to answer that it is indeterminate whether *a* is identical to *b*, then one has to explain the source of this indeterminacy somehow. The easiest explanation is to say that "*a*" and "*b*" are imprecise designators which do not refer determinately to anything. However, such an explanation leads endurantists directly to coincident entities (of the same kind). Instead of accepting coincidence they can argue that *a* and *b* are vague objects which are indeterminately identical. The vagueness of *a* at t_1 and *b* at t_2 is a kind of vagueness that deserves the name of "ontic vagueness".

If *a* and *b* are vague, their names, "*a*" and "*b*", are imprecise in a sense that each will refer determinately to one object and indeterminately to "the other" object. Although imprecise, they will refer determinately to some objects. Hence, I have argued that (contrary to Sainsbury) "*a*" and "*b*" do succeed in individuating objects.

In **chapter IV** the paradox of 1001 cats and the problem of the many were discussed. I have argued that these problems are different problems and the solutions to one need not be solutions to the other. The main difference between these two puzzles is that one is essentially connected with vagueness, while the other is not. I have maintained that the problem of the many arises because of the vagueness of the boundaries of macroobjects. In particular, I have attacked Mark Johnston's arguments that the problem arises independently of vagueness.

In the first section, I proposed a tentative solution to the paradox of 1001 cats, according to which nothing that is a part of an *F* can count as another *F* unless it divides into *F*s. Thus, in fact there is only one cat on the mat, and it is (constituted by) the biggest lump of feline tissue.

In the second section five different solutions given to the problem of the many were reviewed: the "constituters" solution, the "vagueness in the world" solution, the supervaluationist solution, the "relative-identity" solution and the "almost-identity" solution. In particular, I have argued that since the "almost-identity" solution works only if coupled with the supervaluationist solution, it is in fact redundant. A separate sub-section was devoted to the "constituters" solution. The proponent of this solution has argued that the relation of constitution is vague, but I have claimed that in fact he must accept that it is the objects for which the problem of the many arises which are themselves vague.

In the third section I put forward a solution according to which in each case in which the problem of the many arises there is - contrary to appearances - only one (vague) object present. The appearance of multiplicity arises because each such object can be precisified in many ways, but these precisifications have no ontological significance. The problem of the many can be solved if one acknowledges that there is vagueness in the world and that it is an important feature of this world. The original problem arose because in every situation of which we would usually say that it contained just one complex object there seemed to be many equally good candidates for constituting that object. However, my claim is that these candidates are not 'equally good', since they have precise boundaries, whereas the 'genuine' object is fuzzy.

Finally, in the fourth section, I proposed a new account of what it takes for an object to be vague. My account makes use of Peter van Inwagen's considerations concerning vague existence. The results obtained by van Inwagen are used in defining a sufficient condition for being a vague object.

Chapter V was devoted to indeterminate identity in the domain of quanta. The first part investigated the various problems concerning identity, individuality and individuation of quantum particles. This part is based mainly upon the works of Stephen French, Michael Redhead and Paul Teller. They constructed a theory according to which particles can be regarded as transcendental individuals. The consequences of this view for the possible indeterminate identity of quantum particles were investigated. Two other metaphysical possibilities were mentioned, namely the account according to which particles are non-individuals and the view which takes particles to be ephemerals.

In the second part Jonathan Lowe's example of alleged indeterminate identity-over-time between electrons was discussed and criticised. I have argued that quanta are not good candidates for vague objects. If one takes them to be non-individuals, then the question of their identity over time does not arise. If they are treated as ephemerals, there are no puzzling cases of diachronic identity, since as soon as two ephemerals enter a superposed state in which the question of their indeterminate identity could arise, they cease to exist and become a single new ephemeral. Lowe has proposed a new metaphysical stance according to which quantum particles are quasi-objects in the sense that they possess determinate identity conditions outside superposition, but not inside. It seems however, that if this is to be an argument for the indeterminate identity between particles, then it should be justified somehow. The conclusion is that nothing that Lowe says compel one to accept that quanta are vague indeterminately identical objects.

Evans's argument is usually considered by people who do not believe in vagueness in the world to be the main weapon against their opponents. However, as I have tried to show, it is not a decisive argument against vague or indeterminately identical objects. In order for it to work, certain additional - and by no means obvious - assumptions are needed and the vague objects theorist may well not agree to accept them. Without these assumptions the argument is not a proof that the vague objects view is incoherent. Therefore, the argument cannot be used as a quick and convenient way of disposing of that view once and for all.

Thus, there seem to be no principled reasons why one should not maintain that objects as well as linguistic expressions are vague. And it seems that at least objects of our common everyday experience really are vague objects. Vagueness in spatial and temporal boundaries is widespread phenomenon. Moreover often cases of apparent synchronic and diachronic identity between objects cannot be settled determinately. I have tried to argue that that kind of vagueness is ontic vagueness that infects the objects in the world. The assumption that objects are vague allows us to solve the problem of the many and also - although in a limited sense - some of the diachronic identity puzzles.

One may object, however, that the fact that mountains, watches, ships and persons are vague does not show in itself that reality is vague. One might argue that it can only be said that vagueness is a feature of the world, if it is a necessary property of any true and complete description of it; in other words, if reality cannot be described in a completely precise language. This is a much stronger thesis and I did not even attempt to justify it. In my thesis I was concerned mainly with composite material objects and I have tried to argue that such objects are vague. On the other hand, if one questions the existence of any complex material objects and argues, for instance, that reality is a four-dimensional differentiable manifold of spatio-temporal points and describes everything in terms of these points and their sets, then maybe absolute precision in description is attainable. Whether such a description will capture all that one would want a proper description of the world to capture, is a question for scientists. It seems to me, however, that as long as we are prepared to count deserts, tables and guinea-pigs among the worldly objects, vagueness should be regarded as a feature of the world itself as well as a feature of our representations of it.

BIBLIOGRAPHY

Adams R. M., 1979, "Primitive thisness and primitive identity", *Journal of Philosophy* 76, pp. 5-26.

Armstrong, D. M., 1989, *Universals. An opinionated introduction*, Westview Press, Boulder, San Francisco, London.

Barnette, R. L., 1978, "Does quantum mechanics disprove the principle of the identity of indiscernibles?", *Philosophy of Science* 45, pp. 466-470.

Broome, J., 1984, "Indefiniteness in identity", *Analysis* 44, pp. 6-117.

Burgess, A. J., 1984, "Vague identity: Evans misrepresented", *Analysis* 49, pp. 112-119.

----------------, 1990, "Vague objects and indefinite identity", *Philosophical Studies* 59, pp. 263-287.

Butterfield, J., 1985, "Spatial and temporal parts", *The Philosophical Quarterly* 35, pp. 32-44. Also reprinted in Noonan, H. W., 1993b.

Chisholm, R. M., 1973, "Parts as essential to their wholes", *Review of Metaphysics* 26, pp. 581-603. Also reprinted in Noonan, H. W., 1993b.

Copeland, B. J., 1994, "On vague objects, fuzzy logic and fractal boundaries", in Horgan, T., 1994, pp. 83-96.

Cortes, A., 1976, "Leibniz's principle of the identity of indiscernibles: a false principle", *Philosophy of Science* 43, pp. 491-505.

Cowles, D., 1994, "On van Inwagen's defense of vague identity", in Tomberlin, J. E. (ed.) *Philosophical Perspectives* 8: *Logic and Language*, pp. 137-158.

Dummett, M., 1975, "Wang's paradox", in Keefe, R.; Smith, P., (1996), pp. 99-118.

----------------, 1995, "Bivalence and vagueness", *Theoria* 61, pp. 201-216.

Edgington, D., 1993, "Wright and Sainsbury on higher-order vagueness", *Analysis* 53, pp. 193-200.

----------------, 1996, "Vagueness by degrees", in Keefe R., Smith, P., pp. 294-316.

Evans, G., 1973, "The causal theory of names", *Proceedings of the Aristotelian Society Supplementary Volume* 47, pp. 187-208.

-----------, 1978, "Can there be vague objects", *Analysis* 38, p. 208.

Feynman, R.; Leighton, R.; Sands, M., 1965, *Lectures on physics*, vol. III *Quantum Mechanics*, Addison-Wesley Publishing Company, Inc. Reading, Massachusetts.

Fine, K., 1975, "Vagueness, truth and logic", *Synthese* 30, p. 265 - 300.

French, S., 1989, "Individuality, supervenience and Bell's theorem", *Philosophical Studies* 55 (1989), pp. 1-22.

------------, 1989, "Why the principle of the identity of indiscernibles is not contingently true either", *Synthese* 78, pp. 141-166.

French, S.; Krause, D., 1995, "A formal framework for quantum non-individuality", *Synthese* 102, pp. 195-214.

---------------------------, 1995, "Vague identity and quantum non-individuality", *Analysis* 55, pp. 20-26.

French, S.; Redhead, M., 1988, "Quantum physics and the identity of indiscernibles", *British Journal for the Philosophy of Science* 39, pp. 233-246.

Field, H., 1973, "Theory change and the indeterminacy of reference", *Journal of Philosophy* 70, pp. 462-481.

Forbes, G., 1987, "Is there a problem about persistence?", *Proceedings of the Aristotelian Society Supplementary Volume* 61, pp. 137-155. Also reprinted in Noonan, H. W., 1993b.

Garrett, B.J., 1988, "Vagueness and identity", *Analysis* 48, pp. 130-135.

Garrett, B.J., 1991a,"Vague identity and vague objects", *Nous* 25, pp. 341-351.

--------------, 1991b,"Vagueness, identity and the world", *Logique & Analyse* 135-136, pp. 349-358.

--------------- , 1998, *Personal identity and self-consciousness*, Routledge, London.

Gibbins, P. F., 1982, "The strange modal logic of indeterminacy", *Logique et Analyse* n.s. 25, pp. 443-446.

Geach, P. T., 1967, "Identity", Review of Metaphysics 21, pp. 3-12.

---------------, 1973, "Ontological relativity and relative identity", in Munitz, M. K. (ed.), *Logic and Ontology*, NYU Press, pp. 287-302.

----------------,1980, *Reference and Generality*, Cornell University Press Ithaca and London.

Ginsberg, A., 1981, "Quantum theory and the identity of indiscernibles revisited", *Philosophy of Science* 48, pp. 487-491.

Haslanger, S., 1989, "Endurance and temporary intrinsics", Analysis 49, pp. 119-125.

Hawley, K., 1998, "Indeterminism and indeterminacy", *Analysis* 58, pp.101-106.

-------------, 1998b, "Why temporary properties are not relations between physical objects and times", *Proceedings of the Aristotelian Society*, pp. 211-216.

-------------, "How to think about vagueness in the world", typescript.

Horgan, T., 1994, (ed.) *Vagueness*, *The Southern Journal of Philosophy* 33, supplement.

Howard-Snyder, F., 1997, "*De re* modality entails *de re* vagueness", in Rea, M. C., 1997, pp. 290-301.

Huggett, N., 1994, "What are quanta, and why does it matter?", *Philosophy of Science Association*, pp. 69-76.

--------------, 1997, "Identity, quantum mechanics and common sense", *The Monist* 80, pp. 118-130.

Hughes, C., 1997a, "An incredible coincidence", Mind 106, pp. 769-772.

-------------, 1997b, "Same kind coincidence and the ship of Theseus", Mind 106, pp. 53-67.

Johnsen, B., 1989, "Is vague identity incoherent?", *Analysis* 49, pp. 103-113.

Johnston, M., 1987, "Is there a problem about persistence?", *Proceedings of the Aristotelian Society Supplementary Volume* 61, pp. 107-135. Also reprinted in Noonan, H. W., 1993b.

---------------, 1992, "Constitution is not identity", *Mind* 101 (1992), pp. 89-105.

Keefe, R., 1995, "Contingent identity nad vague identity", Analysis 55, pp. 183-190.

Keefe, R.; Smith P., 1996, (eds.) *Vagueness: A Reader*, MIT Press, Cambridge-London.

Kripke, S., 1972, "Naming and necessity", in Davidson, D.; Harman, G. (eds.) *Semantics of natural language*, pp. 254-355.

Le Poidevin, R., 1998, "The past, present, and future of the debate about tense", in Le Poidevin, R. (ed.) *Questions of time and tense*, Clarendon Press, Oxford, pp. 13-43.

Lewis, D., 1968, "Counterpart theory and quantified modal logic", *Journal of Philosophy* 65. All page references are from Lewis, *Philosophical Papers*, vol. 1, pp. 26-38.

------------, 1971, "Counterparts of persons and their bodies", *Journal of Philosophy* 68. All page references are from Lewis, *Philosophical Papers*, vol. 1, pp. 47-54.

------------, 1976, "Survival and identity", in Rorty, A. O., *The identities of persons*, University of California Press. All page references are from Lewis, *Philosophical Papers*, vol. 1, pp. 55-72.

------------, 1983, *Philosophical Papers*, vol. 1., Oxford University Press.

------------, 1986, *On the Plurality of Worlds*, Blackwell, Oxford.

------------, 1987, "Rearrangements of particles: Reply to Lowe", *Analysis* 48, pp. 65-72. Also reprinted in Noonan, H. W., 1993b.

------------, 1988, "Vague identity: Evans misunderstood", *Analysis* 48, pp. 128-130. Also reprinted in Keefe, R.; Smith P., 1996.

------------, 1993, "Many but almost one", in Bacon, J., *Ontology, Causality and Mind: Essays in honour of DM Armstrong*, CUP, New York, pp. 23-38.

Lewis, D.; Langton R., 1998, "Defining intrinsic" in Lewis, D., Papers in metaphysics and epistemology, CUP 1999, pp. 116- 132.

Loux, M. J., 1998, *Metaphysics. A contemporary introduction*, Routledge, London.

Lowe, E. J., 1982a, "On being a cat", *Analysis* 42, pp. 174-177.

-------------, 1982b, "The Paradox of 1,001 Cats", *Analysis* 42, pp. 27-30.

-------------, 1989, *Kinds of being: A study in individuation, identity and the logic of sortal terms*, Basil Blackwell, Oxford.

-------------, 1994, "Vague identity and quantum indeterminacy", *Analysis* 54, pp. 110-114.

-------------, 1995, "The problem of the many and the vagueness of constitution", *Analysis* 55, pp. 179-182.

-------------, 1997, "Reply to Noonan on vague identity", *Analysis* 57, pp. 88-91.

-------------, 1998, *The possibility of metaphysics*, Clarendon Press, Oxford.

------------, 1999, "Vague identity and quantum indeterminacy: further reflections", *Analysis* 59, pp. 328-330.

Merricks, T., 1994, "Endurance and indiscernibility", *Journal of Philosophy* 91, pp. 165-184.

Noonan, H. W., 1982, "Vague objects", *Analysis* 42 (1982), pp. 3-6.

------------------, 1984, "Indefinite identity: A reply to Broome", *Analysis* 44, pp. 117-121.

------------------, 1990, "Vague identity yet again", *Analysis* 50 (1990), pp. 57-62.

------------------, 1991, "Indeterminate identity, contingent identity and Abelardian predicates", *The Philosophical Quarterly* 41 (1991), pp. 183-193. Also reprinted in Noonan, H. W., 1993b.

------------------, 1993a, "Constitution is identity", *Mind* 102, pp. 133-145.

------------------, 1993b, (ed.) *Identity*, Dartmouth.

------------------, 1995, "E. J. Lowe on vague identity and quantum indeterminacy", *Analysis* 55, pp. 14-19.

Odrowąż-Sypniewska, J., 2000, *Zagadnienie nieostrości* [*The phenomenon of vagueness*], WFiS, Warszawa. (*This is a version of my Polish thesis.*)

-----------------------------, 2001, "Quantum indeterminacy without vague identity", *Analysis* 61, pp. 65-68.

-----------------------------, "The supervaluation theory of vagueness", *M. Litt.* dissertation, St Andrews University 1997.

Orłowska, E., 1983, "Semantics of vague concepts", in Dorn, G.; Weingartner, P. (eds), *Foundation of Logic and Linguistics. Problems and Solutions. Selected Contributions to the 7th International Congress of Logic, Methodology and Philosophy of Science*, Plenum Press, Salzburg, pp. 465-482.

Over, D. E. 1989, "Vague objects and identity", *Analysis* 49, pp. 97-99.

Parsons, T., 1987, "Entities without identity", *Philosophical Perspectives* 1, pp. 1-19.

Parsons, T.; Woodruff, P., 1995, "Worldly indeterminacy of identity", *Proceedings of the Aristotelian Society* n.s. 45, pp. 171-191. Also reprinted in Keefe, R.; Smith, P., 1996.

Pawlak, Z., 1983, *Systemy informacyjne. Podstawy teoretyczne*, Wydawnictwa Naukowo- Techniczne, Warszawa.

Pelletier, F. J., 1984, "The not-so-strange modal logic of indeterminacy", *Logique et Analyse* n.s. 27, pp. 415-422.

-----------------, 1989, "Another argument against vague objects", *The Journal of Philosophy*, pp. 481-492.

Post, H., 1963, "Individuality and physics", *The Listener* 70, pp. 534-537.

Rasmussen, S. A., "Vague identity", *Mind* 95, pp. 81-91.

Rea, M. C., 1995, "The problem of material constitution", *The Philosophical Review* 104, pp. 525-552.

------------, 1997, (ed.) *Material constitution. A reader*, Rowman & Littlefield Publishers Inc., New York-Oxford.

Redhead, M., 1982, "Quantum field theory for philosophers", *Philosophy of Science Association* (2), pp. 57-99.

Redhead, M.; Teller, P., 1992, "Particle labels and the theory of indistinguishable particles in quantum mechanics", *British Journal for the Philosophy of Science* 43, pp. 201-218.

Sainsbury, R. M., 1989, "What is a vague object?", *Analysis* 49, pp. 99-103.

--------------------, 1994, "Why the world cannot be vague", in Horgan, T., 1994, pp. 63-81.

Salmon, N., 1982, "*Reference and Essence*", Blackwell, Oxford.

Simons, P., 1997, "On being the same ship(s) - or electron(s): reply to Hughes", *Mind* 106, pp. 761-767.

Stalnaker, R., 1988, "Vague identity", in Austin, D. (ed.), *Philosophical Analysis. A Defense by Example*, Kluwer Academic Publishers, Dordrecht-Boston-London, pp. 349-360.

Teller, P., 1983, "Quantum physics, the identity of indiscernibles and some unanswered questions", *Philosophy of Science* 50, pp. 309-319.

------------, 1986, "Relational holism and quantum mechanics", *British Journal for the Philosophy of Science* 37, pp. 71-81.

Thomson, J., 1983, "Parthood and identity across time", *Journal of Philosophy*, pp.201-220. Also reprinted in Noonan, H. W., 1993b.

Tye, M., 1990, "Vague objects", *Mind* 99, pp. 535-557.

---------, 1994a, "Sorites paradoxes and the semantics of vagueness" in Tomberlin, J. E. (ed.) *Philosophical Perspectives* 8: *Logic and Language*, pp. 189-206.

---------, 1994b, "Vagueness: welcome to the quicksand", in Horgan, T., 1994, pp. 1-22.

Unger, P., 1979, "I do not exist", in Macdonald, G. F., (ed.) *Perception and identity*, The Macmillan Press Ltd, pp. 235-251.

------------, 1980, "The problem of the many", *Midwest Studies in Philosophy* 5, pp. 411-67.

van Inwagen, P, 1990, *Material Beings*, Cornell University Press, Ithaca and London.

van Fraassen, B., 1991, *Quantum mechanics. An empiricist view*. Clarendon Press, Oxford.

Wiggins, D., 1986, "On singling out an object determinately", in P. Pettit, J. McDowell (eds.), *Subject, Thought and Context*, Clarendon Press, Oxford, pp. 169-180.

Williamson, T., 1994, *Vagueness*, Routledge, London - New York.

Wright, C., 1994, "The epistemic conception of vagueness", in Horgan, T., 1994, pp. 133-159.

------------, 2001, "On being in a quandary. Relativism vagueness logical revisionism", *Mind* 110, pp. 45-98.

Zemach, E. M., 1991, "Vague objects". *Nous* 25, pp. 323-340.