

Individuals in Metaphysics and the Philosophy of Biology



The
University
Of
Sheffield.

William Morgan

University of Sheffield
Department of Philosophy

Word Count: 61,555

A thesis submitted in partial fulfilment of the requirements for the degree of
Doctor of Philosophy

Submission date: August 2021

Declaration

I, the author, confirm that the Thesis is my own work. I am aware of the University's Guidance on the Use of Unfair Means (www.sheffield.ac.uk/ssid/unfair-means). This work has not been previously presented for an award at this, or any other, university.

Abstract

Philosophers of biology and metaphysicians are both interested in the nature of biological individuals or organisms. Despite this, there has so far been very little contact between the two. This thesis argues that this should change. It argues that metaphysics can contribute to key debates about the nature of biological individuals in the philosophy of biology, but also that the philosophy of biology is relevant to more general metaphysical debates about material objects.

Chapters 1-3 are concerned with two of the main debates about the nature of biological individuals in the philosophy of biology: the Problem of Biological Individuality, and the Substance-or-Process Question. I argue that some of the main positions in these debates face metaphysical worries. The upshot is that a particular view about the nature of biological individuals should be preferred: biological individuals are *substances* and *units of selection*.

Chapter 4 argues that serious metaphysical views are in tension with the existence of biological individuals. Importantly, it demonstrates that the outcome of debates in the philosophy of biology discussed in earlier chapters is dependent on the answers to metaphysical questions about material objects.

Chapter 5 argues that the philosophy of biology is relevant to the Special Composition Question in metaphysics, which asks, ‘under what conditions do smaller things make up something bigger?’. It argues that solutions to the Problem of Biological Individuality allow metaphysicians to generate a precise and biologically informed answer to the Special Composition Question.

Finally, chapter 6 motivates a novel way of understanding the Problem of Biological Individuality which would allow philosophers of biology to entirely sidestep the metaphysical worries facing their views discussed in chapters 1 to 4.

The thesis should be of interest to philosophers of biology interested in biological individuality, and metaphysicians interested in the nature of substances, composition, and personal identity.

Acknowledgements

I have a number of people to thank for helping me write this thesis. I owe a special thanks to my supervisors, Eric Olson and Ellen Clark, who have taught me a great deal about metaphysics and the philosophy of biology, whose work has been incredibly influential to me, and who have supported me every step of the way. I am also very grateful to Katherine Hawley, Thomas Pradeu, and Elselijn Kingma, whose work has been a great inspiration, and who have very kindly offered me their time to discuss all things philosophical and biological. Radivoj Stupar, Jacob Donskov, Alex Geddes, William Hornett, and Javier, Suarez Diaz have very kindly provided me with helpful feedback on the ideas in various chapters. The thesis has benefitted from feedback at a number of conferences and workshops. In particular, I would like to thank the members of the University of Sheffield graduate seminar, participants of the University of Bordeaux ‘Microbiota, Symbiosis and Individuality Summer School’, participants and organisers of ISHPSSB Oslo 2019, and the participants of the BUMP (Better Understanding the Metaphysics of Pregnancy) 2021 conference at the University of Southampton. This work was supported by the Arts & Humanities Research Council (grant number AH/L503848/1) through the White Rose College of the Arts & Humanities. Some of the material in chapter 2 appears in my article, ‘Are Organisms Substances or Processes?’, published in the Australasian Journal of Philosophy. I am grateful to AJP for allowing me to use the material in this thesis. I dedicate the thesis to Robert Fletcher; my first philosophy teacher.

Table of Contents

<i>Introduction</i>	8
<i>Chapter 1. How Should We Count Biological Individuals? The Problem of Biological Individuality and The Foetus Problem</i>	15
1.1. <i>Introduction</i>	15
1.2. <i>Two Approaches to Biological Individuality: Physiological and Evolutionary</i> 19	
1.3. <i>The Physiological Approach and the Foetus Problem</i>	26
1.4. <i>Responses</i>	37
1.4.1. <i>Reject the Permanence Principle</i>	37
1.4.2. <i>The Pluralist Approach</i>	41
1.5. <i>Conclusion</i>	45
<i>Chapter 2. Are Biological Individuals Substances or Processes?</i>	46
2.1. <i>Introduction</i>	46
2.2. <i>Three Readings of the Process View</i>	49
2.3. <i>Accounts of Substance</i>	51
2.4. <i>Processes are Extended in Time</i>	54
2.5. <i>Activity, Stasis and Persistence</i>	58
2.6. <i>Ecological Dependence</i>	64
2.7. <i>Fuzzy Boundaries</i>	68
2.8. <i>Process Ontologists Are Only Objecting To Particular Characterisations of Substances</i>	71
2.9. <i>What Would a Radical Processual Philosophy of Biology Look Like?</i>	72
2.10. <i>Conclusion</i>	75
<i>Chapter 3: Are We Biological Individuals? Animalism and the Too-Many-Thinkers Problem</i>	77
3.1. <i>Introduction</i>	77
3.2. <i>What Are We? The Views</i>	80
3.3. <i>The Too-Many-Thinkers Problem</i>	84
3.4. <i>The Pluralist Approach and the Too-Many-Thinkers Problem</i>	85
3.5. <i>The Upshot: The Pluralist Approach is in Tension with Our Being Biological Individuals</i>	92
3.6. <i>Reject Animalism or Reject the Pluralist Approach?</i>	93
3.7. <i>Relativism About What We Are</i>	95
3.8. <i>Conclusion</i>	97
<i>Chapter 4. Are There Any Biological Individuals? Biological Individuality and Eliminativism</i>	99

4.1. Introduction.....	99
4.2. How Do Things Persist?	101
4.2.1. The Problem of Temporary Intrinsic.....	102
4.2.2. Four Dimensionalism and Eliminativism about Biological Individuals.....	104
4.2.3. The Stage View and Eliminativism	107
4.3. Can Objects Get Bigger and Smaller?	112
4.4. When Does Composition Occur?	124
4.4.1. Physical Bonding.....	126
4.4.2. Universalism	127
4.4.3. Nihilism.....	130
4.4.4. Organicism.....	134
4.5. Conclusion.....	139
Chapter 5. When Do Things Compose Biological Individuals? Biological Individuality and the Special Composition Question.....	140
5.1. Introduction.....	140
5.2. Organicism Again	142
5.2.1. Lives are homeodynamic events.....	142
5.2.2. Lives are Reasonably Well-Individuated Events	144
5.2.3. Lives are Jealous Events	144
5.3. Criticism 1: Organicism is vague	145
5.4. Criticism 2: Lives are Not Well-individuated.....	148
5.5. Brain Activity?.....	154
5.6. Organicism and Metaphysical Puzzles	156
5.7. A Biologically-Informed Organicism.....	161
5.7.1. An Immunological Understanding of Organicism.....	161
5.7.2. Worries with IUO.....	169
5.7.3. An Evolutionary Understanding of Organicism	171
5.8. Objection to EUO	177
5.9. The Problem of Biological Individuality and the Special Composition Question	181
5.10. Conclusion.....	185
Chapter 6. Does It Matter Whether There Are Biological Individuals?	187
6.1. Introduction.....	187
6.2. The Problem of Biological Individuality and Explanatory Power.....	189
6.3. Nihilism and Particles Arranged Biological Individual-wise	193
6.4. Agnostic Fictionalism about Biological Individuality.....	198

6.4.1. <i>Fictionalism in Philosophy</i>	198
6.4.2. <i>Agnostic Fictionalism about Biological Individuality</i>	201
6.4.3. <i>Avoiding Other Metaphysical Issues</i>	202
6.5. <i>Agnostic Fictionalism and Process Ontology</i>	206
6.6. <i>How Agnostic Fictionalism about Biological Individuality Differs from Promiscuous Realism</i>	207
6.7. <i>Objection: Emergence</i>	208
6.8. <i>Are Philosophers of Biology and Metaphysicians Speaking Different Languages?</i>	211
6.9. <i>Conclusion</i>	214
<i>Conclusion</i>	215
<i>References</i>	218

Introduction

Philosophers are often interested in questions about the nature of biological individuals or organisms, such as human beings, cats, plants, and bacteria. This should be of no surprise. For one thing, biological individuals seem to be what we are. As such, knowing about the nature of biological individuals would presumably tell us something about what sort of things *we* are. Biological individuals are also often the bearers of rights and obligations and can form meaningful relationships. Furthermore, they are the subject of the biological sciences, figuring in our most important scientific theories, such as evolution by natural selection, and our most important scientific fields such as evolutionary biology and immunology. Biological individuals also provide us with numerous health benefits but can also harm us. Finally, biological individuals raise a number of interesting and difficult philosophical puzzles and are arguably the most bizarre and fascinating objects on the planet.

Two branches of philosophy that are particularly interested in the nature of biological individuals are the philosophy of biology and metaphysics. The philosophy of biology is a sub-branch of the philosophy of science that emerged in the 1960's, partly as a result of philosophers noticing that the philosophy of science was too physics-centred, and partly because philosophers started to appreciate the conceptual issues that arise within biology (Godfrey-Smith, 2010; D. Hull & Ruse, 2008; Okasha, 2019, 2).

Trying to provide a definition of 'metaphysics' is notoriously difficult, but perhaps the best we can say (which is not entirely helpful) is that metaphysics is study of *ultimate reality* (Van Inwagen, 2015, 1-2). This raises many other questions such as what 'ultimate' and 'reality' mean, but, as van Inwagen says, we might say that metaphysics tries to 'get behind

appearances' and asks what the most general features of the world are (Van Inwagen, 2015, 2-4).¹

Metaphysicians, therefore, are by no means exclusively concerned with questions about biological individuals, but with the world more generally. Living things, however, have often taken centre stage in metaphysical theories. One metaphysical question, for example, which I will consider in chapter 2, asks what makes something a substance.² Many philosophers believe, however, that living things are the paradigmatic substances (Robinson, 2018; Toner, 2008; Wiggins, 2001, 90). Another metaphysical question asks how it is possible for material objects such as stones, cars and cats to persist through time despite losing parts. Some philosophers, however, believe that living things are the only objects that can persist through the losing of parts (Hoffman & Rosenkrantz, 1997, ch5; Van Inwagen, 1990, ch14). Another question is which kinds of material objects have parts. As we will see, some philosophers have argued that living things are the only material objects with parts (Merricks, 2001; Van Inwagen, 1990). Living things have also been of interest to metaphysicians writing about personal identity, such as the question of what sort of beings we are. Although not all personal identity theorists think that we are biological individuals, almost all of them think that each of us is intimately related to a biological individual.

Both metaphysicians, and philosophers of biology, therefore, are interested in questions about biological individuals. Despite this, there has been very little contact between the two. Whilst there are some notable exceptions (Boyle, 2020; Guay & Pradeu, 2020; Kaiser, 2018; Martens & Guay, 2020; Meincke & Dupré, 2020; Pradeu & Guay, 2015; Triviño & Suárez, 2020;

¹ By 'the world', I mean, as most metaphysicians do, everything that there is; not the earth.

² 'Substance', as used by philosophers, is a technical term, very different from its ordinary everyday use.

Wilson, 1999), most of the time, metaphysics and the philosophy of biology are done independently of each other. It seems to me that most work at the intersection of metaphysics and the philosophy of science is ultimately at the intersection between metaphysics and the philosophy of *physics* (French, 2014; French & McKenzie, 2012; Ladyman & Ross, 2007; Maudlin, 2007; Morganti, 2013; Redhead, 1995).

Why has there been so little contact between metaphysicians and philosophers of biology regarding questions about biological individuals? One reason, I think, is because metaphysicians and philosophers of biology often ask different questions about biological individuals and have different philosophical interests and aims. As we shall see, philosophers of biology, more often than not, are concerned with explanatory power and usefulness in the biological sciences and are interested in many different kinds of biological individuals; not just human beings. In contrast, metaphysicians writing about biological individuals are often mostly concerned with solving metaphysical puzzles about material objects and are mostly concerned with *human* biological individuals (Hoffman & Rosenkrantz, 1997; Olson, 1997a; Snowdon, 2014; Van Inwagen, 1990; Wiggins, 2012). Because metaphysicians and philosophers of biology writing about biological individuals have different interests, it might, therefore, be thought that each discipline is not particularly relevant to the other and, therefore, that there is little reasons for each to engage in the other's work.

The aim of this thesis is to show that there should be more contact between metaphysicians and philosophers of biology writing about biological individuals. Despite there being little contact between these philosophers, I aim to show that each discipline is relevant to the other. On the one hand, and the main focus of the thesis, I will argue that metaphysics can contribute to the key debates about biological individuals in the philosophy of biology. On the other hand, I will

argue that the philosophy of biology is relevant to more general metaphysical questions about material objects. The upshot is that the philosophy of biology should be more metaphysically informed, and that metaphysics can benefit from being informed by the philosophy of biology.

The Plan

The thesis has two parts. The first half, comprising chapters 1-3, is mostly concerned with two of the main debates about biological individuals in the philosophy of biology which have both been taken to be important for the biological sciences.

Chapter 1 is concerned with the first of these debates called *the Problem of Biological Individuality*, which is the question of how to count and distinguish organisms. I argue that one of the main solutions to this problem – the Physiological Approach - faces a metaphysical problem which I call the ‘Foetus Problem’, which the other main solution – the Evolutionary Approach – seems more equipped to avoid.

Chapter 2 considers the second of these debates: the question of whether biological individuals are substances or processes. I aim to clarify the debate and argue that despite the increasing popularity of the so-called ‘process ontology’, philosophers of biology have not yet provided good reasons for thinking that biological individuals are process rather than substances. At the end of the chapter, I outline a version of process ontology that is yet to be defended, but which would have radical implications for debates about biological individuals, including the Problem of Biological Individuality discussed in chapter 1.

Chapter 3 considers a personal question about biological individuals: are *we* biological individuals? I argue that one of the most popular solutions to the Problem of Biological

Individuality – the Pluralist Approach – is in tension with our being biological individuals, and furthermore, is in tension with all the usual accounts of what we are in the personal identity literature. I take this to provide a reason to worry about the truth of the Pluralist Approach.

Combining the arguments of chapters 1 – 3, I hope to have provided metaphysical reasons, for endorsing a certain picture of the nature of biological individuals (if they exist): biological individuals are *substances that are units of selection*.

Chapter 4 asks a surprising question about biological individuals: are there any? Despite it seeming obvious that biological individuals exist, the chapter argues that there are some serious metaphysical views about material objects that are in tension with the existence of biological individuals. If these views are true, this would cause problems for all the usual answers to debates about biological individuals in the philosophy of biology discussed in the first half of the thesis. The aim of this chapter is to demonstrate that debates about biological individuals in the philosophy of biology, as they are currently understood, are dependent on the outcomes of more general metaphysical questions about material objects.

Chapter 5 provides a closer look at one reason for thinking that there are biological individuals by considering van Inwagen's influential answer to a debate in metaphysics called the *Special Composition Question*, which asks, 'when do smaller things add up to, or make a bigger thing?'. I consider two biological worries with van Inwagen's answer and argue that a consideration of the Problem of Biological Individuality provides van Inwagen with the resources to respond to these worries. What this demonstrates is that the philosophy of biology can contribute to debates in metaphysics about material objects.

Finally, in chapter 6, I motivate a novel way to understand the Problem of Biological Individuality and its answers, which would allow philosophers of biology to avoid the metaphysical challenges discussed in chapter 1- 4, whilst still allowing them to receive the benefits of their preferred accounts of biological individuality. The upshot, then, is that metaphysics, whilst exposing difficulties with debates in the philosophy of biology, can also be used to allow philosophers of biology to avoid these worries. A striking conclusion, however, is that according to this novel way of understanding the debate, the Problem of Biological individuality need not be a debate about biological individuals at all.

‘Biological individual?’

Before getting on to the main body of the thesis, I should say something about what I mean by ‘biological individual?’.

By ‘individual’, I mean something that is neither a property, aspect or modification of anything else, unlike, for example, a wrinkle in the carpet, which is simply a modification of the carpet (Van Inwagen, 2015, 28), or ‘brownness’, which is a property of the carpet.³ On the other hand, a carpet is not modification or aspect or property of anything else, and so is an individual. Individuals, in other words, are material objects.

What, though, do I mean by ‘biological individual?’ I don’t just mean those individuals that are studied by biologists. Organs, such as hearts as lungs are individuals, but by how I am using the term, they do not count as biological individuals. Furthermore, perhaps groups or species

³ As we shall see in chapter 2, understood this way, ‘individual’ is synonymous with ‘substance’ on at least one account of substance.

count as individuals (D. Hull, 1976), but by how I am using the term, they do not count as biological individuals. Following, some authors, such as Clarke (2013), I will be using ‘biological individual’ and ‘organism’ interchangeably. It is the topic of the first chapter to determine exactly when things count as biological individuals or organisms, but as I am using the terms, they refer to things, as Ellen Clarke says, ‘smaller than clades [and species, groups and colonies] but bigger than organs’ (Clarke, 2021, 105). Cows and human beings, for example, count as biological individuals or organisms, but hearts, and the species *Homo Sapiens* do not. Whether some putative individuals, for example, Portuguese Man of Wars, count as biological individuals or organisms, as opposed to colonies or groups, is disputed, but this is an issue that will be discussed in chapter 1.

Not all philosophers use ‘biological individual’ and ‘organism’ interchangeably. Many philosophers of biology take the category of biological individual to be larger than the category of organism, holding that whilst all organisms are biological individuals, not all biological individuals are organisms, taking groups, genes and species to be examples of non-organism biological individuals (Pradeu, 2010, 248-249). It seems to me, however, that the questions about biological individuals that I will be discussing in this thesis are primarily questions about organisms, rather than groups or species.⁴ As Clarke, says, for example, the Problem of Biological Individuality is sometimes referred to as the ‘debate about *organismality*’ (Clarke, 2021, 108).⁵ At least in this thesis then, I use the terms interchangeably.

⁴ Although, things are complicated by the fact that some authors think that groups sometimes count as organisms See, for example, Sober and Wilson (1989).

⁵ Italics are mine.

Chapter 1. How Should We Count Biological Individuals? The Problem of Biological Individuality and The Foetus Problem

1.1. Introduction

Counting biological individuals or organisms may seem to be easy.⁶ Most of us would have no trouble counting the number of human beings in a seminar, or the number of animals in the zoo. In fact, counting organisms seems so easy that we often use them to teach children how to count - when you were a toddler, you probably had books asking you to count the number of animals on each page.⁷

When we move away from paradigmatic organisms such as sheep, cows, dogs and human beings, however, things are not always so simple. As Jack Wilson says, ‘the same intuitions that allow us to count puppies and tomato plants with confidence leave us perplexed when we try to count colonial siphonophores like the Portuguese man-of-war’ (Wilson, 1999, 1). Consider the Portuguese man-of-war, which is a jellyfish-like siphonophore, consisting of a translucent balloon-like body and tentacles often longer than thirty feet. Like typical organisms, it can reproduce, it has a unique and uniform genome, and its parts work together as a single functional unit. Biologists have suggested that given the unusual way it develops, with the

⁶ Recall, I am using ‘biological individual’ and ‘organism’ interchangeably.

⁷ This is Ellen’s Clarke example.

fertilized ovum budding off into distinct structures, perhaps it is not an organism at all, but is best understood as a colony of several distinct organisms.

Plants can be difficult to count too. Consider a grove of aspen trees. Whilst the trees appear to be entirely distinct biological units when considered from above ground, each tree is connected underground by a complex root system and has the same genome. Given this, should we treat each tree as a distinct organism in its own right, or rather as organs or parts of one larger organism?

Furthermore, there are even difficulties when counting and distinguishing more familiar organisms. Human beings, for example, are hosts to a vast number of microorganisms which are often involved in many of our biological processes such as the immune system, metabolism and digestion (Dupré & O'Malley, 2009; Pradeu, 2010). Like our other bodily cells that are involved in these processes, does this mean that we should therefore count these microorganisms as parts of us, and hence, that we should count a human being, along with their symbiotic bacteria, as forming a single biological unit?

These are just a few of the many problem cases when it comes to counting organisms. Others include strawberry plants, slime molds, aphids, fish, and fungi.

The question of how to count biological individuals or organisms is called the *Problem of Biological Individuality* (Clarke, 2010).⁸ As real biological examples show, answering the question is not easy. Why, though, should anyone care about it?

⁸ This, at least, is how I am understanding the problem. Other ways of understanding it include 'how should we define 'biological individual'?' (Pradeu, 2010) and 'how does life divide into units?' (Olson, 2020).

Firstly, the question is philosophically interesting in its own right. The problem leads us to consider real biological examples which show just how strange the biological realm can be; stranger perhaps, than philosophers could ever imagine when crafting thought experiments. As JBS Haldane writes, ‘The world is not only queerer than we imagine, it is queerer than we can imagine’.⁹ Consider, for example, Osedax worms, also known as boneworms or zombie worms. These deep sea, mouthless and gutless, bone-eating worms have roots filled with symbiotic bacteria which possibly provide the worms with nutrients that are lacking in their diet. The male of the species are much smaller than the females, and often crawl inside the females, never again to leave or to eat, supplying the females with a constant supply of sperm (Scales, 202, 65-66). This real-life example, which raises the question of how to count and distinguish biological individuals (should we, for example treat the male, female worms and their symbionts and composing a single biological individual?), would not look out of place in a science fiction novel.

Secondly, organisms seem to be what *we* are. As such, knowing how to count organisms will presumably tell us something about what sorts of things we are (Clarke, 2010, 313). Suppose, for example, that human beings and their gut bacteria belong to a single biological unit and that gut bacteria are parts of the human beings that they inhabit. Assuming that we are human beings, this will tell us that we are the sorts of things whose parts include lots of tiny microbes, and hence, that our parts are genetically diverse.

⁹ Found in Wilson (1999, 11).

Thirdly, and perhaps most importantly to philosophers of biology, the question of how to count organisms or biological individuals is taken to be important for biology.¹⁰ Evolutionary biologists, for example, in order to generate predictions about evolutionary processes must be able to count and distinguish distinct biological units (Clarke, 2013). They measure the spread of a trait or genes, for example, but counting how many distinct *organisms* have those genes or trait. I do not simply increase the frequency of my genes by growing new matter that has my genes (Olson, 2020, 63). Rather, I do so only by reproducing new *organisms* with my genes.

The question, more recently, has been taken to be important outside of evolutionary biology too, such as in immunology (Pradeu, 2012, 2019; Tauber, 1994), ecology (DiFrisco, 2019, 847; Huneman, 2014), and for predicting lifespan (O'Malley, 2021; Pepper & Herron, 2008, 625). Philosophers of biology, then, take the Problem of Biological Individuality to be important for practical reasons, and as Pepper and Herron highlight, different criteria for counting organisms provide different answers to some biological questions (2008, 624-625).

Answers to the Problem of Biological Individuality aim to help us count biological individuals by providing criteria for determining when something counts as a biological individual. These answers also provide criteria for determining when something counts as a part of a biological individual. Answers in the philosophy of biology have generally taken two main approaches (Guay & Pradeu, 2016, 6): the *Physiological Approach*, which appeals to physiological processes (such as the metabolism or immune system) to determine when something counts as an organism, and the *Evolutionary Approach*, which instead appeals to the theory of evolution by natural selection. Almost always, philosophers of biology tend to focus on explanatory

¹⁰ Not all philosophers agree, however. Wilson (2000, S301) for example, writes that 'Biology lacks a central organism concept...because the most important questions about organisms do not depend on this concept'. Wilson's view, however, is in the minority.

power in biology or scientific practice when deciding which approach to adopt (Clarke, 2021; DiFrisco, 2019; Pepper & Herron, 2008; Sterner, 2015; Waters, 2018).

In this chapter, I argue that metaphysics can also contribute to answering the Problem of Biological Individuality. Drawing on an argument made by Eric Olson (1997b) in the personal identity literature, I argue that the Physiological Approach faces a metaphysical problem which can be called the ‘Foetus Problem’ (FP).¹¹ It is less clear whether the Evolutionary Approach also faces FP, but I will provide some reasons for thinking that it can avoid it. My argument, then, exposes a difficulty for the Physiological Approach, and may also provide one reason for preferring the Evolutionary Approach. This chapter joins a growing trend among philosophers who believe that metaphysics can play a role in current debates in the philosophy of biology (Guay & Pradeu, 2016; Haber, 2016; Kaiser, 2018; Oderberg, 2020; Olson, 2020; Suárez & Triviño, 2020).

1.2. Two Approaches to Biological Individuality: Physiological and Evolutionary

According to the Physiological Approach, a biological individual is some sort of functional or physiological whole - something whose parts are coordinated and work together to maintain the functioning of the whole (Dupré & O’Malley, 2009; Folse & Roughgarden, 2010, 449; Godfrey-Smith, 2013, 25; Pradeu, 2010; D. S. Wilson & Sober, 1994, 606; Jack Wilson, 1999, 62&89). To abbreviate, we can say that according to the Physiological Approach, an organism

¹¹ Olson’s argument is directed against psychological accounts of personal identity, and he similarly calls the problem that these accounts face the “fetus problem” (Olson, 1997b, 98).

is something whose parts are *physiologically related*. In addition, it holds that something is a part of an organism by virtue of being involved in or contributing to such a whole – by being physiologically related to other parts of the organism. The Physiological Approach attempts to solve the Problem of Biological Individuality by telling us to count Portuguese man-of-wars, aspen tree groves and so on as organisms, only if their parts work together as a single functioning unit.

There are a number of versions of the Physiological Approach, which provide different understandings of what it is for parts to be physiologically related. One version appeals to metabolic interactions, taking an organism to be a self-maintaining system whose parts are constantly involved in the use and exchange of matter and energy in order to allow the organism to grow, develop, and maintain itself (Dupré & O'Malley, 2009; Godfrey-Smith, 2013). It holds that something is a part of an organism by virtue of being involved in its metabolic activity.

One problem with the metabolic version of the Physiological Approach is that it seems to be too vague or unspecific to allow us to count organisms (Clarke, 2021, 114; Godfrey-Smith, 2013, 25; Pradeu, 2010, 252). It is not clear, for example, which interactions count as *metabolic* in the required sense. A flame, for example, seems to be a good example of a self-maintaining system, constantly consuming energy to grow and develop (Campbell, 2015, 150; Cleland & Chyba, 2007, 120). Furthermore, an obvious example of a self-maintaining system whose parts are constantly involved in exchanges of matter and energy is the entire biosphere (Campbell, 2015, 148-149; Clarke, 2021, 114).¹²

¹² Gaia theorists (Lovelock & Margulis, 1974) take the thesis that the earth or its biosphere is an organism (or at least, organism-like) seriously, but this isn't a very popular view.

Another account of biological individuality, which I am taking to be a version of the Physiological Approach, is by Queller and Strassman, which appeals to the notions of *cooperation and conflict*.¹³ According to this account, an organism is ‘a unit with high cooperation and very low conflict among its parts’ (Queller & Strassmann, 2009, 3144). An organism, for example, is something whose parts do not fight for resources, or fight little for resources. This account, then, rules out parasites from being parts of their host organism, but may count beneficial symbionts as parts.¹⁴

As with the metabolic version of the Physiological Approach, I take Queller and Strassman’s account to be too vague, given that it isn’t entirely clear when interactions between objects count as ‘cooperative’, or when conflict between the parts of an organism counts as ‘very low’.

More promisingly, some have tried to provide a precise version of the Physiological Approach by appealing to *immunological activity* (Pradeu, 2010, 2012; Tauber, 1994). Most notably, Thomas Pradeu (2010, 2012) argues that an organism is something whose parts are related and unified by immunological interactions. Specifically, an organism is something whose parts are connected by strong biochemical interactions (often protein-protein interactions) and ‘controlled by systemic immune interactions that repeat constantly at the same medium intensity’ (Pradeu, 2010, 258). Pradeu specifies that the immune interactions must be of a medium intensity - understood in terms of the strength of binding between an immune cell receptor and another entity - because if they are too strong, the latter entity will not be tolerated (Pradeu, 2010, 257). We can abbreviate the immunological account by saying that an organism

¹³ Arguably, Queller’s and Strassman’s account is best taken to be a version of the Evolutionary Approach, given that they understand cooperation and conflict are primarily understood in terms of processes of evolution by natural selection. I, however, am labelling it as a version of the Physiological Approach given that, like other versions of the Physiological Approach, it focusses on the functional interactions between an organism’s parts.

¹⁴ When both symbiotic partners benefit each other, this symbiotic relation is referred to as ‘mutualism’. When one partner benefits whilst the other is neither harmed nor benefitted, this is referred to as ‘commensalism’.

is something whose parts are *immunologically related*.¹⁵ In addition, the immunological account holds that something is a part of an organism only if it is immunologically related to other parts of the organism. The immunological account, therefore, seems to imply that many gut bacteria are parts of their human host, given that they are tolerated by their host's immune system, and interact with their host via strong biochemical interactions (Pradeu, 2012, 247).

I take the immunological version of the Physiological Approach to be the most promising of the three versions discussed here, given the vagueness worry facing the other two versions.¹⁶ In the remainder of the chapter, I will therefore set the metabolic and cooperation and conflict versions aside, and will focus on the immunological version.

The second main approach to biological individuality – the Evolutionary Approach - appeals to the theory of evolution by natural selection to determine when something counts as an organism. According to this approach, an organism is a *unit of selection* - something that has the capacity to participate in evolution by natural selection. According to Lewontin's classical picture, a unit of selection is something which is a member of a population where there is 1) variation in traits (such as height or running speed), 2) differences in reproductive success, and 3) heredity - parents resemble offspring (Lewontin, 1970, 1). Following Godfrey-Smith, we can call such a population a 'Darwinian Population' (Godfrey-Smith, 2013, 19).

Assuming this framework of evolution by natural selection is correct, we can say that according to the Evolutionary Approach, an organism is something that is a member of a Darwinian population (Godfrey-Smith, 2013, 19). This alone, however, does not tell us very much about

¹⁵ I borrow this phrase from Olson (2020, 76).

¹⁶ I am open, however, to the possibility of a more precise metabolic or cooperation account being presented in the future.

what biological individuals are. In particular it leads to another question: under what conditions is something a member of a population where there is variation, heredity and differences in reproductive success?

There are a number of versions of the Evolutionary Approach, which differ in how they understand units of selection, and therefore, how they understand organisms (Clarke, 2013; Godfrey-Smith, 2013; Janzen, 1977). The most straightforward version takes an organism to be something composed of cells with the same genome (to avoid unintended implications, for example, that two of my cells compose an organism, we should probably say that according to this account, an organism is a *maximum sum* of cells with the same genome) (Janzen, 1977; Jack Wilson, 1999, 86-87). The biological motivation for this view is that too much genetic variation between the parts of an organism can result in evolutionary conflict between those parts and hence, can result in an organism ceasing to be a single unit of selection.

The genetic view, however, is not taken seriously by philosophers of biology anymore. As well as implying that there are biological individuals with radically scattered parts, such as a biological individual composed of a parent aphid and all of its offspring produced by asexual reproduction, most biologists think that genetic homogeneity is not required for something to count as a unit of selection. More than this, the view that organisms have genetically homogenous parts is said to be an oversimplification or an idealisation, given that each instance of normal cell division typically involves some mutations. At best, the cells of a multicellular organism are only ever genetically very similar (Clarke, 2011, 2012; Godfrey-Smith, 2009, 82, 2014, 69).

More promisingly, Peter Godfrey-Smith take organisms (at least multicellular organisms) to be reproducing entities that participate in evolution by natural selection by virtue of having three features: 1) germ-soma separation (a distinction between sex and non-sex cells) 2) a bottleneck lifecycle (starting one's life as a single cell before becoming multicellular), and 3) functional integration of parts - a division of labour and mutual dependence among its parts (Godfrey-Smith, 2009, 2013, 21-22).

Similarly Ellen Clarke, takes organisms to be things that possess *individuating mechanisms* which provide them with the capacity to participate in evolutionary processes (Clarke, 2013). She takes there to be two types of individuating mechanisms, which are necessary and sufficient for something to count as an organism. Firstly, organisms are things with *policing mechanisms*, which limit evolutionary conflict between the parts of an organism. Examples include the immune system, a bottleneck lifecycle, germ-soma separation, and pre-programmed cell death (Clarke, 2013, 421). Secondly, organisms are things with *demarcation mechanisms* which increase the likelihood of what Clarke calls, 'between object selection' – they increase the likelihood that organisms will participate in evolutionary processes by making it more likely that there will be variation *between* organisms rather than *between the parts* of organisms. Examples of demarcation mechanism are the skin and cell walls (Clarke, 2013, 424).

In contrast to the Physiological Approach, the Evolutionary Approach (or, at least, many versions of it) hold that gut bacteria are not parts of a human being.¹⁷ This is because a human organism and its gut bacteria do not respond to natural selection as a single unit. As biologists

¹⁷ Some philosophers disagree with this, though. See Dupré and O'Malley (2009, 13), Zilber-Rosenberg and Rosenberg (2008, 723).

might say, a human being and its gut bacteria have different *evolutionary fates* (Dupré, 2020, 154). My lineage, for example, could enjoy evolutionary success whilst the bacteria's lineage does not or vice versa. This is because there is no mechanism guaranteeing that the gut bacteria inside a particular human being will be passed on to the human being's offspring. Further, the bacteria and their offspring could be passed from host to host without the hosts belonging to the same lineage. The organisms of my evolutionary lineage, therefore, could entirely cease to exist, whilst the bacteria inside of me and their offspring continue to thrive in other hosts. As Godfrey-Smith says, a human organism and their gut bacteria do not form *parent-offspring lineages* (Godfrey-Smith, 2013).¹⁸

For similar reasons, it seems plausible that by physiological criteria, the bacteria *Vibrio fischeri* that colonize the Hawaiian bobtail squid count as parts of the squid (or perhaps, that the bacteria and squid compose a further organism who we might call 'Squid-*Vibrio*'). In contrast, given that the squid dispel most of their bacteria to their environment at dawn each day, and hence, there is no mechanism guaranteeing that the squid's bacteria is transmitted to the squid's offspring, bobtail squid and their *Vibrio fischeri* do not form parent-offspring lineages, and hence, by evolutionary criteria, the bacteria and the squid do not belong to a single biological unit (Godfrey-Smith, 2013, 29).

We can see, then, that it makes a difference whether we adopt the Physiological Approach or the Evolutionary Approach, given that they count organisms and their parts differently.

¹⁸ This isn't the case for all host-microorganism relations. Aphids, for example, are inhabited by the bacteria *Buchnera aphidicola*, which are transmitted vertically from parent to offspring via the cytoplasm of maternal eggs (Booth, 2014, 659).

This concludes my brief explanation of the two main solutions to the Problem of Biological Individuality in the Philosophy of Biology. I will now argue that the Physiological Approach faces a metaphysical problem. There are four steps to my argument.

1.3. The Physiological Approach and the Foetus Problem

Step 1. It seems to follow from the Physiological Approach that a foetus is not simply contained by a maternal organism, like an apple in a fridge, or a metal coin swallowed by a toddler, but is a *part* of her. Elseijn Kingma, who has recently argued that pregnancy provides an interesting case study for the Problem of Biological Individuality, argues that both the metabolic and immunological versions of the Physiological Approach strongly suggest that a foetus is a *part* of its mother (2019, 628-629, 2020b, 208-209, 2020a, 1042). Whether she is right that this follows from the metabolic version is hard to say, owing to its vagueness (as discussed in the previous section). It does, however, seem to follow from the immunological version. Whilst a foetus is genetically different from its mother, in most cases, it directly interacts with, and is tolerated by its mother's immune system (Howes, 2007, 195; Pradeu, 2010, 256, 2012, 112). The details of foetal-maternal tolerance are complex,¹⁹ but it involves a foetus undergoing strong biochemical interactions and medium intensity immune interactions with parts of its mother. A foetus, therefore, counts as a part of its mother according to Pradeu's immunological version of the Physiological Approach.

It might instead be thought that the correct implication of the Physiological Approach is not that a foetus is a part of its mother, but that a foetus, along with its mother, are parts of a *third*

¹⁹ See Pradeu (2012, 111-115 and 174) for the complex biological details.

organism, which we might call a ‘mother-foetus’. The mother-foetus is not the same thing as the mother or foetus, but has them as parts. At least two authors endorse this view (Gilbert, 2014; Takeshita, 2017).

It doesn’t matter for present purposes whether this is right implication of the Physiological Approach. My argument only requires that a foetus is a proper part of *some* organism.²⁰ Hence, if you think that the correct implication of Physiological Approach is that a foetus is a part of a mother-foetus organism, rather than its mother, simply substitute my claim that a foetus is a part of its mother (according to Physiological Approach) with the claim that a foetus is a part of a mother-foetus.

Step 2. Secondly, if the Physiological Approach is true, then, depending on how it is understood, either a foetus is not an organism *at any stage of pregnancy*, or that there is at least a stage of foetal development when a foetus is not an organism.

Consider the former option first. Why should we think that if the Physiological Approach is true, then a foetus is not an organism at any stage of pregnancy? Well, some philosophers take the Physiological Approach to come with what Godfrey-Smith calls an “exclusion principle” (from now on, I will call this the ‘Exclusion Principle’) which states that organisms cannot have parts that are themselves organisms (Godfrey-Smith, 2013, 26).²¹ These philosophers take a physiological whole to something whose parts are *maximally* physiologically (for example, immunologically) related – something whose parts are physiologically related but which is not a part of some larger thing whose parts are physiologically related. The idea is that a

²⁰ x is a proper part of y =df x is a part of y and x is not identical to y.

²¹ This exclusion principle has been popular in metaphysics. See, for example, Oderberg, (2020, 23) and Hoffman and Rosenkrantz (1997 93-94).

physiological whole is the largest thing (in a hierarchy of things that are related by part-whole relations), whose parts are physiologically related. Consider a cell that is a part of a human being. Whilst it has its own immune system, and its parts are physiologically related (Pepper & Herron, 2008, 624; Pradeu, 2010, 29-32), it is a part of some larger thing which has an immune system and whose parts are physiologically related (the entire human being). The cell, then, unlike the entire human being, is not the physiological *whole*, but merely a part of that whole. What goes for cells also goes for the other parts of organisms too. As such, if a foetus is a part of its mother, and assuming that mothers are organisms, then by the Exclusion Principle, a foetus is not an organism.

A number of philosophers of biology who accept the Physiological Approach have said things which sound like an endorsement of the Exclusion Principle. Pradeu, for example, considers whether a colony of insects such as a hive of bees, counts as a single organism - a 'super-organism' (Wheeler, 1911) with the individual insects of the colony as parts. Given the presence of immune activity at the colony level in some colonies, Pradeu says that this 'may imply that, in those cases, the "organism" is the colony, *rather than each insect*' (Pradeu, 2012, 252).²² What Pradeu seems to be saying here is that if the colony is an organism, then the individual insects are not, but are merely parts of an organism, and hence, he seems to be endorsing the Exclusion Principle. Queller and Strassman also seem to endorse the Exclusion Principle when they say that 'the organism is the largest unit of near-unanimous design' (Queller & Strassmann, 2009).²³ Consider that biological things can be ordered in hierarchies based on part-whole relations. For example, in a particular hierarchy that contains a human

²² Italics are mine.

²³ It should be mentioned that, as Godfrey-Smith (2013, 26) points out, Queller and Strassmann in the very same paper (2009, 3144), and in another, (2016, 869) say things that are incompatible with the Exclusion Principle. As Godfrey-Smith says, 'This is an example of writers being pulled, I think, both by the appeal to some sort of exclusion principle and by the empirical cases (such as honey bee colonies) that suggest that organisms making up organisms is possible' (2013, 26).

being, the order might be: particles, genes, cells, a human being, and perhaps the homo sapiens species at the top. Queller's and Strasmman's view is that the organism is the largest member of the hierarchy whose parts are highly cooperative. Notice, though, that there can only be one candidate for being *the largest member*, which rules out the parts of organisms from being organisms.²⁴

(It is also worth noting that some philosophers find it convincing that even if an organism can be a part of another organism, an organism cannot be part of an organism *of the same kind* (Kingma, 2018, 175). If these philosophers are correct, this would arguably rule out a foetus from being an organism if it is a part of its mother, given that if a foetus is an organism at all, it would arguably be an organism of the same kind as its mother - a human organism).

Not all proponents of the Physiological Approach, however, accept the Exclusion Principle. Godfrey-Smith is tempted by the Exclusion Principle, but in the end seems to adopt a “gradient approach” according to which organisms can have parts that are also organisms, but to a lesser or higher degree than the organism they are part of (Godfrey-Smith, 2013, 26-27).²⁵ It might be thought, for example, that a cell that is a part of a human organism is an organism but to a lesser degree than the human organism, or that a colony of bees is an organism but to a lesser degree than the individual bees that make it up. The proponent of the Physiological Approach, then, might claim that despite a foetus being a part of its mother, it is still an organism, albeit to a lesser degree than its mother.²⁶

²⁴ Pepper and Herron (2008, 622) may also be assuming the exclusion principle. In this paper, they ask whether something is an organism *rather* than a part of an organism, which seems to assume that parts of organisms cannot themselves be organisms.

²⁵ Godfrey-Smith, then, seem to assume here that an organism and a part of an organism could not be an organism to the same degree, which is disputable. The argument in the chapter that follows, though, would still work if we reject this assumption.

²⁶ Presumably, no one will take the foetus to be an organism to a higher degree than its mother.

Nonetheless, even if the Physiological Approach allows that organisms can have parts that are organisms, it seems plausible that if it is understood immunologically, there will be a stage of pregnancy when a foetus is not an organism *to any degree*. This is because a foetus' immune system develops gradually and is still premature even when the baby is born. Research suggests that the human lymphatic system is in place by eight weeks of gestation, but remains immature for some time (McGovern et al., 2017, 3). Furthermore, many types of immune cell are not present in foetuses until a few weeks into the gestational period, and often take some time to mature. T cells and Natural Killer cells, for example, have been found in foetuses only as early as 8-9 weeks, (Ledford, 2017), and T-cell maturation only occurs between 8-12 weeks of gestation (Zhivaki & Lo-Man, 2017, 586). Dendritic cells, which are crucial for targeting foreign entities for destruction (Ledford, 2017), have been detected in human fetal skin as early as 9 weeks of gestation (Zhivaki & Lo-Man, 2017, 568), but have only been found to be functional by 13 weeks of gestation (Ledford, 2017). Given this, whilst a zygote may have its own immune system, and the individual cells of the early multicellular foetus have their own immune systems, it seems plausible that there will be some time during the early gestational period when the foetus as a whole (the multicellular thing) lacks the degree of immune activity necessary for it to be an organism *to any degree*. According to the immunological account, an organism, therefore, probably did not emerge until between 8-13 weeks of the gestational period. There need be no precise point when the organism emerges, but it certainly was not there from conception.

In summary then, depending on how the Physiological Approach is understood, either a foetus is not an organism at any stage during pregnancy (if the Exclusion Principle is adopted), or there is at least a period of foetal development when a foetus is not an organism (to any degree).

Step 3. If a foetus is not an organism, however (if the Exclusion Principle is accepted), then it seems plausible that a foetus never *becomes* an organism. Similarly, if a foetus is an organism at some point during pregnancy, but there is nonetheless an early stage of pregnancy when a foetus is not an organism (if we accept the gradient approach), then it seems plausible that an early non-organism foetus never becomes an organism.

Why think this? Well, almost all metaphysicians think that nothing could be an organism for only part of its existence - no non-organism could become an organism and no organism could become a non-organism (Blatti, 2020; Hoffman & Rosenkrantz, 1997, 157; Olson, 1997a, 136, 2007, 27; Snowdon, 1990, 97-98, 1991, 111; Van Inwagen, 1990, 145; Wiggins, 1980, 24). Call this principle the ‘Permanence Principle’. Note that the Permanence Principle is not the stronger view that organisms are *essentially* organisms – if organisms cannot be organisms temporally, it still may have been the case that a particular fish was a slice of cheese. What the Permanence Principle rules out is something coming into existence as a fish and later becoming a slice of cheese.

Why accept the Permanence Principle? Well, it certainly seems intuitive or plausible (Snowdon, 1990, 98). If there are any properties an organism could not survive the loss of, the property ‘being an organism’ seems to be one of them. I will, however, say more about why we should accept the Permanence Principle in section 3.1.

Suppose, then, that the Permanence Principle is true and hence, no non-organism can become an organism. If foetuses or early foetuses are not organisms (as the Physiological Approach holds), then it follows that they never become organisms. Similarly, it implies that organisms

were never non-organism fetuses. If the Physiological Approach comes with the Exclusion Principle, organisms only come into existence at birth when a foetus is no longer a part of its mother.²⁷ Alternatively, if the Physiological Approach does not come with the Exclusion Principle, since early fetuses would not count as organisms, then organisms do not come into existence until some weeks or months into the gestational period when a sufficiently mature immune system emerges.

This alone is a reason to worry about the Physiological Approach – surely it is obvious that a foetus (or an early foetus) is numerically one and the same thing as the later organism (Kingma, 2018, 178). That organisms began their lives as fetuses (or early fetuses) inside a womb seems to be common knowledge and is assumed by medical professionals and biologists.

Step 4. Importantly, though, given that the Physiological Approach holds that fetuses or early fetuses never become organisms, it faces a difficult question: what happens to fetuses or early fetuses, when organisms come into existence?²⁸

Consider first the version of the Physiological Approach that accepts the Exclusion Principle, and hence, implies that fetuses are not organisms during any stage of pregnancy. Combined with the Permanence Principle, this implies that fetuses never become organisms – if they were to become organisms, something could be an organism temporarily, which is incompatible with the Permanence Principle. What, then happens to fetuses when organisms come into existence at birth? What is certain is that if the Physiological Approach and the

²⁷ Kingma calls this the ‘beginning at birth’ view (Kingma, 2018, 175).

²⁸ Olson (Olson, 1997b) argues for different reasons that psychological accounts of personal identity imply that we were never fetuses but came into existence later, so we can similarly ask what happened to the foetus when *we* come into existence.

Permanence Principle are true, they never become organisms. There seem to be two options, but each is problematic.

Firstly, perhaps at birth (when a foetus is no longer a part of its mother), foetuses cease to exist and are replaced by organisms (Olson, 1997b, 100). More specifically, perhaps the matter that composes a foetus ceases to compose it and comes to compose a new thing – the organism (Kingma, 2018, 175-176). This option would certainly be very sad and surprising. It would imply that mothers will never get to hold the being that spent 9 months in their womb, and that the process of pregnancy inevitably involves the destruction of a foetus.

More importantly, though, this option isn't just sad, but implausible. Firstly, it does nothing to alleviate the worry that it just seems obvious that a foetus is numerically the same thing as the later baby organism. Secondly, whilst it might be plausible that causing something to *lose* its physiological complexity could cause it to cease to exist, it is less plausible that *increasing* something's physiological complexity – causing it to become something whose parts are maximally physiological related, or have a more mature immune system - is the sort of thing that can cause something to cease to exist. We normally expect living things to die or cease to exist by decaying or losing their functional capacities; not by gaining them.²⁹ I take this first option, therefore, to be implausible.

The second possibility is that when organisms come into existence at birth, foetuses continue to exist but come to share all of their matter with an organism (Olson, 1997b, 100). The idea is that at birth, the matter that composes the foetus continues to compose the foetus, but starts to compose a numerically distinct being – the organism - simultaneously. Hence after birth,

²⁹ See Olson (1997b, 101) for a similar line of reasoning.

where we thought there was just one living thing, there are actually, two – the organism, and the being that was once a foetus. To capture this idea, we can say that according to this view, the organism and the ex-foetus are ‘entirely co-located’. The view that distinct material objects can be entirely co-located might seem strange, but it has been reasonably popular among metaphysicians (Baker, 2000; Thomasson, 2007, 78-79; Wiggins, 1968). It has been said, for example, that a statue and the lump of matter of which it is made are distinct but entirely co-located objects, such that the lump, ‘constitutes’ the statue.

But even those who think that there can be distinct entirely co-located objects do not think that there can be entirely co-located objects of the *same kind* (Olson, 1997b, 101; Wiggins, 1967). Hence, if the ex-foetus is co-located with an organism, it cannot also be an organism. In any event, it follows from the Permanence Principle that the ex-foetus (something that was once a non-organism) could not be an organism. Nonetheless, the ex-foetus would be *physically indistinguishable* from an organism since it would be composed of the same matter, arranged in the exact same way, as an organism. In particular, the ex-foetuses, like the organism, would be a *physiological whole* but without being an organism. The Physiological Approach, though, precisely tells us that to be an organism *just is* to be a physiological whole. The co-location response, then, rather than allowing the Physiological Approach to respond to the Foetus Problem, implies that the Physiological Approach is false.

The version the Physiological Approach that accepts the Exclusion Principle, therefore, faces a difficult metaphysical question, which I am calling the Foetus Problem (FP). But what about the version of the Physiological Approach that rejects the Exclusion Principle, such as Godfrey-Smith’s gradient approach? Does this also face FP?

It seems to me that it does, and that it faces a particularly worrying version of FP. As we saw, whilst this version of the Physiological Approach does not rule out the parts of organisms from being organisms, it seems to follow from it that there is a stage of foetal development when a foetus is not an organism. I suggested that by immunological criteria, an organism probably does not appear, according to this approach, until around 8-13 weeks of the gestational period (it could be later or earlier than this, but the important point is that an organism was not there from conception). Suppose this is true. What happened to the non-organism foetus that existed during the first couple of months or so of pregnancy? If the Permanence Principle is true, whatever happened to it, it did not become an organism. The only options seem to be that it ceased to exist, or it continued to exist as a non-organism entirely co-located with an organism, but we have seen that both of these options are problematic.

This version of FP would be particularly worrying because it would imply that every pregnant organism, despite what we ordinarily think, is actually pregnant with two foetuses – one non-organism foetus that came into existence around the start of pregnancy, and one organism foetus that came into existence around the second or third month of pregnancy. It is hard to believe, though, that every process of pregnancy, excluding twinning, involves the creation of two foetuses.

Mammalian pregnancy, therefore, presents the Physiological Approach – both those versions which accept and reject the Exclusion Principle - with a metaphysical problem. I think, however, that my argument can also be extended from pregnancy to other biological phenomena too, such as hydrozoa budding (D. Hull, 1978). In hydrozoa budding, a part P, of an organism O, buds off and forms a new organism N, whilst O continues to exist. If P is not an organism prior to budding, and organisms cannot be organisms temporarily, as many

philosophers believe, then P is not identical to the later organism N. Hence, we can ask, what happens to P when N comes into existence? If the Permanence Principle is true, then one thing is for sure, P never becomes an organism. FP, then, can be extended to biological cases other than mammalian pregnancy.

Does the Evolutionary Approach also face FP? This is not so clear, and it will probably depend on which version approach is adopted. I think, though, that there is a case to be made for thinking that it avoids it. Regardless of the question of whether a foetus is a part of its mother according to the Evolutionary Approach, which does not have a clear answer (Kingma, 2020a1043 & 1044), there are reasons for thinking that a foetus, even in the early stages of its development, such as the zygote stage, is a unit of selection. Consider, for example, Clarke's version of the Evolutionary Approach, which takes an organism to be something that possess mechanisms for participating in natural selection (Clarke, 2013). Whilst a foetus may be lacking some of these mechanisms, such as mature gametes, and a proper functioning immune system, some of these mechanisms are already in place, such as having its own genome, being descended from a bottleneck, having its own germ-line (Grose, 2020, 1053-1054) and having mechanisms for inhibiting mutations. Furthermore, some of these mechanisms, such as being descended from a bottleneck, and having mechanisms for inhibiting mutations, are present in zygotes, and hence, right at the start of development. There are, therefore, reasons for thinking that foetuses and zygotes are units of selection, and hence, organisms according to the Evolutionary Approach. If this is true, then the Evolutionary Approach avoids FP. More, however, needs to be said about this. It may be that by some versions of the Evolutionary Approach, such as Hull's 'interactors and replicators' view, foetuses and zygotes do not count as organisms (Hull, 1980). At any rate, I think it is clear that the Physiological Approach at least faces FP.

In the remainder of the chapter, I will consider some responses to my argument. For simplicity, the discussion will mostly be about the Physiological Approach that adopts the Exclusion Principle. What I say, however, can be modified to apply to the version of the Physiological Approach that rejects the Exclusion Principle.

1.4. Responses

1.4.1. Reject the Permanence Principle

My argument relies on the truth of the Permanence Principle (nothing could be an organism temporarily), which is crucial for my claim that if foetuses are non-organisms they can never become organisms. I didn't provide an argument for this principle, but took it to be intuitive. The proponent of the Physiological Approach, however, might reject the Permanence Principle. They might argue that organisms begin their lives as non-organism foetuses, and at birth (or sometime before birth if we reject the Exclusion Principle) *become* organisms, just as non-philosophers can become philosophers. No one thinks that philosophers came into existence as philosophers. 'Philosopher' is a *phase sortal* – it does not permanently apply to philosophers given that every philosopher was once a non-philosopher (Wiggins, 1967, 7, 1980, 24). Why should we think that 'organism' is any different?

One worry with this response is that the Problem of Biological Individuality is often taken to partly be a question about what it takes for organisms to *persist* - what is it for an organism at one time to be identical to a being at another time (Godfrey-Smith, 2016; Huneman, 2020; Pradeu, 2016; Wilson, 1999). This is because whilst, as we have seen, there is a question about

counting biological individuals at a time, there is also a question about how to count biological individuals *through time*. When, for example, an amoeba divides into two distinct cells, is this a case of two new offspring individuals coming into existence and replacing the parent individual, or is it simply a case of the original amoeba getting bigger, now being composed of two cells? Or consider metamorphosis, such as the transition of a caterpillar into a butterfly - does such an event involve only one individual – the very same individual is first a caterpillar and then a butterfly – or does it involve two individuals – the caterpillar individual ceases to exist and is replaced by a distinct butterfly individual? (Wilson, 1999, 7-8 and 100). In order to answer these questions, we need to know what it takes for organisms to persist. Pradeu, in fact, claims that one of the main attractions of, and motivations for, the Physiological Approach is that it does a good job of explaining how organism persists through time (Pradeu, 2012, 237-238). He argues that it follows from his immunological version of the Physiological Account that the persistence of organisms through time is a matter of the *continuation of their immunological and biochemical activity* (Pradeu, 2010, 260, 2018,106). The idea is that I am identical to some being in the past because if you were to follow the immunological activity of that being in the past through time to this present moment, you would find that it has been occurring continuously, and is now occurring in me.

The Problem of Biological Individuality, then, is (partly) a question about what it takes for organisms to persist. Presumably, though, it is a question about what it takes for organisms to persist as opposed to what it takes for *non-organisms* to persist. As such, the accounts of organismic persistence that philosophers of biology provide won't apply to non-organisms. This can be demonstrated with Pradeu's account, which as we have seen, is tied to his immunological account of when something counts as an organism: if x and y are identical by virtue of being causally connected by the relevant biochemical interactions constitutive of

being an organism - biochemical and immunological interactions - then presumably x and y must both be organisms.

Foetuses though, (or early foetuses), according to the Physiological Approach are non-organisms. As such, accounts of what it takes for organisms to persist won't apply to them – these accounts will take foetuses and non-organisms to have different persistence conditions. If two things at different times have different persistence conditions, however, then they must be non-identical. This is because a thing's persistence conditions are supposed to apply to it throughout *all* of its career. If, however, a thing existing at an earlier time and a thing existing at a later time were to have distinct persistence conditions but be identical, it would be possible for a thing to change its persistence conditions partway through its career (Olson, 1997a, 29 & 84). Given this, if a foetus and the later organism that develops from it have distinct persistence conditions, then they must be non-identical. As such, a foetus could not become an organism.

If this is right, then if proponents of the Physiological Approach are concerned with what it takes for organisms to persist, and their accounts are closely tied to their accounts of when something counts as an organism, as Pradeu's version of the Physiological Approach is, they will not want to hold that foetuses can become organisms.

Another worry with rejecting the Permanence Principle is that it might be thought that if organisms are organisms temporally, it won't be clear what it takes for organisms to persist. Why is this? Well, in contrast to phase sortals which temporarily characterise things, some philosophers have argued that each object is associated with a *substance sortal* - a kind or a concept which tells us what kind of thing a thing is in the most basic or fundamental sense (Wiggins, 1980, 24). Importantly, substance sortals are supposed to determine the persistence

conditions of things that fall under them (Wiggins, 1980, 48). ‘Organism’ is typically taken to be a substance sortal. Suppose, though, that organisms are only organisms temporarily, and hence, that ‘organism’ is a phase sortal. What substance sortal would organism’s and soon-to-be organisms like fetuses fall under? This is not clear. It might be argued that the appropriate sortal it is something like, ‘biological object’. Like ‘material object’, however, this seems much too general to provide persistence conditions for objects, and hence, to be a substance sortal.³⁰ Given this, if it is not clear what substance sortals organisms (and soon-to-be-organisms) fall under, and substance sortals are supposed to specify a thing’s persistence conditions, it is not clear what it takes for organisms (and soon-to-be -organisms) to persist, and hence, how to count organisms over time.

Suppose, though, that I am wrong about all of this. Even if it is not incoherent for philosophers of biology to hold that something is first a non-organism and then an organism, this view raises some difficult questions.

Firstly, if an organism was once a non-organism foetus, then what sort of living thing was it before it was an organism? Secondly, when an organism was a non-organism foetus, where did its spatial boundaries lie then? Should we, for example count the placenta as a part of it, or do its boundaries only extend as far as the umbilical cord?³¹ Thirdly, if a non-organism can become an organism, can it then become a non-organism again? Suppose, for example, that an organism’s immune system was to become entirely compromised, such that the organism could no longer survive without external help, such as a protective suit or machine.³² Plausibly, by

³⁰ Samir Okasha has similarly argued that ‘biological individual’ is too general to be a sortal concept in a talk at a workshop at the University of Southampton (2020) entitled ‘On the Very Idea of Biological Individuality’.

³¹ See Kingma (2018), who considers where the spatial boundaries of a foetus are.

³² A real-life case is David Vetter, whose immune system was so comprised that he had to spend his entire life inside a protective bubble to survive.

the immunological understanding of the Physiological Approach, there would no longer be an organism. Would this, however, cause the thing that is an organism to cease to exist, or would it continue to exist as a non-organism?

These questions don't have obvious answers. In contrast, if organisms are organisms permanently, we can know what kind of living thing organisms are at any stage of their career, we can consult accounts of biological individuality to determine where their spatial boundaries are at any time during their existence, and we can be certain that organisms cease to exist when they cease to be organisms.

I will make one more point in this section. As I mentioned earlier, many, if not most metaphysicians think that organisms cannot be organisms temporarily. Regardless of my earlier points in this section then, it would therefore be surprising and important news if proponents of the Physiological Approach are required to be committed to a view that many or most metaphysicians reject. At the very least, it would imply that the Physiological Approach is highly metaphysically controversial.³³

1.4.2. The Pluralist Approach

Finally, it might be argued that proponents of the Physiological Approach who also accept the *Pluralist Approach* to the Problem of Biological Individuality can avoid FP. According to the Pluralist Approach, or at least one version of it, both the Physiological Approach and the

³³ One option that I have not discussed is for proponents of the Physiological Approach to adopt a version of process ontology or four dimensionalism. If they did this, they could argue that the very same living entity has a "foetus temporal part" and a later "organism temporal part". A living entity then, is first a non-organism and then an organism, but only in the sense of having differing parts. Process ontology and four dimensionalism will be discussed in subsequent chapters, but I will say here that they are highly metaphysically controversial. In the next chapter, I will argue that process ontology in the philosophy of biology is unmotivated.

Evolutionary Approach are correct. More specifically, pluralists hold that each approach picks out a distinct kind of biological individual. The Pluralist Approach is actually the norm among philosophers of biology (Godfrey-Smith, 2013; Pepper & Herron, 2008; Pradeu, 2016; Wilson, 1999). Godfrey-Smith (2013), and Jack Wilson (1999), distinguish between *Evolutionary individuals* – biological individuals that are units of selection – and *Physiological individuals*³⁴ – biological individuals that are physiological wholes.³⁵ Viruses, for example, have been said to be Evolutionary individuals, given their ability to reproduce, but not Physiological individuals because they lack metabolic activity (Godfrey-Smith, 2013, 28).³⁶

Importantly, notice that Evolutionary individuals and Physiological individuals must be numerically distinct. This is because they have different parts, or at least, the conditions that something must satisfy to be a part of them is different. Consider a human being. If this is Physiological individual, then given what was said earlier, the gut bacteria inside of it are parts of it. On the other hand, if a human being is an Evolutionary individual, then, given that a human being and its gut bacteria have different evolutionary fates, the gut bacteria are not parts of it. Hence, a human being could not be both an Evolutionary individual and a Physiological individual, and more generally, no Physiological individual could be an Evolutionary individual, vice versa. This is Wilson's view (Wilson, 1999). He argues that in a region where a human being is located, there are at least two distinct but overlapping biological individuals – an Evolutionary individual and a Physiological individual – which share much of their matter. Wilson's pluralism, therefore, has much in common with the co-location view discussed in the previous section. It differs from this view, however, because it does not take these overlapping

³⁴ Godfrey-Smith's terminology is actually 'Darwinian Individuals' and 'Organisms' (Godfrey-Smith, 2013).

³⁵ Wilson actually takes there to be six kinds of biological individuals, but for our purposes, I will ignore these.

³⁶ Although, see Dupré and O'Malley (2009, 7) who disagree, providing some reasons for taking viruses to be physiological wholes.

individuals to have *all* of their matter in common - gut bacteria are parts of the Physiological individual, for example, but are not parts of the Evolutionary individual.

Notice also, given what I said in the previous section, that the Physiological individual and the Evolutionary individual plausibly come into existence at different times. At least in the case of mammals, Evolutionary individuals come into existence as foetuses or zygotes, given that foetuses and zygotes are plausibly units of selection, whilst Physiological individual come into existence some time after birth when a physiological whole emerges (or some time before if the Exclusion Principle is not adopted).

With this distinction between Physiological individuals and Evolutionary individuals, the proponent of the Physiological Approach who accepts the Pluralist Approach can respond to FP as follows: A foetus is an Evolutionary individual, and (hopefully) survives birth long into adulthood. Some time after birth, however, a Physiological individual comes into existence, coming to share much of its matter with the Evolutionary individual that was once a foetus, although as we have seen, they do not come to share all their matter. Hence, FP is avoided because we need not say that at birth, foetuses cease to exist, or become entirely co-located with an organism. Rather, at birth, foetuses continue to exist, coming to share much of their matter with a Physiological individual.

This is probably the best solution for proponents of the Physiological Approach to avoid FP. As I said, the Pluralist Approach is also already widely accepted among philosophers of biology. The Pluralist Approach, however, has a worrying consequence. Assuming that *we* are biological individuals (Olson, 1997a; Snowdon, 2014), it implies that we could never know what kind of biological individual we are. According to the Pluralist Approach, where we

thought there was only one biological individual, there are at least two, who share much of their matter in common. How then could I ever know whether I am the Evolutionary individual that began its life as a foetus, or the Physiological individual that began its life at birth? (Olson, 2001, 266). It seems we could never know. It doesn't help to say, for example, that I am whichever biological individual is currently writing this paper, or yawning, or thinking about what is for dinner. I cannot determine which biological I am by focussing on what actions I am performing, and considering which biological individual is also performing those actions, because whenever I type, yawn, or have a certain thought, and so on, so do both a Physiological individual and an Evolutionary individual.

It follows from the Pluralist Approach, then, that we could never know what kind of biological individual we are. As such, if the Pluralist Approach is true, we could never know when we came into existence, when we will cease to exist, and whether we have our bacteria as parts. Furthermore, whilst it seems clear that a foetus is a part of its mother according to the Physiological Approach, it is much less clear whether this is the case according to the Evolutionary Approach (Kingma, 2020a, 1043-1044). Given this, if the Pluralist Approach is true, pregnant mothers cannot be sure whether foetuses are parts of them.

This objection to the Pluralist Approach will be discussed in more detail in chapter 3, where I will consider the relationship between biological individuality and personal identity. In that chapter, I will consider whether proponents of the Pluralist Approach can respond to this objection, and whether the objection really a problem. For now, though, I will say that I take this implication of the Pluralist Approach to be a serious one, because one reason for caring about the Problem of Biological Individuality is, as we saw at the start of the paper, that answers to it would ideally help us to understand what sorts of beings we are (Clarke, 2010, 313).

1.5. Conclusion

I have provided an argument against the Physiological Approach of biological individuality, and perhaps also one reason for preferring the Evolutionary Approach. I do not take my argument to be conclusive. It could be that there is a version of the Physiological Approach that is not vague and avoids FP. It might be that the benefits of accepting the Physiological Approach in the biological sciences outweigh the metaphysical problems it faces. Or perhaps philosophers of biology will not be particularly worried that the Pluralist Approach implies that we could never know what kind of biological individual we are, or might be happy to reject the Permanence Principle, despite most metaphysicians accepting it. I hope, however, to have shown what metaphysical implications, and the associated worries, follow from a prominent solution to the Problem of Biological Individuality, and that metaphysics, not just explanatory power in biology, can contribute to important debates in the philosophy of biology. If philosophers of biology disagree with my arguments, I also hope to have highlighted where there may be important differences between how metaphysicians and philosophers of biology tend to think about organisms.

Chapter 2. Are Biological Individuals Substances or Processes?³⁷

2.1. Introduction

When philosophers of biology ask, ‘what is a biological individual?’, they are mostly concerned with the Problem of Biological Individuality – they are interested in an answer to this question that will allow us to count and distinguish biological individuals, such as the Physiological or Evolutionary Approach. Recently, however, some philosophers take it to be the question of whether biological individuals are *substances* or *processes*. I will call this the ‘Substance-or-Process Question’.

Whilst the Problem of Biological Individuality and the Substance-or-Process Question are both questions to do with the nature of biological individuals, they differ in important respects. Importantly, whilst, as we have seen, solutions to the Problem of Biological Individuality aim to provide criteria that can allow us to count biological individuals, this is not straightforwardly the case for answers to the Substance-or-Process Question. We could agree, for example, that biological individuals are processes, but be none the wiser about how to count them. Similarly, we could agree that the Physiological Approach is the right solution to the Problem of Biological Individuality, but be none the wiser about whether biological individuals are substances or processes. In this chapter, I will be concerned with the Substance-or-Process Question.

³⁷ Much of the material in this chapter appears in Morgan (2021). I thank the Australasian Journal of Philosophy for allowing me to include it in this thesis.

The predominant view among philosophers since Aristotle has been that organisms are substances; a view that I will soon explain. Recently, however, some philosophers of biology have argued that organisms are not substances but are *processes*. We can call this the Process View. John Dupré and Daniel Nicholson are perhaps the biggest advocates of the Process View. They write:

[t]he world – at least insofar as living beings are concerned – is made up not of substantial particles or things, as philosophers have overwhelmingly supposed, but of processes (Dupré and Nicholson, 3, 2018).

The Process View certainly seems surprising. Organisms seem to be very different from paradigmatic processes such as raining, running, and fermentation. We usually think that processes are *performed by*, or *done by*, or *happen to* living things, such as cell regeneration, metabolic activity, and growing; we don't tend to think that organisms are *identical* to processes.

Despite this, the Process View is increasing in popularity in the philosophy of biology (Meincke 2019; Baptiste and Dupré 2013; Lidgard and Nyhart 2017; Pemberton 2019; DiFrisco 2018; Bueno, Chen, and Fagan 2018; Nicholson 2019; Jaeger 2018; Guay and Pradeu 2016; Seibt 2018; Dupré and Nicholson 2018). Its proponents, the so-called 'process ontologists', argue that philosophical and empirical considerations require taking living entities to be processes rather than substances, and that doing so constitutes a radical ontological shift in western philosophy (Dupré and Nicholson 2018, 11; Nicholson 2018, 153). It has also been argued that the Process View has important implications for biology (Bertolaso & Dupré, 2018;

Dupré & Nicholson, 2018, 4 and 30-38). If process ontologists are right, this would, therefore be important news for metaphysics, the philosophy of biology and biology.

The aim of this chapter is to consider whether process ontologists provide good reasons for abandoning an ontology of living substances. I argue that they do not. Specifically, the main claims that process ontologists make about living entities are not only compatible with all the usual historical and contemporary accounts of substance, but are also often accepted by substance ontologists. There is no need, therefore (at least not yet) to abandon the well-established tradition that takes organisms to be substances. That being said, at the end of the chapter, I will outline what a radical processual philosophy of biology could look like. The view that I outline is clearly incompatible with the things that all substances ontologists have said about the nature of biological individuals, and would have radical implications for the philosophy of biology, including how to understand the Problem of Biological Individuality. It would also have important implications for biology. Such a view, however, is yet to be defended.

The structure of the chapter is as follows. I begin by clarifying what the Process View is, suggesting that there are three possible readings of it, and explaining which reading process ontologists in the philosophy of biology actually adopt. I then briefly present the usual historical and contemporary accounts of substance. Next, I then present the main claims that process ontologists have made about the nature of living entities,³⁸ arguing that these are compatible with living entities being substances on all the usual accounts of substance, and that they are often accepted by paradigmatic substance ontologists. I conclude that process

³⁸ I mostly focus on the work of Dupré and Nicholson, and others in their collection of essays *Everything Flows: Towards a Processual Philosophy of Biology* (Dupré and Nicholson, 2018).

ontologists are only objecting to specific characterisation of substances – ones that take substances to be three dimensional, generically ontologically independent, persisting by virtue of an unchanging essence, and to have precise boundaries. These are characterisations that do not figure in the usual historical and contemporary accounts of substance, and which are rejected by many substance ontologists. Finally, I consider what a radical processual philosophy of biology that would cause trouble for an ontology of substances might look like.

Two points before I begin. Following Dupré and Nicholson, I use ‘substance’ and ‘thing’ interchangeably,³⁹ using ‘entity’ as a neutral term to refer to both substances and processes. Secondly, when I talk about ‘process ontology’ I am specifically talking about process ontology *in the philosophy of biology* and not in other domains such as the philosophy of physics or ontology more generally.⁴⁰ What I say here, therefore, may not apply to process ontology in other domains.

2.2. Three Readings of the Process View

I want to begin by clarifying what the Process View is. As I see it, there are three readings of it.

Firstly, the ‘eliminativist’ reading holds that biological individuals do not exist (Snowdon, 2020, 240). According to this reading of the Process View, living entities are eliminated in favour of processes. The thought behind this reading is that it is somehow built into our notion of an organism or biological individual that they are non-processual (Snowdon, 2020, 240).

³⁹ ‘Thing’ is often used by philosophers in a more neutral way, interchangeable with ‘object’ or ‘entity’ (Lewis, 1986, 213). Used this way, any entity, including a process, is a thing.

⁴⁰ For work on the latter, see Seibt, (Seibt, 1990, 1997, 2010).

The eliminativist reading does not say that cats, human beings, and so on, do not exist. Rather, it says that whilst they exist, they are not biological individuals, but some other kind of entity (processes). There is a stronger version of the eliminativist reading as I present it here, but I will return to this in the final section of the chapter.

There is no indication that process philosophers of biology accept the eliminativist reading. They seem to accept the existence of organisms, but simply deny that they are substances.

Secondly, there is the ‘reductionist’ reading. According to this reading, biological individuals exist and are substances, but they are *reducible* to processes (Frédéric Bouchard, 2018, 194). The idea is that biological individuals are substances, but substances are *nothing more* than, or are identical to processes.⁴¹ Put more clearly, it holds that one kind of entity - a substance - can be explained or understood entirely in terms of another kind of entity - a process - (Nolan, 2011, 282). According to the reductionist reading then, biological individuals are processes, but they are also substances – it is just that the category of substance can be explained entirely in terms of the category of process.

It seems to me that the reductionist reading does not capture the view of processual philosophers of biology either, who seem to be arguing that biological individuals are process *rather than* substances.

Finally, there is what I call the ‘actual’ reading of the process view – the view that processual philosophers of biology, it seems to me, actually hold. According to this reading, biological individuals exist, they are identical to processes, but unlike the reductionist reading, it does not

⁴¹ According to at least one understanding of reduction, if x reduces to y, then $x=y$ (Dorsey, 2016, 416).

take substances to be reducible to processes. Rather, it holds that substances and processes belong to distinct ontological categories, and so that biological individuals being processes rules out their being substances.

2.3. Accounts of Substance

What is substance ontology and what are substances? This is difficult to say. The term ‘substance’ has a technical meaning in philosophy very different from its use in ordinary English, where it perhaps means ‘stuff’ as in the sentence, ‘there is a strange substance on the floor’. In philosophy, the term is often credited to Aristotle, and it has been prominent in the works of Locke, Hume, Kant and many others. Whilst it has generally been agreed that substances are in some sense basic or fundamental entities, and that living entities are paradigmatic substances (Robinson 2018; Wiggins 2001, 90; Furth 1988, 53; Dupré and Nicholson 2018, 6; Loux 1991, 25), there is no universal agreement about how substances should be characterised. In this section, I briefly present the most influential accounts of substance in the history of philosophy, many of which are discussed in more detail by Hoffman and Rosenkrantz in their book-length discussion on substances (1997). There are controversies about how these accounts should be understood, and whether they are rivals. My aim, however, is simply to provide a feel for how substances are often understood.

The Negative Account: *a substance is that which is neither said of, nor in a subject.*

In *Categories*, Aristotle says that a substance is that which is neither *said of*, nor *in* a subject (Categories, 2a11). The idea is that a substance is neither a state, activity nor a property (or an aspect or condition) of anything else, unlike a wrinkle in the carpet which is simply a

modification of the carpet (Van Inwagen, 2015, 27). Socrates' tiredness is not a substance because it is a state of Socrates. On the other hand, Socrates is not a state, activity, or property of anything. Understood this way, 'substance' is close in meaning to 'individual'.

The Independence Account: *a substance is something that depends on no other entities for its existence.*

A popular account of substance takes substances to be ontologically independent entities. Descartes, writes,

By substance, we can understand nothing other than a thing which exists in such a way as to depend on no other thing for its existence. (Descartes, 1985, 114)

How independence is to be understood is up for debate (Toner 2011; Gorman 2006; Lowe 1998), and is something I will return to in section 4.⁴² The relevant sort of independence, however, is not normally taken to be a *causal* independence, but some sort of *ontological* or *metaphysical* independence (E.J Lowe, 1998b, 136-137). One difference between causal and ontological independence is that causal independence is thought to be diachronic (it occurs across time), whilst ontological independence is thought to be synchronic (it occurs at the same time).

The Persistence Account : *a substance is any entity that can persist through change.*

⁴² The Negative Account is arguably a version of the Independence Account (Hoffman & Rosenkrantz, 1997, 21).

Aristotle also claimed that a substance is that which can remain numerically one and the same whilst receiving contrary properties (4a10; Hoffman and Rosenkrantz 1997, 9; Furth 1988, 53). A human being, for example, is a substance because it remains the same entity despite being bent over at one time, and standing straight at another.

The Substratum Account: *a substance is a propertyless bare particular.*

It has been suggested that substances are *bare particulars* - entities that properties *inhere* in whilst lacking properties in their own right (Descartes, 1985, 156; Hoffman & Rosenkrantz, 1997). According to this account, a substance is what would be left if an entity, such as an organism, was stripped of all its properties.

The Bundle Account: *a substance is a bundle or cluster of properties.*

Some philosophers have claimed that a substance is a bundle of properties, or more precisely, of *property instances* (Hawthorne, 1995; Hoffman & Rosenkrantz, 1997, 27). This view was held by Hume (Hoffman and Rosenkrantz, 1997, 26; Hume, 1978, book 1, Part 4). Admittedly, it isn't entirely clear whether Hume thought there are any substances. On one reading of Hume, the bundle view *eliminates* substances in favour of bundles of properties (or impressions or ideas?). On another reading, however, Hume *identifies* substances with bundles of properties (Hoffman & Rosenkrantz, 1997, 26; Van Inwagen & Sullivan, 2020).

The Form and Matter Account: *a substance is a form-matter complex.*

In *Metaphysics Z*, Aristotle says that substances are *form-matter* complexes (1029a5-30; Robinson 2018). The matter of an object is what it is made of, whilst the form is what makes it the sort of object it is. A table, is a substance, according to this account, because it is a composite of both some matter (such as particles or some wood) and a *table-form*. Some contemporary philosophers, for example Koslicki (2008, 2018), have defended an account of substances along these lines.

This completes my brief look at the usual historical and contemporary accounts of substance.⁴³ Again, my intention was just to give an idea of how substances have been understood, rather than analyse each account in detail. Importantly, we have seen that there is no such thing as *the* substance view. Objections to an ontology of substance, therefore, will need to make it clear which account(s) of substance they are objections to, or identify a problematic feature of all or most accounts of substance. Process ontologists are not explicit about which account(s) of substance they are addressing, but I will now argue that *all* the usual accounts of substance discussed in this section are immune to their objections.

2.4. Processes are Extended in Time

Process ontologists often claim that living entities and other processes are extended in time by having temporal parts (DiFrisco, 2018; Dupré & Nicholson, 2018, 11).⁴⁴ What is a temporal part? The idea is that just as entities are spread out across different spatial regions by having different spatial parts located at those regions, processes (and other temporally extended

⁴³ Two accounts of substance I have not discussed are those presented by Spinoza (1p14) and Leibniz (§§8, 14). Their omission, however, does not affect my argument.

⁴⁴ It is generally agreed that processes are extended in time, although not everyone agrees. See (Galton & Mizoguchi, 2009; Meincke, 2018; Seibt, 1997; Rowland Stout, 1997) for some dissenters.

entities) are spread out across time by having different parts located at different times. Consider a process such as fermentation which has three stages. Suppose that the first stage occurs on 1st March, the second stage between the 1st-4th March and the third stage between the 4th-14th March. Assuming that processes have temporal parts, each of these stages corresponds to a distinct temporal part occurring at different times: one located at the 1st March, another located between the 1st-4th March, and another located between the 4th-14th March. Notice, then, that processes and other entities with temporal parts are never *entirely* present at a time or instant, but are only *partly* there by having a part located at that time (Olson, 2007, 100). Our instance of fermentation, for example, is only partly present at the 4th March, by having a temporal part located there.

According to processual philosophers of biology, living entities are like fermentation. Consider human beings. Not only do they have spatial parts such as cells, organs, but they also have temporal parts such as a *the first half of one's life*, which is an entity that looks just like human being, but which lasts for half as long as the human it is a part of. They also have a *foetal temporal part* which is an entity that spans around the first 40 weeks of a human beings' life. I was, therefore, never wholly inside my mother's womb, but was only partly there by virtue of having a temporal part that was inside of her womb, in the same way that I was never wholly inside the fridge, but was only partly inside of it by having my hands in the fridge.⁴⁵

Do substance ontologists take living entities to be have temporal parts? Some philosophers who we might identify as substance ontologists think that material entities only have spatial parts (Lowe, 1998b; Van Inwagen, 1990; Wiggins, 1980). These philosophers, often called

⁴⁵ The temporal part's theorist may, however, say that I was wholly inside my mother's womb in virtue of having a temporal part that was wholly inside my mother's womb.

three dimensionalists (in contrast to proponents of temporal parts, who are often called *four dimensionalists*), take entities to be wholly present at each time that they exist. Unlike proponents of temporal parts, they believe that I existed yesterday not by virtue of having a temporal part that existed yesterday, but because ‘all of me’ existed yesterday.

James DiFrisko, however, claims that taking entities to have temporal parts requires ‘discarding the category of substance as the paradigm for individuality in favour of the weaker and more flexible category of process’ (DiFrisko, 2018, 79). If he is right, then living entities cannot be substances and also be temporally extended.

Whether living entities have temporal parts is controversial, and it seems to me that process ontologists have not provided reasons for thinking that living things have temporal parts. Suppose, however, that they do in fact have temporal parts. I’m not convinced that this would require discarding the category of substance. It seems to me that whether entities have temporal parts is an issue orthogonal to questions about substances. This is because all the usual accounts of substance presented in section 2 are compatible with substances having temporal parts. Consider The Negative Account: something, such as an organism, could have temporal parts whilst also being neither a state, activity nor a property of anything else. Similarly, something could have temporal parts, whilst also being ontologically independent, and hence qualify as a substance according to the Independence Account. The same is true of the Substratum, Bundle, and Form-Matter Complex Accounts.

What about Aristotle’s Persistence Account (which, recall, takes a substance to be something that can remain numerically one and the same despite receiving contrary properties)? ‘Persistence’ is usually understood neutrally, to capture both three dimensional and temporal

parts or four dimensional views of change (Lewis, 1986; Sider, 1997). Consider a hot poker which becomes cold. According to three dimensionalism, the poker is first hot and then cold by virtue of having the property of being hot at an earlier time and having the property of being cold at a later time. In contrast, according to temporal parts views, the poker is hot and then cold, not by having the properties of being hot and then cold, but by virtue of having a *temporal part* located at an earlier time that has the property of being hot, and having another temporal part located at a later time that has the property of being cold. Both three dimensionalism and temporal parts views, therefore, take entities to persist through change.

Despite this, it might be argued that temporal parts views are incompatible with something remaining *numerically one and the same despite receiving contrary properties*, as Aristotle's Persistent Account requires (Seibt, 1997, 149). Consider our poker example. As we have seen, unlike three dimensionalism which takes the poker to be literally hot and then literally cold, temporal parts views take the poker to be hot and then cold only in the derivative sense of having a hot temporal part and a cold temporal part. Strictly speaking then, it is not numerically one and the same entity that is first hot and then cold, but distinct temporal parts.

That being said, it is nonetheless numerically one and the same poker that has the hot and cold temporal parts as parts, and we do often attribute a property to something if only one of its parts has the property - we say, for example, that I am sunburnt even though only my ears are sunburnt (Olson, 2007, 123).

We can distinguish, therefore, between two interpretations of Aristotle's Persistence Account: Firstly, a *strict* interpretation, which holds that something persists through change only if it literally has contrary properties at different times. This is incompatible with an ontology of

temporal parts. Secondly, there is a more *generous* interpretation which allows that temporally extended entities can be numerically one and the same whilst receiving contrary properties in the sense of having temporal parts located at different times with contrary properties. Unlike the strict interpretation, the generous interpretation is compatible with an substances having temporal parts. Unfortunately, Aristotle never mentioned temporal parts, so we can't be sure whether he would be happy to accept the generous interpretation. At any rate, we can see that there is a legitimate interpretation of Aristotle's Persistence Account which has not yet been ruled out and which is compatible with an ontology of temporal parts.

It seems to me, then, that all the usual accounts of substance are compatible with an ontology of temporal parts. If it turns out that living entities have temporal parts, this is not, therefore, a reason to abandon an ontology of substances.

2.5. Activity, Stasis and Persistence

Process ontologists often say that processes are dynamic whilst substances are static (Dupré & Nicholson, 2018, 13-14; Meincke, 2018, 369; Nicholson, 2018, 154). As Dupré and Nicholson say,

[T]he default mode of a thing is stasis...For a process, however, change is the norm (Dupré and Nicholson 2018, 14).

No one would deny that living entities are constantly changing. They have a metabolism, meaning that they are constantly taking in matter from their environment in order to sustain themselves and expelling matter they no longer require. Even as I write this, my cells are constantly being replaced. Furthermore, living entities *require* a metabolism. As Dupré and Nicholson point out, leave a stone in your loft and it will be there ten years later, but leave your

pet hamster there for a few weeks and there certainly won't be a hamster to come back to (Dupré and Nicholson 2018, 15)! Dupré and Nicholson find metabolic turnover to be '[o]ne of the strongest motivations for adopting process ontology in biology' (Dupré and Nicholson 2018, 15):

Overall, the reality of metabolism forces us to recognize that organisms, despite their apparent fixity and solidity, are not material things but fluid processes...As process, and unlike things or substances, organisms have to undergo constant change to continue to be the entities they are (Dupré and Nicholson 2018, 17).

If it is right to characterise substance as static and unchanging, then Dupré and Nicholson would be absolutely right that the active nature of living entities forces us to deny that living entities are substances. Such a characterisation, however, is not right. Firstly, none of the usual accounts of substance presented in section 2.3. imply that substances must be static. They are all entirely compatible with substances being dynamic and having a metabolism. Secondly, substance ontologists often stress that paradigmatic substances are dynamic and constantly changing. As Helen Steward points out, Aristotle – the paradigmatic substance ontologist – takes living entities to be paradigmatic substances, and invokes the form-matter distinction precisely in order to accommodate persistence through change (Steward, 2020, 48). According to Montgomery Furth's interpretation of Aristotle, Aristotle takes a living substance to be

a semi-permanent warp or bend informing the local matter, which the matter flows through at various rates during the organism's life history (this is called metabolism), while the form imposes the continuity (Furth, 1978, 638-639).

For Aristotle, then, paradigmatic substances are dynamic. Dupré and Nicholson do in fact say that Aristotle's understanding of living substances is 'more congenial to a process perspective than that of his followers (Dupré and Nicholson 2018, 6). This is odd though because many of Aristotle's followers follow him in stressing the dynamic nature of living substances. David Wiggins, for example, stresses the remarkable ability of living substances to renew themselves through change (Wiggins, 1980, 84-90). He argues that substances have a *principle of activity* - something that determines what an entity is, and establishes its spatial and temporal boundaries (Wiggins, 2001, 2012, 2016, 213). It isn't entirely clear what Wiggins takes the principle of activity for living substances to be, but he is happy for this to be fleshed out with biological detail. Adam Ferner suggests that it might be understood by appealing to accounts of biological individuality, for example, by appealing to immunological activity (Ferner, 2016, 141). Similarly, Peter van Inwagen, who says that his account of living things is 'extraordinarily like' Aristotle's account of living substances, (Van Inwagen, 1990, 15) holds that each living entity has *a life* - a self-maintaining biological activity that constantly takes in matter from the organism's environment, unifying it into its structure and expelling matter it no longer requires (Van Inwagen 1990, ch.9&14). Prominent substance ontologists, therefore, are explicit that living things are dynamic rather than static.

Perhaps it will be argued that in biology, substance ontology is often tied to the machine conception of the organism (MCO), which takes living entities to be little different from complex artefacts such as clocks or engines (D. Nicholson, 2013, 2018). Nicholson argues that given the metabolic nature of organisms, which sets organisms apart from machines, MCO is inappropriate. For one thing, unlike machines, organisms incorporate their fuel into their bodily structure (D. Nicholson, 2018, 146). Steward points out, however, that whilst MCO might be tied to substance ontology *in biology*, substance ontology was introduced by

Aristotle long before MCO, and Aristotle's account of living substances as dynamic, self-renewing entities, clearly denies that organisms are machines (Steward, 2020, 47-48).

Instead, it might be argued that when process ontologists say that substances are static, they don't mean that substances cannot change their matter, but rather that they have an *unchanging essence*, or *core*, that persists through change (Dupré and Nicholson 2018, 24; Meincke 2019, 5; Guay and Pradeu 2016, 318). Dupré and Nicholson say that,

Things persist...by virtue of their continued possession of certain essential properties, which make those things what they are and which remain unchanged over time (Dupré and Nicholson 2018, 24).

Similarly, Meincke says,

[T]here is believed to be an intrinsic unchanging core in every substance, defined by a set of essential properties or capacities (Meincke, 2019, 5).

Their claim is that substances are supposed to possess some special permanent properties that are required for them to exist. This has been referred to as 'Essentialism'. Dupré and Nicholson take Essentialism to be problematic. They write,

The problem for substance ontology has always been that it is extraordinarily difficult to specify any such change-exempt descriptive properties that permanently characterize the essence of things (Dupré and Nicholson 2018, 24).

Substance ontologists, however, need not, and often do not take organisms to have an unchanging essence or core. Notice that none of the accounts of substance outlined in section 2 make reference to an unchanging essence or core. Importantly, many substance ontologists do not appeal to this idea either. Steward takes living substances to persist, despite metabolic turnover, by virtue of the spatiotemporal continuity of their matter (Steward, 2020, 50-51).⁴⁶ She makes no mention of an unchanging core or essence. Wiggins also says that his principle of activity does not require substances to have a ‘permanent core’ (Wiggins, 2016, 272). It is true that Wiggins takes an organism’s principle of activity to be essential to it, but this seems to be relatively harmless if it is understood in terms of biological processes and interactions, as suggested by Ferner.

More interestingly for our purposes is the account of persistence defended by van Inwagen and Olson (Olson, 1997a, 135; Van Inwagen, 1990, 143-145). Following Locke, Van Inwagen takes an organism to persist just so long as its biological life continues, a life, as we saw, being a special biological activity encompassing all of an organism’s living activity. Olson presents this idea in terms of vital functions:

If x is an organism at t and y exists at t^* , $x=y$ if and only if the vital functions that y has at t^* are causally continuous with those that x has at t (1997a, 135).

How ‘vital functions’ or ‘life’ should be understood is up for debate, but Olson and van Inwagen are happy for this to be filled in with biological detail (Olson, 1997a, 136; Van Inwagen, 1990, 84). We might, for example, understand this in terms of metabolic, or

⁴⁶ More precisely, there must be spatiotemporal continuity of a sort that is typical of the kind of changes that that kind of object can undergo (Steward, 2020, 51).

immunological activity, or some other biological process. The idea, though, is that I am identical to someone in the future or the past by virtue of being causally connected to that future or past being by the relevant biological functions or activity that keeps us alive (whatever they may be). Again, this does not appeal to an unchanging core or essence, but only to the continuity of biological activity.

The Van Inwagen/Olson account of persistence is interesting because it is strikingly similar to accounts of persistence preferred by process ontologists (or those who find process ontology appealing) which also appeal to the causal continuity of processes (Dupré and Nicholson 2018; DiFrisco 2018; Guay and Pradeu 2016; Pradeu 2018). Alexandre Guay and Thomas Pradeu, for example, who are tempted by process ontology, take the identity of an organism through time to be the result of the continuation of biological activity such as metabolic or immunological activity (Guay and Pradeu 2016; Pradeu 2018).

It might be argued, though, that even though both substance ontologists and process ontologists both appeal to the continuity of biological activity to account for the persistence of organisms, substance ontologists are still committed to Essentialism. Van Inwagen, for example, holds that an organism persists just so long as it retains the *same life*.

In response, firstly notice that the view that an organism persists just so long as it retains its life does not imply that an organism's life is essential to it. Rather, it only implies that an organism's life is permanent – once it has its life, it can't lose it without ceasing to exist. This is compatible, however, with an organism coming into existence with a different life from the one it actually has. Suppose we ignore this, though, and assume that an organism's life, according to van Inwagen is essential to it. If this is a version of Essentialism, then like

Wiggins’, it is relatively harmless, given that ‘same life’ simply refers to the continuation of biological activity rather than any mysterious permanent unchanging property. At any rate, if this counts as Essentialism, then many process ontologists, who take processes to exist by virtue of activity, also seem to be committed to some sort of Essentialism. Nicholson, for example, even says that ‘for an organism, *activity is a necessary condition* for existence’ (Nicholson, 2018, 153).

Finally, perhaps it will be argued that Olson and Van Inwagen (and perhaps Wiggins, Steward and Aristotle) are not really substance ontologists, but are process ontologists in disguise. I don’t think, however, that there is any reason to think this. Nothing they have said about living entities is in conflict with the usual accounts of substance, and their understanding of organisms is strikingly similar to Aristotle’s’ account of living substances in *Metaphysics Z*. At any rate, if these paradigmatic substance ontologists are not the target of process ontologists criticisms, then it is unclear who is. This response, then, threatens to make process ontology a truism that no one denies.

2.6. Ecological Dependence

Dupré and Nicholson claim that processes are dependent on their environment (Dupré & Nicholson, 2018, 20-22). In contrast,

A thing is taken to be what it is independently of the relations it enters in...Moreover, the properties...that determine its boundaries and its continued existence are grounded in features that lie entirely within those boundaries (Dupré and Nicholson 2018, 21).

As Dupré and Nicholson point out, all living entities enter into complex interactions with entities in their environment. Aphids, for example, undergo symbiotic interactions with the bacteria *Buchnera aphidicola*, providing the aphids with amino acids (Booth, 2014, 659). Likewise, human beings are hosts to a vast number of symbiotic bacteria that are important for their metabolic and immunological functioning (Dupré and O'Malley 2009; Pradeu 2010, 256;). Given their characterisation of things as independent entities, Dupré and Nicholson claim that the ubiquity of symbiotic interactions in nature 'poses major problems for an ontology of things or substances' (Dupré and Nicholson 2018, 21).

What do Dupré and Nicholson mean when they say that living entities are dependent upon their environment? One suggestion is that they mean that living entities *causally* depend on entities in their environment. No substance ontologists, however, will deny that living entities are causally dependent on their environment – this is an empirical fact, and no account of substance denies this. The causal dependence of organisms on their environment, therefore, provides no reason to worry about substance ontology.

Alternatively, perhaps Dupré and Nicholson mean that living entities are dependent on their environment in a metaphysical, or ontological sense. If this is what Dupré and Nicholson mean, then they seem to have the *Independence Account* of substance in mind as their target.

It is important to note, however, that the Independence Account is only one account of substance, and that many of the other usual accounts discussed in section 2.3. do not take ontological independence to be a condition of substancehood. The ontological dependence of living substances on their environment, therefore, is compatible with many accounts of substance.

More importantly, though, the Independence Account of substance, or at least many versions of it, are actually compatible with the ecological ontological dependence of living entities. Importantly, a distinction needs to be made between *rigid* and *generic* ontological dependence (Fine, 1995; E.J Lowe, 1998a; Tahko & Lowe, 2016). X rigidly depends on y if and only if x could not exist without y existing. The set, $\{x,y,z\}$, for example, rigidly depends on its particular members x, y, and z, because it would not exist if any of the members did not exist. (Tahko & Lowe, 2016). Similarly, the Cheshire Cat's smile rigidly depends on the Cheshire Cat. On the other hand, x generically depends upon objects of type F iff x could not exist without *some* objects of type F existing (E.J Lowe, 1998a, 141). Electricity generically depends on electrons because whilst it does not depend on the existence of any particular electron, it would not exist without there being any electrons (Tahko & Lowe, 2016).

I imagine that when Dupré and Nicholson say that living entities depend on entities in their environment, they must mean *generic* dependence rather than rigid dependence (if they are indeed talking about ontological dependence). It would be implausible to believe that an organism ontologically depends on any particular entity in their environment. No one thinks, for example, that an aphid is ontologically dependent on any particular bacterium in its environment.

Some philosophers of biology, however, claim that *lineages* are particulars or individuals (Dupré, 2017), and it might be argued that whilst aphids are not rigidly ontologically dependent on any particular bacterium, they are rigidly ontologically dependent on a particular bacterial lineage or are perhaps even that they are rigidly ontologically dependent on their own lineage.

Suppose that lineages are individuals. The view that organisms rigidly ontologically (not causally) depend on a particular lineage is controversial, and something I take to be false. I won't argue for this claim here, but it seems implausible to me that an organism is rigidly ontologically dependent on the lineage of any particular entity in its environment. That is, it seems implausible to me that it is *metaphysically impossible* for me to exist if the lineages of entities in my environment associated with me did not exist. Put differently, it seems metaphysically possible that I exist but the lineages of entities in my environment that I am associated with do not exist, and that I am associated with entities of different lineages. Furthermore, I agree with those philosophers, such as Lowe, who think that organisms are not ontologically dependent on their own lineage (E.J Lowe, 1998a, 152).⁴⁷ At any rate, I do not think that process ontologists will want to accept that living entities are rigidly ontologically dependent on a particular lineage, (including one's own lineage) or for that matter, *any* entity distinct from themselves, given their gripe with Essentialism. Suppose, for example, that an aphid rigidly depends on a particular bacterial lineage. This implies that the aphid would not exist without that lineage, and hence that the lineage is *essential* to it. As we have seen, this is the sort of essentialist view that process ontologists want to avoid. If Dupré and Nicholson mean ontological dependence, then they must, therefore, mean *generic dependence*, and so their claim must be that whilst processes are generically dependent, substances are generically independent.

Most independence accounts of substance, however, are understood in terms of *rigid* independence, and so are compatible with substances being generically dependent on their environment. Here are Lowe's and Gorman's accounts:

⁴⁷ In other words, I reject Kripke's necessity of origin thesis (Kripke, 1980).

x is a substance = df x is a particular and there is no particular y such that y is not identical with x and the identity of x depends on the identity of y (E.J Lowe, 1998a, 151).

x is a substance = df x is a particular, x is unified in the right way, and there is no particular y such that y is not identical with x, y is not one of x's parts, and the identity of x depends on the identity of y (Gorman, 2006, 166).

Both of these accounts of substance only say that substances are rigidly independent entities, which is compatible with living entities being substances and being generically dependent on entities in their environment. They are only incompatible with living entities being substances and being *rigidly* dependent on entities in their environment such as a particular bacterium or a particular lineage. No one, however, thinks that living entities are rigidly ontologically dependent on entities in their environment such as a particular bacterium. As we have seen, some might think that living entities are rigidly dependent on particular lineages, but this seems implausible to me, and given their anti-essentialism, process ontologists ought to agree.

The ecological dependence of living entities on their environment, therefore, does not provide a reason for taking living entities to be processes rather than substances.

2.7. Fuzzy Boundaries

Process ontologists stress that processes have *vague* or *fuzzy* boundaries (Dupré & Nicholson, 2018; Meincke, 2018). By this, they mean that there is no definite fact of the matter about when a process comes into existence, ceases to exist, or sometimes whether something belongs to a

process as a part. There is, for example, no definite fact of the matter about when a hurricane begins, or whether some atoms around its edges are parts of it.

The vagueness of living boundaries is puzzling. Perhaps it is ontological – there is somehow vagueness *in the world* (Van Inwagen, 1990, 241). Perhaps it is epistemic – there really is a determinate answer to the question of where an organism’s boundaries are, we are just ignorant of the answer. Alternatively, perhaps it is linguistic - there are many candidate referents of the word ‘organism’ and no one has decided which one it applies to (Lewis, 1986, 212). Call the mystery of vague boundaries, ‘the Problem of Vague Boundaries’. Process ontologists argue that the Problem of Vague Boundaries can be solved if organisms are processes rather than substances. Dupré and Nicholson say that,

[T]he problem of vague boundaries turns out not to be a problem at all, as processes tend to lack clearly defined boundaries to begin with (Dupré and Nicholson 2018, 35).

Similarly, Meincke says that taking organisms to be processes,

allows us to relax about vagueness. That natural processes tend to have vague boundaries goes without saying. The crucial point is that there’s nothing wrong with that;... vagueness just lies in the nature of processes. (Meincke, 2018, 375).

It isn’t clear, though, why taking organisms to be processes allows us to avoid the Problem of Vague Boundaries. Even if we accept that living entities are processes, it still isn’t clear how we should understand the vagueness of their boundaries - is it ontological, epistemological or linguistic? If it is ontological, how should we make sense of the idea of vagueness in the world?

If the Problem of Vague Boundaries is a problem, then it seems that it is a problem for substance ontology and process ontology alike.

Process ontologists might argue that processes *by their very nature* have vague boundaries, and as such, if living entities are process, the vagueness of their boundaries is to be expected. Pointing out that a problem is to be expected, however, does not solve the problem or make it any less mysterious. It might be expected that living entities have vague boundaries if they are processes, but this doesn't tell us how to make sense of the vagueness.

In addition, it could equally be argued that substances by their very nature have vague boundaries too, given that paradigmatic substances such as tables, cars, mountains, stones and so on have vague boundaries too. A car may have clearer boundaries than a tornado or an instance of fermentation or an organism, but there is still no definite answer to the question of how many atoms must be taken away from a car before it ceases to exist.

Process ontologists might argue that this is a reason for abandoning an ontology of substances for artefacts and non-living natural entities too. More generally, perhaps process ontologists will argue that a condition for an entity to be a substance, unlike a process, is that it has precise boundaries, or that substances are defined in such a way that, by definition, they lack vague boundaries. As I see it, though there is no reason to think this. Of course, it is possible to define 'substance' by stipulating that substances have non-vague boundaries, but none of the usual historical accounts presented in section 2.3. do this. It is no feature of any of these accounts that there is a definite answer to questions about where the boundaries of substances lie. They are in fact entirely silent on this matter. There seems no reason, then, why something with vague boundaries could not also be neither said of nor in a subject (the Negative Account),

ontologically independent (the Independence Account), persists through change (the Persistence Account), a bare particular (the Substratum Account), a form-matter complex (the Form-Matter Account) or a bundle of properties (the Bundle Account). Some substance ontologists are even explicit that they take substances to have vague boundaries (Van Inwagen, 1990, ch17,18&19). Vagueness then, does not pose a particular problem for substance ontology.

2.8. Process Ontologists Are Only Objecting To Particular Characterisations of Substances

We have seen that the main claims that process ontologists make about the nature of living entities – temporal extension, metabolism, ecological dependence, and vague boundaries – do not cause trouble for an ontology of substances. These claims are not only compatible with all the usual historical and contemporary accounts of substance, but are often explicitly endorsed by paradigmatic substances ontologists too. Process ontologists, therefore, have not provided good reasons for abandoning an ontology of substances for the living world.

What has emerged from this discussion is that process ontologists are only objecting to specific characterisations of substances – ones that takes substances to be three dimensional, generically ontologically independent, persisting by virtue of a mysterious ‘unchanging core’, being machine-like and having precise boundaries. Taking substances to have these features may well be untenable for understanding the living world, but as I hoped to have shown, many typical substance ontologists often do not take substances to have these features, nor are they features of the usual historical and contemporary accounts of substance presented in section 2.3. Notice, therefore, that I am not simply arguing that it is possible to tinker with the concept

of a substance or interpret accounts of substance in a way that avoids the process ontologists' criticisms. Rather, I am arguing that all the usual historical and contemporary accounts of substance, and the ways that paradigmatic substance ontologists understand substances, already avoid their criticisms.

2.9. What Would a Radical Processual Philosophy of Biology Look Like?

I want to end this chapter by considering what a processual philosophy of biology might look like that clearly is in tension with an ontology of substances, and that would have significant implications for the philosophy of biology and biology.

Some philosophers have argued that there are no countable processes but only *process* (Crowther, 2018; Hornsby, 2012). They take processes to be 'space-filling stuffs' like gold or water, rather than particulars (Crowther, 2018, 70; Hornsby, 2012, 237). Just as we cannot count how many *waters* there are, because there are no such particulars as *waters*, we cannot count how many processes there are (Steward, 2013, 806). Rather, there is only *more or less* of some process going on. There cannot, for example, be one or more fermentations but only *more or less* fermentation occurring.

Taking the biological world to contain living process rather than processes or substances, which we can call the 'Massy Process View', would involve a radical departure from understanding living entities as substances. It would not merely imply that living entities have fuzzy boundaries, but that there are no living particulars to have boundaries at all. There would only be *living process* or stuff. This would have radical implications for debates in the philosophy

of biology. One of these is the Problem of Biological Individuality. Recall that I said at the start of this chapter that the Problem of Biological Individuality and the question of whether biological individuals are substances or processes are debates that are currently independent of each other. This is not true, however, if we accept the Massy Process View. In particular, if the biological world contains living process rather than living processes, then there are no biological individuals to count. The Problem of Biological Individuality, then, would be a misguided question. It would be like asking how to count waters, or asking where the boundaries of waters are. Rather than asking how to count biological individuals, or how to determine where their boundaries are, we could only ask how *much living activity* or *life* there is, and how it is distributed. Furthermore, existing solutions to the Problem of Biological Individuality would be misguided. If the Massy Process View is true, the Problem of Biological Individuality, and its solutions, would, therefore, have to be reformulated.

The Massy Process View would also have implications for measuring evolutionary change. As I explained in chapter 1, biologists measure the spread of a trait in a population or determine gene frequency by determining how many biological *individuals* have that trait or genes. According to Massy Process View, though, there are no biological individuals to have traits or genes, and hence, measuring trait or gene frequency could not be done by counting biological individuals, but would have to be done by some other means. I suspect that for pragmatic reasons, evolutionary biologists and philosophers of biology would have to continue to pretend or act as if there are biological individuals, in order to measure evolutionary change, whilst acknowledging that this is simply a useful fiction.

This radical Massy Process View is not a view that processual philosophers of biology currently endorse. To see this, recall the three interpretations of the Process View that I

presented in section 1. The Massy Process View is an example of the ‘eliminativist’ reading of the process view, given that it holds that there are no organisms or other living particulars, but only living process.⁴⁸ In contrast, the actual reading – the view that process philosophers actually adopt - holds that there are many countable and distinct living particulars such as organisms (Dupré & Nicholson, 2018, 13-14).

The Massy Process View, then, it yet to be defended, but it would constitute a processual philosophy of biology that is radically in conflict with the main claims of substance ontology, and would have radical implications for issues in the philosophy of biology and biology.

It might be argued, however, that the Massy Process View is actually similar to Dupré’s *Promiscuous Individualism* (Dupré 2012, 241), and hence, that something like it is already held by at least one process philosopher of biology. According to *Promiscuous Individualism*, there are a number of equally good or legitimate ways to carve the biological world into distinct biological individuals, and how we choose to do so is dependent on our interests. It takes there to be a vast number of different kinds of biological individuals, corresponding to our different interests. This is not because the existence of biological individuals is interest-relative or a matter of convention, but because the world is populated by a vast number of different kinds of biological individuals with different boundaries, and which ones we choose to pick out is dependent on our interests.

⁴⁸ It is actually stronger than the version of the eliminativist reading that I presented in section 2.2 As I presented the eliminativist reading there, it is the view that entities such as cats human beings and cows still exist; it is just that they are not biological individuals. The Massy Process View, however, holds that there are no living particulars such as cats and human beings at all.

It seems to me, however, that rather than being similar to Promiscuous Individualism, the Massy Process View is in fact the polar opposite view. Whilst the Massy Processual View takes there to be no biological individuals, Promiscuous Individualism takes there to be many. Furthermore, whilst the Massy Process View holds that there are no ways that the world is carved up into distinct biological individuals, Promiscuous Individualism holds that there are many ways in which it is carved up into distinct individuals. I take the Massy Process View, and Promiscuous Individualism, therefore, to be opposite views.

Finally, regardless of the relation between the Massy Process View and Promiscuous Individualism, it might be argued that Dupré's Promiscuous Individualism is nonetheless in tension with substance ontology. I don't see, however, why we should think this. There is no immediate reason why a substance ontologist is prohibited from believing that there are a number of equally good, but different ways of carving up the biological world into distinct biological substances. None of the usual historical and contemporary accounts of substance are in conflict with Promiscuous Individualism. Of course, substance ontologists may want to reject Promiscuous Individualism, but this need not have anything to do with them being substance ontologists.

2.10. Conclusion

Process ontologists in the philosophy of biology have not provided good reasons for abandoning an ontology of substances. There is no reason why substances cannot be temporally extended, dynamic, ecologically dependent and have vague boundaries. This is not because accounts of substance can be tweaked or tinkered with in order to accommodate these features, but because they already accommodate them. Furthermore, many substance ontologists

maintain that living entities do indeed have these features. The objections of process ontologists are only levelled at particular characterisations of substances – ones that take substance to be three dimensional, generically ontologically independent, persisting by virtue of an unchanging core, being machine-like and having precise boundaries. These features do not, however, figure in the usual historical and contemporary accounts of substance, and many substance ontologists will deny that living substances have them.

That being said, perhaps it is true that lots of talk and practice in *biology* treats living entities as if they are static, have precise boundaries, and an unchanging core, and so on. Process ontologists would be right to point out that this is misleading. Addressing this shortcoming, however, does not require abandoning an ontology of substances. More needs to be said, then, if process ontologists want to show that substance ontology is inadequate for the philosophy of biology.

Finally, I outlined what an anti-substantialist processual philosophy of biology might look like that appealed to the category of massy process. This version of the process view – the Massy Process View - would have radical implications for debates in the philosophy of biology and biology, such as the Problem of Biological Individuality and measuring evolutionary change. The Massy Process View, however, is yet to be defended.

Chapter 3: Are We Biological Individuals? Animalism and the Too-Many-Thinkers Problem

3.1. Introduction

The first two chapters of this thesis chapter have been concerned with two of the main questions about biological individuals in the philosophy of biology: 1) how should we count biological individuals and 2) are biological individuals substances or processes. This chapter asks a more personal question about biological individuals: are *we* biological individuals? That is, is each of the beings that we are identical to a biological individual?

This is not a question that arises in the philosophy of biology. One reason for this is because the question of what sort of thing we are may seem irrelevant to the main interests of philosophers of biology. As we have seen, philosophers of biology are often concerned with tricky cases about counting and distinguishing biological individuals, such as siphonophores and plants. Regardless of whether we are biological individuals, these tricky cases still arise. Similarly, regardless of whether we are biological individuals, the question of whether biological individuals are substances or processes remains.

Another reason, I think, why philosophers of biology do not ask this question is because it may seem obvious that we are biological individuals, in particular, human beings. When we look in the mirror, a biological individual stares back at us (Olson, 2007, 23), when we brush our teeth, or talk, so does a biological individual. When we go to the doctors and a biological individual is treated, it seems that *we* are treated. These seem like good reasons for thinking that we are

biological individuals, and as such, I don't think philosophers of biology ever really question whether we are biological individuals. As I mentioned in chapter 1, Clarke even says that one reason for caring about the Problem of Biological Individuality and the notion of the biological individual in the first place is because 'that is what we are' (Clarke, 2010, 313). She does not provide an argument for thinking that we are biological individuals, but takes it to be obvious. Notice also that my discussion of the Pluralist Approach to the Problem of Biological Individuality in section 1.4.2. assumed that we are biological individuals.

Many metaphysicians, however, have entertained the possibility that we are not biological individuals. More than this, the view that we are biological individuals (human beings or human animals), often called *Animalism*, is actually the minority view amongst philosophers in the personal identity literature. Whilst almost all philosophers writing about personal identity believe that we all bear a very special and intimate relationship to a biological individual, most have denied that this relationship is *identity*, taking it to be something weaker. The main reason for this, as we shall see, is that many have been persuaded that biological individuals, and the beings that we are, have different properties.

There are, however, a number of arguments in favour of Animalism, one of the most powerful being the *Too-Many-Thinkers Problem*, often also called the *Thinking-Animal Problem* (Carter, 1988; Mackie, 1999; Merricks, 2001, 86; Olson, 1997a, 80-81 & 106-107; Snowdon, 1990, 93-95; Van Inwagen, 1990, 290, n.45).

In this chapter, I argue that despite appearances, the question of whether we are biological individuals is relevant to the philosophy of biology. In particular, building on my discussion at the end of chapter 1, I argue that the Pluralist Approach to the Problem of Biological

Individuality is in tension with our being biological individuals. Specifically, if the Pluralist Approach is true, then Animalism faces an analogous version of the Too-Many-Thinkers-Problem.⁴⁹ As a consequence, if the Pluralist Approach is true, then we may have to reject the plausible-sounding view that we are biological individuals.

This is important for metaphysicians and philosophers of biology alike. It is important for personal identity theorists because it shows that if the Pluralist Approach is true, then Animalism may be in trouble. It is important for philosophers of biology because as I said earlier, one reason for caring about the Problem of Biological Individuality in the first place is the assumption that we are biological individuals. If philosophers of biology want to continue to accept the Pluralist Approach, then, they may have to reject this assumption, and hence, they may lose one motivation for caring about the Problem of Biological Individuality.

In light of this tension, we might accept the Pluralist Approach and reject Animalism. Alternatively, we might accept Animalism, and reject the Pluralist Approach. I argue that there is a good reason to go with the latter option, given that the Pluralist Approach, on closer inspection, is actually in tension with *all* the usual accounts of what we are in the personal identity debate, and seems to require its proponents to be committed to a radical and controversial view about personal identity.

⁴⁹ I am not the first person to notice that there is an analogous version of the Too-Many-Thinkers problem if the Pluralist Approach and Animalism are true. Olson has already briefly highlighted the problem in a book review of Jack Wilson's book on biological individuality (Olson, 2001, 266). My contribution, however, is to argue that the problem shows that the Pluralist Approach and Animalism are in tension, and ultimately to provide an objection to the Pluralist Approach.

3.2. What Are We? The Views

The topic of personal identity is a branch of metaphysics that deals with questions that arise about ourselves in virtue of our being persons (Olson, 2021). The majority of discussion in the personal identity literature is about what it takes for a person to persist through time: what events could we survive, what events would cause us to cease to exist, and what makes it the case that a past or future being is you?

Another question about personal identity, however, which I will focus on, is *what are we?* That is, what sort of things are you, I, and other human people, metaphysically speaking (Olson, 2007)? In this section, I will outline the usual answers to this question in the personal identity literature, starting with the view that we are biological individuals.

Animalism

According to Animalism, we are biological individuals. More specifically, Animalists hold that we are identical to human animals – a kind of organism or biological individual (Olson, 1997a; Snowdon, 2014; Van Inwagen, 1990). Animalism does not say that we are essentially animals, or that we are animals permanently, although most Animalists do believe this (Blatti, 2020; E. Olson, 1997a; Thornton, 2019; Toner, 2011a; Van Inwagen, 1990). It is simply the view that we are animals.

Despite Animalism being the most obvious account of what we are, Animalism has been the minority view among philosophers. The alternatives to Animalism all hold that we bear an intimate relation to an animal, but they deny that this relationship is identity. Proponents of these views may say that we “are” animals, but only in a loose sense of being intimately related to one. If this intimate relation is not identity, however, then what else could it be?

The Soul View

A historically important view says that we are immaterial souls – things or substances that are not made of matter (Descartes, 1985; Swinburne, 1984, 2019, ch4).⁵⁰ The Soul View rules out our being biological individuals because biological individuals are made of matter. Rather it holds that we are each intimately related to a biological individual, which keeps us alive and which we control (Swinburne, 2019, 1).

Whilst the Soul View is not taken seriously by many philosophers anymore because it faces some well-known objections,⁵¹ it could help to demonstrate how something could be intimately related to an animal without being identical to one.

The Brain View

The majority of philosophers writing about personal identity believe that we are material things. If we are not animals, though, then what material things are we? According to one view, we are *parts* of animals. Most philosophers who hold this view believe that we are *thinking* parts of animals such as brains (T. Campbell & McMahan, 2010; Hudson, 2001; Parfit, 2012; Tye, 2003, 142), or parts of brains (Puccetti, 1973). One motivation for the Brain View is that the brain is the seat of our psychological activity, and many people have the strong intuition that what sort of thing we are is to do with our psychology (Olson, 2007, 77-78). Many people, for example, have the intuition that if your brain was removed from the

⁵⁰ A variation of this view holds that each of us have an immaterial soul as a part.

⁵¹ Although Richard Swinburne is a notable exception.

organism's head it is currently in and transplanted into the head of another organism, you would move location from one organism to another. Since, however, no organism moves location, but your brain moves, the best explanation, it might seem, is that you simply are your brain (or part of one).

The Constitution View

Some philosophers believe that we are not biological individuals or animals but are things *constituted* by them (Baker, 2000). We briefly saw a version of the Constitution View (or co-location view) in chapter 1 (see section 1.3). As a reminder, constitution is supposed to be a relation that holds between two material objects such they are made of the same matter, and where one is said to *constitute* the other (a lump of clay, for example, is said to constitute a statue). According to the Constitution View about personal identity, then, each of us is intimately related to an animal not because we are identical to an animal, but because each of us is made of the same matter as an animal.

Many of the same intuitions about the importance of psychology for personal ontology that motivate accepting the Brain View also provide motivations for The Constitution View. Baker (Baker, 2007, 81-82), for example, who accepts the Constitution View, argues that unlike organisms, we are essentially things that have a *first-person perspective*, and so must be numerically distinct from organisms.

The Temporal Parts View

Some philosophers think that we are temporal parts of animals. The notion of temporal parts was discussed in chapter 2. Those philosophers who think that we are temporal parts of animals tend to think that we are also composed of temporal parts (they do not think that we are instantaneous entities). Again, one motivation for accepting the Temporal Parts View is to do with intuitions about the importance of psychology for personal ontology. Some philosophers, for example, as we have seen, think that we essentially have mental properties. Combined with an ontology of temporal parts, such a philosopher might also think that we are things entirely composed of temporal parts with mental properties, which we might call ‘person parts’. But consider human animals. If they have temporal parts, then it seems that they have some temporal parts that are not person parts, such as foetal temporal parts, or the temporal parts of animals that exist when animals are in a vegetative state. It might be argued, then, that we are not identical to animals but are temporal parts of them. In particular, each of us is a temporal part of an animal that is composed of all of the temporal parts of an animal, minus the animal’s non-person parts, such a foetal temporal part (Olson, 2007, 110).

Nihilism

Finally, according to Nihilism about personal ontology, we bear no relation to biological individuals because we don’t exist. Whilst a surprising view, Nihilism has actually been defended by a number of philosophers (Brenner, 2018; Rosen & Dorr, 2002; Sider, 2013; Stone, 2005; Unger, 1979). I won’t discuss Nihilism in this chapter, but a version of it will be discussed in the next chapter.

This section should have made it clear what the view that we are biological individuals is, and what the alternatives are. In the following section, I will present one of the best arguments for Animalism called the Too-Many-Thinkers Problem.

3.3. The Too-Many-Thinkers Problem

The Too-Many-Thinkers Problem aims to show that those who deny that we are animals face metaphysical and epistemic challenges. The problem actually has three components (Olson, 2007, 35-37), but I will focus on one of these: the epistemic component.

Here is the problem. Suppose that we are not animals (for example, that we are instead things constituted by animals, or brains). Nonetheless we are presumably each intimately related with an animal, as all the usual accounts of what we are (except Nihilism) accept. When I write, for example, an animal writes, when I sneeze, an animal sneezes. Importantly, the animal that we are each intimately related with is presumably mentally just like us. Why is this? Well, my mental activity is presumably the result of me having a brain and a nervous system. Furthermore, it seems that the animal must have the exact same thoughts and experiences as me. If the animal did not think, or if the animal thought different thoughts from me, it would be a mystery why. But if the animal and I are mentally alike, how can I fail to be the animal? Surely, the best explanation for the animal and I having the same thoughts and experiences is that I *am* the animal (Olson, 2007, 29).

The philosopher who denies that we are animals could argue that the animal who shares my thoughts and experiences is distinct from me. Such a philosopher would be committed to there being two thinkers for every one of my thoughts. Suppose we are willing to accept this counter-

intuitive implication. This, however, raises a difficult question: since the animal and the non-animal that I supposedly am think the same thoughts and have the same experiences, how can I be sure that I am the non-animal rather than the animal? (Olson, 2007, 36)? Suppose that I have the thought, 'I am not an animal'. Both the animal and the non-animal have this thought. Of course, the animal's belief would be mistaken, but how can I know that I am not the animal making the mistake? It seems I could never know. Given this, it seems that there is no reason to believe that we are non-animals rather than animals.

The Too-Many-Thinkers Problem against anti-animalist views (or for Animalism) is generated because these views imply that there are two candidate things for being me – an animal and a non-animal who think the same thoughts and have the same experiences – and no good reason to believe that we are the latter rather than the former. Animalists seem to avoid this problem by holding that there is only one candidate for being me – the animal.

Things however, may not be so simple for Animalism if the Pluralist Approach is true. I will argue that if Animalism and the Pluralist Approach are both true, then there are at least two candidate things for being me, and no reason to suppose that I am one rather than the other. Animalism, then, would face an analogous version of the Thinking-Animal Problem.

3.4. The Pluralist Approach and the Too-Many-Thinkers Problem

As I highlighted in chapter 1, many, if not the majority, of philosophers of biology, accept the Pluralist Approach. That is, they think that more than one solution to the Problem of Biological Individuality is correct. The version that I considered holds that both the Physiological Approach and the Evolutionary Approach are true because they pick out distinct kinds of

biological individuals – Physiological individuals and Evolutionary individuals – who are located roughly in the same spatial location. As we saw, if the Pluralist Approach is true, then Physiological individuals and Evolutionary individuals must be distinct – nothing could be both a Physiological Individual and an Evolutionary individual. This is because these individuals often have different parts, or if they don't, what it takes for something to be a part of each biological individual is different. If a human being is a Physiological individual, for example, its gut bacteria are parts of it, whilst if it is an Evolutionary individual, it is not. Furthermore, as I explained in chapter 1, if these individuals both exist, then they plausibly come into existence at different times too. If the Pluralist Approach is true, therefore, in the rough region where I am, there must be at least two distinct individuals who share much of their matter.

We have actually briefly seen a version of the analogous version of the Too-Many-Thinkers Problem facing Animalism if the Pluralist Approach is true, at the end of chapter 1. In that chapter, I assumed that Animalism is true, and used the argument as an objection to the Pluralist Approach. Now, however, that we have seen that there are popular alternatives to Animalism, it is less clear whether it can be assumed that we are biological individuals. As such, the argument may only establish that the Pluralist Approach is in tension with the truth of Animalism, which does not on its own provide an objection to the Pluralist Approach. Perhaps instead it provides a reason for rejecting Animalism.

At any rate, here is the argument as an argument for the claim that the Pluralist Approach is in tension with the truth of Animalism. Suppose the Pluralist Approach is true. Then in the rough region where I am, there are two distinct biological individuals – a Physiological individual and an Evolutionary individual - who share much of their matter in common, although not all

of it. These individuals often perform many of the same activities. When the Physiological individual goes to the shops, so does the Evolutionary individual, when the Evolutionary individual watches television or reads a book, so does the Physiological individual. Importantly, it is plausible that the Physiological individual and the Evolutionary individual will have the same thoughts and experiences, because whilst they do not have all their parts in common, they share a brain and a nervous system. As such, in the region where I am located, there are two biological individuals who think the same thoughts. Presumably if I am an animal, I am one of these individuals, and we have seen that I could not be both of them. This therefore raises a difficult question: how could I ever know which of these individuals I am? Both individuals have the same thoughts and experiences, so no matter of introspection could allow me to determine which of these individuals is me.⁵² If the Pluralist Approach and Animalism are true, I can therefore never know which individual I am. Suppose, for example, that I believe that I am the Physiological individual, and that I have the thought, 'I am a Physiological individual'. Both the Physiological individual and the Evolutionary individual will have this thought. The Evolutionary individual's belief that they are a Physiological individual would be false, but how can I be sure that I am not the Evolutionary individual, and hence, that I am the one making the mistake? If the Pluralist Approach is true, Animalism, therefore, faces an analogous problem to the Too-Many-Thinkers Problem.

It might be argued that the version of the Too-Many-Thinkers Problem facing Animalism if the Pluralist Approach true is much less severe than the original version facing anti-Animalist views. This is because, assuming that both the Physiological individual and the Evolutionary individual are both animals, whilst I would never be able to know what kind of animal I am, I

⁵² Olson (2001, 266) has made a similar point.

can still be sure that I am *some kind* of animal – I can know that I am either a Physiological individual or an Evolutionary individual.

Whilst this seems true, I think it would still give us reason for worrying about the truth of Animalism because it would imply that a number of important questions about what we are, are unanswerable.

Firstly, whilst we could know we are animals, it would still be impossible to know which of the things in the world we are, or what specific kind of thing we are. This would seem to be a strike against an account of what we are.

Secondly, one question about what we are is what parts we have (Olson, 2007, 4). Consider the millions of gut bacteria inside of us. If it turned out that these are parts of us, this would tell us something significant about what sort of thing we are. It would tell us, for example, that the kind of beings we are have many cells as parts that are not descended from a zygote that formed through the act of conception, and as such, that our parts are hugely genetically diverse. Gut bacteria as we seen, however, are parts of a human Physiological individuals, but not parts of human Evolutionary individuals. If the Pluralist Approach and Animalism are true, then, it is impossible to know whether we are the sorts of things that have gut bacteria as parts, and therefore, whether are parts are hugely genetically diverse. Furthermore, the question of whether we are the kinds of things that can have our offspring as parts is surely an important question about what we are, as is the question of whether we were once parts of our mother. We saw in chapter 1 that a foetus is a part of its mother according to the Physiological Approach, but that it is much less clear whether a foetus is a part of its mother according to the Evolutionary Approach. There are at least some reasons for thinking that foetuses are not parts

of their mothers according to the Evolutionary Approach (Grose, 2020). As such, if Animalism and the Pluralist Approach are true, pregnant mothers, cannot know whether foetuses are parts of them, and we cannot be sure whether we were once parts of our mothers. Significant questions about what we are then, are unanswerable.

A related question about what we are is what *makes* something a part of us, or put differently, what determines where our boundaries lie (Olson, 2007, 4). What, for example, makes it the case that my brain, or my skin cells are parts of me but my watch or socks are not? Presumably an answer to this question will tell us what makes *anything* a part of us. As we have seen, though, what makes something a part of a Physiological individual is different from what makes something a part of an Evolutionary individual. Something is a part of a Physiological individual if and only if it is physiologically related to the rest of the individual (where this may be understood in terms of metabolic or immunological interactions, for example). On the other hand, something is a part of an Evolutionary individual if it, along with the rest of the individual, jointly act as a unit of selection. If the Pluralist Approach and Animalism are true, therefore, it is impossible to know what makes it the case that something a part of us.

Another question about what we are is when we begin to exist – were we ever zygotes, for example? It seems plausible, however, that Physiological individuals and Evolutionary individuals (if they both exist) come into existence at different times. As we saw in chapter 1, there are reasons for thinking that Evolutionary individuals come into existence at the zygote stage of pregnancy, given that a zygote already has mechanisms for participating in evolution by natural selection. In contrast, there are reasons for thinking that Physiological individuals come into existence some time later. If the Exclusion Principle is adopted, then they do not come into existence until after birth. If the Exclusion Principle is not adopted, then they

plausibly come into existence when there is a functioning immune system, which I gave reasons for thinking is not before a couple of months after conception. Either way, it seems that Physiological individuals would come into existence later than Evolutionary individuals. Given this, if Animalism and the Pluralist Approach are true, it is impossible to know whether we were zygotes.

Finally, another question about what we are is what it takes for us to persist. Pradeu, as we saw in chapter 1, argues that Physiological individuals persist by virtue of the continuity of physiological processes, such as immunological and biochemical activity (Pradeu, 2012, 249). It is not entirely clear what it would take for Evolutionary individuals to persist. According to Wilson's version of the Pluralist Approach, however, each kind of biological individual has different persistence conditions (Wilson, 1999). As such, if the Pluralist Approach and Animalism are true, and different kinds of biological individuals have different persistence conditions, then we can never know what it takes for us to persist.

The worry then, is that if Animalism and the Pluralist Approach are true, then a number of questions about our metaphysical nature (questions about our parts and persistence conditions) are unanswerable.

Why think, though, that if the Pluralist Approach is true, this would be a reason to worry about the *truth* of Animalism? Surely my argument only establishes the weaker conclusion that if Animalism and the Pluralist Approach are both true, some metaphysical questions about ourselves would be unanswerable. This does not obviously show, however, that if the Pluralist Approach is true, then Animalism is false. There must, after all, be some questions - some important metaphysical questions- that we can never know the answer to, and perhaps

questions about our parts and our persistence are examples of these unanswerable metaphysical questions.⁵³

The worry with this response is that if it is impossible for us to know the answer to these kind of questions about ourselves, we might wonder whether it is possible to know the answer to *any* philosophical questions about ourselves, or even about the world more generally. If some of the most fundamental questions about ourselves, such as about our parts and persistence, are unanswerable, then we might wonder whether the answer to any philosophical questions about ourselves and the world are within our grasp. Therefore, if we think that many important philosophical questions about ourselves and the world are answerable, we better think that questions about our parts and persistence are answerable too.

Here is a more concrete reason to think that the Pluralist Approach is in conflict with the truth of Animalism: if there are both Physiological and Evolutionary individuals, then perhaps there are also many other sorts of individuals too. There might, for example, also be *Psychological individuals* –individuals who are made of the same matter as Physiological and Evolutionary individuals, think their thoughts, but which persist in virtue of the causal continuity of their psychological capacities, and so have their psychological capacities essentially.

This would be bad news for Animalism, given that Psychological individuals would not be animals (or organisms/biological individuals). This is because animals do not have their psychological capacities essentially (human animals would continue to exist in a vegetative state, for example). As such, if there are Psychological individuals, which does not seem so

⁵³ Ned Markosian (1998) at least thinks that the question of the conditions under which things compose something is unanswerable. If this is right, then the question of whether something is a part of us would presumably be unanswerable too.

far-fetched if there are both Physiological and Evolutionary individuals, then we can never know whether we are animals, and therefore whether Animalism is true.

3.5. The Upshot: The Pluralist Approach is in Tension with Our Being Biological Individuals

I hope to have shown, then, that the Pluralist Approach is in tension with our being biological individuals. I think that this is an interesting and important result for both philosophers of biology and metaphysicians.

Firstly, I imagine that most philosophers of biology believe that we are biological individuals – it is only metaphysicians who have suggested otherwise. The Pluralist Approach however is currently the most popular solution to the Problem of Biological Individuality. Many philosophers of biology, then, will be surprised to learn that their views about biological individuality are in tension with our being biological individuals. Furthermore, and as I said before, given that one motivation for caring about the Problem of Biological Individuality is the assumption that we are biological individuals, accepting the Pluralist Approach may therefore get rid of one motivation for caring about the Problem of Biological Individuality.

Secondly, some metaphysicians who accept Animalism think that most issues about biological individuals in the philosophy of biology have little bearing on the truth of Animalism. Paul Snowdon seems to think this. He claims that whilst questions about the nature of biological individuals are important questions for the biological sciences, they are not important when considering whether Animalism is true. As he says,

Of course, the working out of answers to these problems [about biological individuals] in the philosophy of biology is relevant to determining the general *consequences* of Animalism. But most of these consequences will not provide grounds for worrying about the *truth* of animalism...(Snowdon, 2014, 111).

If what I have said here is true, then this may not be the case. As I have shown, if the Pluralist Approach is true, then there is a reason to worry about the truth of Animalism.

Thirdly, if the Pluralist Approach is true, then the Too-Many-Thinkers Problem argument for Animalism loses its force, given that Animalism would face a similar problem. This would be significant since the Too-Many-Thinkers Problem is often taken to be one of the main arguments for Animalism.

Given that the Pluralist Approach is tension with Animalism, there are at least two options. Firstly, we might accept the Pluralist Approach and reject Animalism. Secondly, we might accept Animalism and reject the Pluralist Approach. Ultimately, I think the second option is preferable, for reasons I will now explain.

3.6. Reject Animalism or Reject the Pluralist Approach?

Philosophers of biology who accept the Pluralist Approach may argue that in light of my arguments, we should reject Animalism.

The first problem with this, however, is that, the other usual non-animalist views about what we are, (such as the Constitution View, the Brain View, and the Temporal parts View) already

face the original Too-Many-Thinkers Problem. Rejecting Animalism for one of these other views, then, will not allow proponents of the Pluralist Approach to escape Too-Many-Thinkers-style worries.⁵⁴

Secondly, and more importantly, on closer inspection, the Pluralist Approach is actually in tension with *all* of the usual accounts of what we are, that I presented in section 3.2; not just Animalism. Suppose, for example, that the Pluralist Approach and Constitutionalism are true. As we saw, according to the Constitution View, whilst we are not identical to biological individuals, we are each intimately related to one in virtue of being constituted by one. If the Pluralist Approach is also true, however, then are we constituted by Physiological individuals or Evolutionary individuals? It seems that we could never know. We cannot be constituted by both, given that constitution is a relation that holds between one thing and another; not between one thing and many. Similarly, suppose that the Pluralist Approach and the Temporal Parts View are true: if we are temporal parts of biological individuals, then are we temporal parts of Physiological individuals, or temporal parts of Evolutionary individuals? Again, there seems no way of knowing.

The problem is actually much worse than this, given that non-animalist views already face the original version of the Too-Many-Thinkers Problem. Consider the Constitution View again. The original Too-Many-Thinkers-Problem, ignoring the Pluralist Approach, shows that we can never know whether we are biological individuals, or things constituted by biological

⁵⁴ It might be argued that the Brain View actually avoids the Too-Many-Thinkers Problem. Specifically, someone might argue that despite appearances, human animals don't think, or that they only think in a derivative sense in virtue of having a brain that thinks (Olson, 2007, 80). This response, however, relies on the questionable assumption that if the brain thinks, then the human animal that it is a part of does not think. Furthermore, it could equally be argued that it is the human organism that thinks and the brain that thinks derivatively (Olson, 2007, 81). I'm not convinced, then, that the Brain View avoids the Too-Many-Thinkers Problem.

individuals. Adding the Pluralist Approach to the mix, there are now at least four objects that are candidates for being us, and no way of determining which of these things we are: are we 1) things constituted by Physiological individuals, 2) things constituted by Evolutionary individuals, 3) Physiological individuals or 4) Evolutionary individuals? Similarly, consider again the Temporal Parts View. Putting the Pluralist Approach aside, a problem for the Temporal Parts View is that I can never know whether I am a temporal part of a biological individual or a biological individual. If the Pluralist Approach is true, however, then things are even worse than this: are we 1) temporal parts of Physiological individuals 2) temporal parts of Evolutionary individuals 3) Physiological individuals or 4) Evolutionary individuals?

The Pluralist Approach therefore is in tension with a number of accounts of what we are; not just Animalism. It actually makes the original version of the Too-Many-Thinkers Problem that these anti-animalist accounts face worse by generating more candidates for being us. Rather than rejecting Animalism, then, I think my argument shows that we should be worried about the Pluralist Approach.

3.7. Relativism About What We Are

Perhaps proponents of the Pluralist Approach will argue that all my argument shows is that all the *usual* accounts of what we are that I discussed earlier are problematic, and that we need to accept an account of what we are that is very different from these usual accounts. What would such an account look like? The most obvious one that comes to mind is what we can call *Relativism About What We Are (RAWWA)*.⁵⁵ According to RAWWA, there are a number of candidates for being me, and indeterminate which of these candidate I am. More specifically,

⁵⁵ See Sider (2001a) and Olson (1997) who discuss a view like this.

my personal pronouns refer ambiguously to a number of distinct things and don't determinately refer to any one of them, and so in asking which one is me, there is no determinate answer.

The proponent of the Pluralist Approach who accepts RAWWA could argue, then, that there are at least two candidate beings for being us – Physiological individuals and Evolutionary individuals - and it is indeterminate which of these beings we are. More specifically, our personal pronouns refer ambiguously to a Physiological individual and to an Evolutionary individual. It is therefore neither definitely false to say that I am a Physiological Individual, nor that I am an Evolutionary Individual. Each of these is as good as any answer to the question, 'what am I?'.

Fully embracing RAWWA, the proponent of the Pluralist Approach might want to say that there are things corresponding to each of the usual accounts of what we are in the personal identity literature. In that case, the proponent of the Pluralist Approach might want to say that just as it is indeterminate whether we are Physiological individuals or Evolutionary individuals, it is also indeterminate whether we are things constituted by Physiological individuals, things constituted by Evolutionary individuals, brains, and so on. There are, therefore, many candidates for being us, according to this view, and indeterminate which of these we are.

RAWWA about what we are may be the account of what we are that fits best with the Pluralist Approach. It should be clear, though, that RAWWA is pretty controversial. It implies that whenever I think about myself, my thoughts are not just about me but are also about many other things, and that whenever I refer to myself, I am also referring to many other beings simultaneously. It also implies that many of our beliefs about ourselves are neither determinately true nor false. On the particularly abundant version of RAWWA outlined in the

previous paragraph, for example, it implies that it is neither definitely true nor false that I am an organism. It also implies that my belief that by gut bacteria are parts of me is in some sense right because some of the things that I refer to with my personal pronouns do have gut bacteria as parts, for example, a human Physiological individual or a thing constituted by a human Physiological individual, but it is in some sense false because some of the things that my personal pronouns refer to do not have gut bacteria as parts, such as an Evolutionary individual, a thing constituted by an Evolutionary individual, and a brain. Given that there are reasons for thinking that a foetus is a part of a human maternal physiological individual, but not a part of a human maternal Evolutionary individual, it may also imply that it is indeterminate whether a foetus is a part of its mother, or whether we were parts of our mothers.

Perhaps philosophers of biology would be happy to accept these consequences of RAWWA. Proponents of the Pluralist Approach, for example, may argue that whilst it is indeterminate whether we are Physiological or Evolutionary individuals, it is still sometimes useful to think and act as if we are *determinately* one of these individuals, or to pretend for practical reasons that my pronouns refer only to one individual. They may, then, be happy to take the answer to the question, ‘what are we?’ to be context-dependent. At any rate, I think it is important news that accepting the Pluralist Approach seems to require us to accept a radical and controversial account of personal identity such as RAWWA. I, at least, would rather not accept RAWWA.

3.8. Conclusion

This chapter has argued that the Pluralist Approach is in tension not only with Animalism, but with all the usual accounts of what we are in the personal identity literature such as the Constitution View and the Temporal Parts View. The account of what we are that seems to fit best with the Pluralist Approach is a particularly radical one, such as RAWWA. Given

RAWWA's troubling implications, I think this shows that we should be worried about the truth of the Pluralist Approach. At any rate, it is important news that the account of what we are that fits best with the Pluralist Approach is one such as RAWWA.

Pulling the threads of the thesis so far together, I have provided metaphysical reasons for preferring certain answers to some of the main debates about biological individuals in the philosophy of biology. Chapter 1 provided an objection to the Physiological Approach to the Problem of Biological Individuality, which I argued the Evolutionary Approach avoids. In the present chapter, I presented a worry with the Pluralist Approach to the Problem of Biological Individuality. With these two chapters, then, I have provided metaphysical reasons for preferring a monistic solution to the Problem of Biological Individuality, in particular, for preferring the Evolutionary Approach.

Furthermore, in chapter 2, I argued that there have so far been no persuasive reasons for abandoning the well-established tradition which takes living things to be substances. Combining the arguments in chapters 1-3, then, I have provided metaphysical considerations for taking biological individuals (or organisms) to be substances, and to be units of selection.

Chapter 4. Are There Any Biological Individuals? Biological Individuality and Eliminativism

4.1. Introduction

So far, I have focussed on three questions about biological individuals (or organisms): 1) how should we count biological individuals, 2) are biological individuals substances or processes and 3) are we biological individuals. In considering these questions, I provided reasons for preferring a particular view about the nature of biological individuals: biological individuals are substances and units of selection.

Another question about biological individuals, however, is whether there are any. That is, do biological individuals exist? By this, I am not asking whether organisms have an inferior status to some other objects, which is what some philosophers seem to be asking when they ask whether biological individuals exist. Michael Ruse, for example, in his paper ‘Do Organisms exist?’ (Ruse, 1989) seems only to be asking whether organisms can be *reduced* to other objects such as molecules or atoms. What reductionism about organisms amounts to is up for debate,⁵⁶ but reductionists, Ruse included, do not typically think that there are no organisms.⁵⁷ In contrast, I am asking whether there are any organisms at all.

⁵⁶ See, for example, (Brigandt & Love, 2017; Sarkar, 1992)

⁵⁷ Ruse says, ‘I know that cows and horses exist...My question rather is ...what is it about organisms that makes them organisms?’ (Ruse, 1989, 1061). Similarly, Dupré says, ‘Of course, the reductionist does not say, bluntly and absurdly, that houses [or organisms], for example, don’t exist (Dupré, 2012c, 72).

Some readers might find this question absurd (Dupré, 2012c, 72; Ruse, 1989, 1061). Surely it is obvious that there are biological individuals or organisms. When I look outside, I can see a cat playing in my garden, and my neighbour watering their plants. Is this not proof enough that there are biological individuals? Granted, the philosophy of biology shows that it is often difficult to count biological individuals or to grasp their metaphysical nature (for example, to know whether they are substances or processes), and metaphysical consideration might lead us to question whether we are biological individuals, but surely we can be certain that biological individuals exist.

Turning to metaphysics, however, shows that this is not so obvious. This chapter argues that some serious metaphysical views about material objects are in conflict with the existence of biological individuals. This would seem to be bad news for the philosophy of biology: if there are no biological individuals, then there is no way to count them, and so the usual solutions to the Problem of Biological Individuality would be false. Furthermore, if there are no biological individuals, then they are neither substances nor processes. As we will see, many process ontologists are even committed to one of these metaphysical views. Despite my arguments in chapters 1-3, then, if there are no biological individuals, they cannot be substances or units or selection. This would also seem to be bad news for some areas of biology too. Recall, that I said in chapter 1 that biologists measure the spread of a particular trait in a population by determining how many biological individuals have that trait. If there are no biological individuals, then, we might wonder how, or if we can, measure the spread of traits.

Whilst I do think that some of the arguments for adopting these eliminativist views about biological individuals in metaphysics are good or compelling, the aim of this chapter is not

ultimately, however, to argue that there are no biological individuals; I leave this question open. Rather, I mainly aim to demonstrate that answers to debates in the philosophy of biology, as they are currently understood, are often dependent on what the right answers are to metaphysical questions about the nature of material objects more generally – questions which by no means have obvious answers.

4.2. How Do Things Persist?

A prominent question in metaphysics, which turns out to be relevant to the question of whether there are any biological individuals, asks how material objects persist through time. It asks, for example, what makes it the case, that a material object is hot at one time and cold at another whilst remaining the same object, or what makes it the case that a material object is identical to some material object that existed in the future or in the past. This question was discussed in chapters 1 and 2, although it was restricted to organisms. We can ask more generally, however, how *any* material object persists, such as stones, cars and electrons.

Recall from chapter 2 that when it comes to accounts of persistence, there are two camps. In the first camp are the three dimensionalists, who believe that material things only have spatial parts, and persist by virtue of being wholly present at each time that they exist. In the other camp, there are four dimensionalists, who believe that things not only have spatial parts, but also have temporal parts. They believe that things are not wholly present at each time that they exist, but are present at different times by having temporal parts located at different times, like a football match, which has a first and second half located at different times. Four dimensionalists believe that I am hot and then cold by virtue of having a hot temporal part and a cold temporal part. I think that everything I have said here and in chapter 2 is sufficient

enough for readers to grasp what temporal parts are, but it might be helpful to provide Olson's formal definition here:

x is a temporal part of y =df x is a part of y, and every part of y that does not overlap x exists only at times when x does not exist (Olson 2007, 100).

Suppose, for example, that there are temporal parts, and consider the temporal part that occurs between my first and second birthday. Call it A. A is a temporal part of me because it is a part of me, and every part of me that does not overlap with A only exists at times when A does not exist, such as my temporal part located between 9-10 am today, or my skin cells that fell off yesterday. The idea is that a temporal part 'takes up' the entirety of an object whilst it exists (Olson 2007, 100).

We saw that a number of process philosophers of biology accept four dimensionalism, or at least, they take it to be true of organisms. Four dimensionalism, however, has also been a reasonably popular view in metaphysics about material objects more generally (Heller, 1990; Lewis, 1986; Quine, 1948; Sider, 2001b).

4.2.1. The Problem of Temporary Intrinsic

Four dimensionalism certainly seems to be a strange view. We don't normally think of ourselves, stones and cars as being spread out across time like a football match – it seems strange to say that a stone has parts such as a *first and second half*. When we think of the parts of a stone, we usually think of things such as atoms. Why, then, would anyone accept four dimensionalism?

One of the most influential arguments for four dimensionalism is from David Lewis, and has been called *the Problem of Temporary Intrinsic*s. Lewis argues that we should accept four dimensionalism because three dimensionalism is unable to accommodate changes in a thing's intrinsic properties (Lewis, 1986, 203). Intrinsic properties are properties that a thing has in virtue of the way it is in itself, such as a thing's shape. These are in contrast to extrinsic properties, which are properties that a thing has in virtue of the way it relates to other things, such as *being a brother*, or *being married*. The Problem of Temporary Intrinsic is a problem about how the very same thing could have contrary properties at different times: suppose, for example, that I am sitting down, and thereby have a bent shape. A few minutes ago, though, I was standing up and therefore had a straight shape. I therefore have both a bent shape and lack a bent shape. It is a matter of logic though, that nothing can both have a bent shape and lack a bent shape. How, then, could I have both shapes?

The answer might seem obvious – I have a bent shape *now*, and lacked a bent shape *a few minutes ago*. There is no problem, it might be argued, because I do not have these properties at the same time.

Lewis argues, however, that this would make intrinsic properties such as shape extrinsic, given that such properties would always be had *in relation to a time*. Nothing, then would have a shape in virtue of how it is in itself. Lewis takes this to be 'simply incredible'. He says, '[i]f we know what shape is, we know that it is a property, not a relation' (Lewis, 1986, 204).

Lewis argues that four dimensionalism solves this problem. He argues that intrinsic properties of ordinary material objects are not had temporarily and hence, are not had relative to times.

Rather, they are had timelessly by a material object's temporal parts. For something to have a bent shape at one time, and a straight shape at another time is to have a temporal part located at one time that is *timelessly* or permanently bent, and another temporal part located at another time that is *timelessly* straight (Lewis, 1986, 204).

Despite some philosophers being unconvinced by the force of Lewis' argument (Hawley, 2001, 17), the Problem of Temporary Intrinsic has been taken by many to be a strong argument for four dimensionalism. Four dimensionalism has also been praised for having a number of other metaphysical virtues. In particular, it offers clever solutions to a number of metaphysical puzzles about material objects, one of which we shall see in section 4.3. (Olson, 2007, 106; Sider, 1996, 442-446). I will argue now, however, that four dimensionalism is in tension with the existence of biological individuals.

4.2.2. Four Dimensionalism and Eliminativism about Biological Individuals

Why think that four dimensionalism is in tension with the existence of biological individuals? Well, four dimensionalism implies that material objects, at least ones like organisms and stones, have far fewer properties than we ordinarily take them to have. As we have just seen, it implies that strictly speaking, material objects such as cats and human beings do not have temporary properties such as having a shape, a weight, or being hot or cold; these are properties of a material object's momentary temporal parts, which they have permanently. Strictly speaking, then, I relate to these properties not by having these properties, but by having *parts* that have those properties. Most strikingly, as Olson argues, four dimensionalism even seems to imply that familiar objects such as apples and cats are *unobservable things*, given that the property of being perceived is temporary. This is because, as he says,

My stages [temporal parts] may be perceived, but if I had the property of being perceived I should also have the property of not being perceived, for being perceived in a temporary property (Olson, 2007, 123).

The property of being perceived then, is not a property that I have. Rather, it is a property that my momentary temporal parts have. Strictly speaking then, I don't have the property of being perceived; I only have the property of having a perceived temporal part. Four dimensionalism, then, seems to imply that many familiar objects such as cats are shapeless, massless, colourless, 'unobservable theoretical entities' (Olson, 2007, 123).

Given this, it is certainly questionable whether four dimensionalism is compatible with the existence of biological individuals. Compare with the eliminativist reading of the Process View discussed in chapter 2. According to this reading of the Process View, organisms do not exist because it belongs to the very idea of a biological individual that is a non-processual entity. Similarly, it seems reasonable to think that it belongs to the very notion of a biological individual or organism that it is a perceivable entity, and has properties such as a shape and mass. If this is true, then four dimensionalism eliminates biological individuals in favour of four dimensional things.⁵⁸

It might be argued that there is a sense in which biological individuals, on the four dimensionalist picture, are observable, and have colour mass and shape, given that we often attribute a property to something if only its parts have that property (Olson, 2007. 123). It

⁵⁸ One might wonder whether the momentary temporal parts could be biological individuals. I will return to this later on in this section.

would be perfectly acceptable, for example, to say that I have dry skin, if only my feet have dry skin. Four dimensionalists might claim then that living entities are observable and have properties such as mass and weight, in a derivative sense, by virtue of having parts which have these properties (Sider, 2000).

Whether this is a good response is unclear. One worry with it is that whilst we do often attribute a property to a thing if only its parts have the property, this is done in an arbitrary or variable way.⁵⁹ We would never, for example, say that an organism is hand-shaped, and whilst we say that a car is powerful if its engine is, we don't say it is powerful if its battery is. At any rate, it seems to me that the notion of an organism or biological individual is of something that is *non-derivatively* observable and actually has a weight, mass and so on; not simply of something that has these properties derivatively.

Here is another reason for thinking that four dimensionalism is incompatible with the existence of organisms. It seems plausible that if a thing *x* is able to change with respect to a property *y*, then *x* must itself have *y* (Sider, 2000, 86). For example, if living things are able to change with respect to their shape or mass, then it seems plausible that they must have a shape or mass. According to four dimensionalism, however, living things do not have a shape or mass – only their parts have these properties (and recall, that according to four dimensionalism, the stages can't change with respect to these properties either). Hence, four dimensionalism seems to imply that living things cannot change with respect to their shape or mass. Plausibly, though, it belongs to the very idea of an organism that organisms can change with respect to such properties. If this is true, then four dimensionalism implies that living things are not organisms. Admittedly, whether it belongs to the very idea of an organism that it can change with respect

⁵⁹ Eric Olson pointed this out to me.

to its shape and mass is contentious. It at least seems plausible, however, if we consider the Physiological Approach to biological individuality, which, recall takes an organism to be a functionally integrated whole self-maintaining whole that persists through the constant gaining and losing of matter.⁶⁰

There are, therefore, at least two reasons for thinking that four dimensionalism is in tension with the existence of biological individuals. Notice that if these arguments are sound, then this is also significant for how we should understand process ontology in the philosophy of biology. Consider the eliminativist reading of the Process View, which, recall, eliminates biological individuals in favour of processes. Whilst process ontologists do not take themselves to be adopting the eliminativist reading, we saw that the majority of process ontologists take biological individuals to have temporal parts. If what I have said in this section is right, then, most process philosophers of biologists should actually be understood as adopting the eliminativist reading of the Process View, and hence, as eliminating biological individuals from their ontology.

4.2.3. The Stage View and Eliminativism

A similar view to four dimensionalism is the Stage View (Hawley, 2001; Sider, 1996). Consider that temporal parts (if they exist) come in different temporal lengths, some spanning many years, whilst others are instantaneous. Call the instantaneous temporal parts *stages*. Whilst four dimensionalism takes ordinary material objects such as frogs and stones to be composed of temporal parts, the Stage View takes ordinary objects to be stages. According to

⁶⁰ I am less clear on whether something that could not change with respect to its mass and shape could count as an organism by evolutionary criteria.

the Stage View, material objects, therefore, only exist for a moment, and so it implies that it is impossible for an object existing at one time to be identical to an object existing at another time. It is impossible, for example, for the very same tennis ball to be shiny and new at one time, and dull and damaged at a later time. Rather, according to the Stage View, what appears to be numerically one and the same tennis ball existing at different times are actually distinct stages that are causally connected by spatio-temporal continuity, some of which are shiny, and others that are damaged. The existence of damaged tennis ball stages, for example, is the result of earlier-existing shiny stages receiving trauma (Hawley, 2001, 42 and 70).

As with four dimensionalism, the main motivation for the Stage View is its ability to offer solutions to a number of metaphysical puzzles (Hawley, 2001). As with four dimensionalism, for example, it provides a response to the Problem of Temporary Intrinsic: what appears to be a persisting object with contrary temporary properties, are really lots of causally connected distinct objects that differ in their permanent properties (Lewis, 1986, 204; Sider, 2000, 86). No one first has a bent shape, and then a straight one. Rather, there is an instantaneous being that is timelessly bent, existing at an earlier time and another instantaneous being that is timelessly straight that exists at a later time, and which is causally connected to the first instantaneous being.

The Stage View has some counter intuitive implications. For one thing, it implies that I will never finish writing this sentence – that person will be numerically distinct from me. It implies that I was never 10 years old, and that I will not be meeting my friends tonight for dinner – we will all have ceased to exist by that time. Neither should I bother applying for jobs, or worry

about whether I fed my cats before leaving the house – he ceased to exist the moment I left the house.⁶¹

More importantly for our purposes, as with four dimensionalism, there are reasons for thinking that the Stage View is in tension with the existence of biological individuals. This is because it might be argued that it belongs to the very notion of an organism that organisms are dynamic and constantly changing their matter over time. As Olson writes,

[O]rganisms by their very nature constantly exchange old parts for new ones [and undergo other sorts of changes]. If nothing *could* ever survive a change of any of its parts, then organisms are metaphysically impossible (Olson, 2007, 30).

Similarly, Hoffman and Rosenkrantz say that if something is unable to undergo mereological change, then '[e]vidently, such a substance [or material object] is not an organism' (Hoffman & Rosenkrantz, 1997, 153).

That the very notion of what it is to be an organism or biological individual involves activity or change seems to follow from both the main approaches to biological individuality. Consider the Physiological Approach, which often takes a biological individual to be a metabolic or immunological whole. The very idea of a metabolic whole, however, is of something that is constantly taking in matter from its environment to sustain itself, making the matter part of it, and expelling matter that it no longer requires. A instantaneous being, however, is not the sort of thing that can gain or lose parts - it is too short-lived. For similar reasons, an instantaneous being does not seem to be the sort of thing that can constantly undergo strong biochemical and

⁶¹ This may not be true – I may care about what happens to my future stages, or my cat's future stages.

medium intensity immune interactions. Again, this requires that an entity is active rather than static. I imagine that if the Stage View is true, for similar reasons, nothing would count as an organism according to the Evolutionary Approach. Clarke, recall, says that an organism is something that has demarcation mechanisms that provide it with the capacity to participate in evolution by natural selection, such as a bottleneck lifecycle, and mechanisms for preventing evolutionary conflict between an organism's parts such as pre-programmed cell death and an immune system. It seems doubtful that a static being would qualify as having such mechanisms.

Stage theorists may say that even though objects existing at different times are never identical, this is not as bad as it seems. Hawley, for example, says that even though objects existing at different times are never identical, we can still talk about objects being *the same* over time. More specifically, according to Hawley, two numerically distinct objects satisfy the predicate 'are the same object' if they are causally connected in the appropriate way (Hawley, 2001, 62), and she thinks that this is all that is required for our ordinary beliefs about persistence to be satisfied. We can still say, for example, that the mouldy loaf of bread is the *same loaf of bread* as the one that was fresh a week ago, given the causal connectedness of bread stages. Similarly, even though the current reference of the thought 'I will complete this sentence' lacks the property of completing this sentence, the sentence will nonetheless come out as true, given that the referent of the current thought is causally connected to a future stage who will finish this sentence.

On the Stage View theorist's, semantics, then, it might be argued, even though strictly speaking there are no biological individuals, there are nonetheless distinct *biological individual stages* which often satisfy the predicate 'is the same biological individual', or that even though there are no biological individuals, we can nonetheless talk about a biological individual stage now

as being *the same biological individual stage* (on the special way that stage theorists understand ‘same’) as one in the future, given that the biological individual stage is causally connected to a biological stage in the future. Similar, even though, there are no biological individuals, and nothing ever gains parts, the sentence, ‘this biological individual gained parts’ often comes out as true – it is true when there is a biological individual stage A that is causally connected to another biological individual stage B that existed earlier than A, and A has more parts than B.

Alternatively, it might be argued that the Stage View, despite appearances, is actually compatible with the existence of biological individuals. In particular, it might be argued that for something to be a biological individual, it need not be something that actually has the property of being dynamic and of constantly changes its parts. Rather, it simply must be causally connected in the correct way to other biological individual stages. For something to be a biological individual, it might be thought, something need not itself persist through the changing of its parts or arrangement of its parts, but rather must be causally connected to a past or future stage that has different parts, or a different arrangement of parts.

This would have the interesting implication that being a biological individual is an extrinsic matter, given that it would imply that whether something is a biological individual depends on its relation to other stages, and not simply on the way it is of itself. Whilst philosophers of biology may be happy to accept that being a biological individual is an extrinsic matter (as we shall see in the next chapter), I imagine that this might make some philosophers uncomfortable.

At any rate, I am inclined to think that the notion of a biological individual requires not simply that something is causally connected to a future or past being that differs in its parts, but rather

is of that something that can *literally* change its parts. I don't have a strong argument for this claim, but it seems to me that someone who thinks that organisms can be static, non-changing things, has misunderstood the notion of the organism. Hence, it seems to me that if it is conceded that nothing ever changes its parts, then this is to concede that there are no organisms.

If what I have so far is right, then two views about how things persist are in tension with the existence of biological individuals. In the next section I will consider another reason for thinking that biological individuals do not exist.

4.3. Can Objects Get Bigger and Smaller?

One reason we would have for denying the existence of biological individuals would be if it is impossible for objects to have different parts at different times. Olson calls this the *Doctrine of Mereological Constancy (DMC)*:

DMC: Necessarily, if x is a part of y at some time, then x is a part of y at every time when y exists (Olson, 2006).

DMC, it seems to me, is incompatible with the existence of biological individuals or organisms because, as I explained in the last section, it seems built into the notion of an organism that organisms are constantly exchanging their matter. If it turns out that DMC is true, then, this would cause trouble for biological individuals.

Suppose that DMC is true. How should we understand metabolic turnover? There are two options. Firstly, when a living thing expels a particle, perhaps it ceases to exist and is replaced

by a distinct being much like it but with one less particle. Alternatively, perhaps when a living thing expels matter, they don't lose parts, but rather become a scattered and disconnected object. According to this option, I exist for as long as all of the particles that currently compose me exist, and hence, over time, I gradually become more and more scattered as more of my particles are scattered across the cosmos. I, therefore, have a very strange history – I am much older than we ordinarily think I am, and only live as a biological individual-shaped thing for a very short time – for the brief time that my particles are arranged human-organism-wise, before dispersing again. As Olson says regarding a particular human being:

She has existed for billions of years. She has spent most of her career as a non-descript and highly rarefied cloud of interstellar dust. Much later she became confined to earth, and at one point she coalesced into human form – but not for long, for she will begin almost instantly to disperse once more. She will then be replaced by a numerically different...being (Olson, 2006).

If either of these options are true, then organisms are metaphysically impossible. Rather, there are only biological individual-shaped objects that are constantly replacing each other. As Olson writes,

If nothing *could* ever survive a change of its parts, then organisms are metaphysically impossible; what we think of as an organism is in reality only a series of “masses of matter” that each take on organic form for a moment – until a single particle is gained or lost – and then pass that form on to a numerically different mass’ (Olson, 2007, 30).

Why would anyone accept DMC? A powerful argument for it is the *Paradox of Increase* (Chisholm, 1976, 157; Hoffman & Rosenkrantz, 1997, 155-160; Olson, 2006, 2007, 153-164).

Suppose we want to make an object A bigger by adding B to it as a part - we want to make it the case that A first lacks B, and then has B as a part. We then do whatever it would take to make B a part of A, for example, by attaching, or joining B to A. Have we made B a part of A? It seems that we have not, but rather have only altered A's surrounding by making it the case that B is attached to it, as shown below:



(Chisholm, 1976, 158)

Figure 1

What is the problem? Well, if B has become a part of anything after joining, it has become a part of something composed of A and B. This object, however, did not gain A as a part because it did not exist before the joining took place (Chisholm, 1976, 158). Or, if it did exist, it existed as a scattered object that already had A as a part, and in joining A and B, we simply made it into a connected object (Olson, 2006, 391).

Furthermore, if nothing can ever get bigger by gaining a part, then it seems that nothing can ever get smaller by losing a part either. Suppose X is composed of Y and Z, and we want to make X smaller by removing Z. Suppose we do this by doing whatever is required to make it the case that Z ceases to be a part of X, if such a thing is possible. Have we thereby made X

event. A gains B as a part in the sense that A does not have, as parts, any of B's temporal parts that are located before the joining event, but all of the temporal parts of B located after the joining event are temporal parts of A. A, then, does not really gain B as a part (and it does not even have the whole, of B as a part; only a temporal part of it). This is because according to Four Dimensionalism, things have their temporal parts timelessly. A therefore timelessly has the temporal parts of B located after the joining events as parts. Put differently, A's later temporal parts (located after the joining event) have parts in common with B, but its earlier ones do not (Olson, 2006, 410). In it in this loose sense that A gains B as a part.

There are a number of worries with adopting four dimensionalism in order to solve the paradox, which I will not consider here (Olson, 2006, 411-414). For our purposes, though, it is significant to note that if what I said about four dimensionalism in section 4.2.2. is right, then four dimensionalism is in tension with the existence of biological individuals. Solving the paradox by adopting four dimensionalism, then, won't be of help if we want biological individuals in our ontology.

Identity is time-relative

One way of resisting DMC is to take identity to be *time relative*. Consider the paradox again. What we want to do is make A bigger by joining B to it. If this really does make A bigger, then A must have a part other than B, call it C, such that B and C, after joining, compose A, as figure 3 shows.

Before:



After:



A

(Olson, 2006, 400)

Figure 3

The paradox arises because C seems to be identical to A before B is joined with A. C, however, does not gain B as a part.⁶² Assuming then that A is identical to C, A does not gain B as a part either.

One way to solve the paradox, then, is to take C to be identical to A *before joining, but not after*. The suggestion is that A and C are one thing before the joining takes place, but are two things afterwards. Anyone who accepts this is committed to the more general principle that one and the same thing at one time might become a thing and another thing at another time, and hence, that identity is time-relative.⁶³

The problem, however, is that this response seems incoherent because it implies that two things can be identical yet differ in their properties. To see this, consider that before joining, A has a property that C lacks, namely, the property of one day having B as a part. As Olson asks,

⁶² C and B compose some other thing, and recall that by the usual understanding of composition, if two things compose something, then they cannot have any parts in common. If C gained B as a part, however, then C and B would have a part in common, namely B.

⁶³ Gallois (1990) holds a view like this.

though, ‘How can a thing be about to grow when that very thing is *not* about to grow?’ (Olson, 2006, 403-404).

Co-location

Philosophers who believe that material objects can be entirely co-located – a view we explored in chapters 1 and 3 - can provide a solution to the paradox (Olson, 2006, 407). I just said that the paradox arises because A and C seem to be identical. Proponents of the co-location, however, can deny this. They can argue that before joining, A and C are distinct yet entirely co-located. After joining, however, A becomes larger by gaining a new part, whilst C remains the same size.

We have already seen some worries with the co-location view. Here is another, which Olson calls the *Indiscernibility Problem* (Olson, 2007, 63): Consider that A and C before joining are qualitatively different, given that A will gain B as a part, whilst C will not. A and C, though, are made of the same matter, arranged in the exact same way. What, then, could account for them being qualitatively different (Olson, 2006, 407)? As Olson says,

How can putting the same parts together in the same way in the same circumstances give you qualitatively different wholes? (Olson, 2007, 63)

Applied to biological individuals, the co-location solution says that biological individuals are entirely co-located with at least one other object. My cat, then, currently shares its matter with another object, which we can call ‘Co-Cat’. Suppose, then, that my cat eats some food and thereby gains some cells – the Cs. According to the co-location response, whilst my cat gains the Cs as parts, Co-Cat does not. Rather, after eating, Co-Cat and the Cs come to compose my

cat. Before eating, however, my cat and Co-Cat were physically indistinguishable. What, then, could account for them being qualitatively different? Given that the cat and Co-Cat are physically indistinguishable before eating, what accounts for the fact that my cat, but not Co-Cat, got bigger?

Proponents of co-location might argue that the qualitative difference between co-located objects is brute - there is no explanation for why materially coincident objects are qualitatively different (Olson, 2007, 63). Presumably there are some facts that are brute. The fact that electrons are negatively charged seems like a good example.

It doesn't seem to me, though, that facts about why objects gain or do not gain parts are good candidates for being brute. At any rate, this response does nothing to alleviate the worry that it just seems implausible that things that are made of exactly the same matter, arranged in exactly the same way could be qualitatively different (Olson, 2006, 408).

Notice also, that many philosophers will take it to follow from this solution that something could be physically indistinguishable from an organism without being an organism. As we saw in chapter 1 section 1.3, even those philosophers who believe that objects can be co-located do not think that objects of the same *kind* can be co-located. As such, anything co-located with an organism, such as Co-Cat, would not be an organism. Nonetheless, given that such a thing would be made of the same matter, arranged in the exact same way, as an organism, it would be physically indistinguishable from an organism. As such, such a thing would be physically just like an organism, but without being one.

Importantly, this would seem to imply that the usual solutions to the Problem of Biological Individuality are false. Consider the Evolutionary Approach, which takes an organism to be a unit of selection (for example, something that possesses mechanisms for participating in evolution by natural selection, such as an mechanisms for limiting genetic variation). If a cat possess such mechanisms, then presumably Co-cat does too (since Co-cat is made of the same matter, arranged in the same way as a cat). Co-cat, then, would count as a unit of selection. Co-cat, though, as we have said, is not an organism. As such, something could be a unit of selection without being an organism. The Evolutionary Approach, however, tells us that to be an organism is precisely to be a unit of selection. The Evolutionary Approach, then, would be false. By similar reasoning, the Physiological Approach would be false too – something could be a physiological whole without being an organism, implying that the Physiological Approach is false. Many philosophers of biology, then, would not find this solution attractive.

Funny Persistence Conditions

Rather than accepting co-location, we might respond to the paradox by holding that C does not exist before joining, but comes into existence after the joining has taken place. The idea is that in joining A and B, a new object, C, comes into existence, composed of the parts that A was composed of before joining, and which A comes to have as a part. Proponents of this solution would be committed to the following principle: ‘whenever any object gains a part, a new thing, composed of the object’s original parts, is thereby created’ (Olson, 2006, 406). According to this solution, whenever I gain a cell as a part, I manage to bring a new object into existence composed of all of my cells minus the new one. It seems that this object would be a good candidate for being an organism, or at least would very organism-like - it is just like me minus one measly cell. As such, the solution implies that every time I gain a new cell, I bring an organism, or organism-like being into existence. Presumably this organism would have the

same thoughts as me, given that we are like-for-like, except for one cell. The same would apply to all biological individuals whenever they gain a new part. This solution, then, would face the Too-Many-Thinkers Problem, discussed in the previous chapter.

If this is not problematic enough, it also implies that an organism, or an organism-like being can be brought into existence by virtue of activity that is independent of the activity of any of its parts – I can bring an entire organism or organism-like being into existence merely by gaining a new particle – a particle that is not even a part of the organism or organism-like being. The strangeness of this solution to the paradox is perhaps best appreciated by seeing how it responds to the Paradox of Decrease. Suppose that A is composed of B and C, and we make A smaller by removing B. According to this solution, this would result in C ceasing to exist, and A to become composed of its matter. This is surprising because it holds that we can make an object go out of existence by rearranging objects that were never parts of it (Olson, 2006, 406). This solution then, is not attractive.

Sparse Ontology

Finally, Olson argues that one can respond to the paradox by denying that when A gets bigger by B being joined to it, A comes to be composed of B and an object that is all of A minus B, which so far we have been calling C. Put differently, we can deny that after joining, there is such an object as C. Proponents of this view do not hold that B is A's only part, but rather that whilst there is no such thing as C, there are some smaller things which, if they were to compose something, would compose C. To see this, consider figure 4 below.

Before:



A

After:



A

(Olson, 2006, 404)

Figure 4

According to this solution, A, before joining, is composed of D, E and F. After joining, however, when A gains B as a part, A ceases to be composed of D, E and F, and these cease to compose anything at all. Rather, D E and F *and* B come to compose A.

As with the other solutions this solution is controversial. It is committed to the view that whenever something grows, the original parts cease to compose anything (Olson, 2006). Using Olson's example, suppose we build a model house, and decide later that we want to add a chimney to the top. We then do what is required to make it the case that the chimney is a part

of the house. According to this view, whilst before adding the chimney, there was something composed of the bricks minus the chimney, after attaching the chimney, there is nothing composed of those original bricks. Rather, there is only something composed of the original bricks and the chimney.

This solution, which Olson calls the Sparse Ontology solution, therefore faces a similar worry to the Funny Persistence Conditions view – it holds that we can cause some things, the xs, to cease composing something by altering objects that are neither the xs, or parts of the xs. For example, we can cause some bricks to cease composing something by joining them to a chimney. Why, however, should the joining of a chimney to some bricks, cause those bricks to stop composing something? Just as it is implausible to think that when something gains a new part, another object comes into existence, it might be thought that it is just as implausible to think that when something gains a new part, the original parts, which originally composed something, cease to compose something. In the next section, I will provide a reason for thinking that when something gains a part, the original parts cease to compose something, but as we will see, this reason is controversial and actually implies that many objects, including model houses, stones, and tables, do not exist at all. Some people, then, may not find this an attractive solution to the paradox.

In summary of this chapter so far, I have argued that answers to two debates in the metaphysics of material objects - how things persist, and whether objects can gain or lose parts - provide challenges to the existence of biological individuals, and that since process ontologists are committed to one of these answers – four dimensionalism - the Process View itself is arguably also in conflict with the existence of biological individuals. These answers, then, cause problems for debates about biological individuals in the philosophy of biology discussed in

chapters 1 -3, which assume the existence of biological individuals. I have made a number of assumptions. I assumed, for example, that the very idea of a biological individual is of something that is observable, has properties such as mass and shape and colour, can change with respect to these properties, and can change its parts. These assumptions seem plausible to me, but someone may dispute them.

In the next and final section of the chapter, I will, however, consider a metaphysical view that is, without a doubt, in conflict with the existence of biological individuals. The reasons for thinking that this view is in conflict with the existence of biological individuals does not require one to be committed to any assumptions that some may find controversial. Furthermore, this view is surprisingly hard to refute.

4.4. When Does Composition Occur?

The Paradox of Increase raises another question about material objects: if things can grow by gaining parts, under what conditions is something a part of a material object? We have seen that philosophers of biology have provided conditions under which something is a part of a biological individual, but what does it take for something to be a part of a material object more generally?

Metaphysicians have considered this question by focussing on a related question: under what conditions do smaller material objects add up to a bigger material object? Put more clearly, when do things *compose* another thing? Van Inwagen, who is primarily responsible for this question being so influential in metaphysics calls this the Special Composition Question (SCQ)

(Van Inwagen, 1990, 31).⁶⁴ Suppose I have many lego bricks. What has to happen for those many bricks in order for them to compose a further object which has them as parts, such as a lego house? Composition is usually understood in the following way:

The xs compose y =df each of the xs is a part of y, every part of y shares a part with one or more of the xs, and no two of the xs have a part in common (Van Inwagen, 1990, 22-23).

According to this definition, lego bricks compose a house because each brick is a part of the house, every part of the house shares a part with at least one the bricks and no two of the bricks have a part in common.

SCQ asks for a multigrade relation that holds among some things if they are to compose a bigger thing. In other words, it asks for a completion of the following schema:

($\exists y$ the xs compose y) if and only if...

Whilst the question is easy to grasp, it has proven incredibly difficult to answer. More importantly for our purposes, many of the usual answers are in tension with the existence of biological individuals, as we shall now see.

⁶⁴ Although, the question was raised earlier by asked Hestevolt (1981).

4.4.1. Physical Bonding

It might be thought that some things compose a larger thing when they are physically bonded in some way: to get the lego bricks to compose a larger thing, we need only to physically bond the bricks together. An answer to SCQ along these lines looks something like this:

$(\exists y \text{ the } xs \text{ compose } y)$ if and only if the x s are physically bonded

This physical bonding relation could be understood in a number of ways. Perhaps the relevant relation is as weak as physical contact – to get things to compose something, one need only bring them into contact with each other. Or perhaps the relation needs to be something stronger such as gluing, or bolting. Perhaps the right kind of bonding must be so strong, such that there must be no discernible boundary between the parts (Van Inwagen, 1990, 33-37 and 56-60).

A physical bonding answer might seem promising given that the parts of paradigmatic composites such as stones, tables and cars, are physically bonded. Unfortunately, on closer inspection, it is not very plausible, as van Inwagen shows (Van Inwagen, 1990, 56-60). Suppose we were to glue two human beings together. It seems implausible that in doing so a new object comes into existence with the two human beings as parts. It doesn't matter how strong the type of bonding is. Suppose that an evil surgeon was to amputate the hands of two human beings and fuse their stumps together such that there is no discernible boundary between them. Even still, it seems implausible that this would cause a new object to be brought into existence with the human beings as parts. (Van Inwagen, 1990, 59).

More importantly for our purposes, however, is that physical bonding answers are incompatible with the existence of biological individuals. This is because many of the parts of biological

individuals are liquids, and so cannot be physically bonded (Hoffman & Rosenkrantz, 1997, 99). As such, a physical bonding answer is of little help to the philosopher who wants biological individuals in their ontology.

4.4.2. Universalism

If not a physical bonding answer, what other answer should we adopt? One option is that whenever there are some (non-overlapping) material objects, there is something that they compose (Lewis, 1986, 211).⁶⁵ This view has been called Universalism (Van Inwagen, 1990, 75), and it is a core principle of classical mereology.⁶⁶ Whilst Universalism takes there to be all the usual ordinary objects such as cats and stones, it also takes there to be many unusual objects, such as something composed of the Eiffel Tower, my left shoe, and a single particle on the moon. This might seem counterintuitive, but its proponents say that we should not worry about this. They often say that in ordinary life, we simply don't notice these strange scattered objects (Lewis, 1986, 213; Markosian, 1998, 228).

Why accept Universalism? One reason is that it may seem arbitrary to believe that composition sometimes occurs, that it does not always occur – it might seem arbitrary to think that particles arranged table-wise compose something, for example, but that particles arranged table-wise plus particles arranged plate-wise do not (Hawthorne & Michael, 1996; Sidelle, 2002, 119). Universalism is also able to offer solutions to a number of complex metaphysical puzzles such as problems about vagueness (Lewis, 1986, 212; Sider, 1997, 216-219).

⁶⁵ Lewis's view is actually that for any things *whatsoever*, not just material objects, there is something that they compose (Lewis, 1986, 212fn9). He thinks, for example, that there is something composed of my cat and the number 2.

⁶⁶ Łeśniewski (1927) is often taken to be the founder of classical mereology.

Universalism, however, faces some problems. Van Inwagen raises the following objection. Suppose that Universalism is true, and that I am composed of particles at every time that I exist. Consider the particles that composed me ten years ago, which we can call the Ps. The Ps do not compose me now, given that they are radically scattered across the world, and I am not a scattered object. The Ps, however, according to Universalism, do compose something. Call the thing that they compose Q.

If Universalism is true, though, it is plausible that the Ps always compose the same object (Van Inwagen, 1990, 75). This is because according to Universalism, the arrangement of the Ps is irrelevant to them composing something. If, however, the arrangement of the Ps is irrelevant to them composing something, then it seems plausible that their arrangement is irrelevant to the *identity* of the thing that they compose. Suppose, for example, the xs which compose something start to move radically apart from each other. How long does the object that the xs compose continue to exist when this starts happening? Only two options seem available: 1) It ceases to exist immediately, 2) it exists as long as the xs exist. As van Inwagen says, any option between would be arbitrary:

If the [xs] “automatically” compose an object, then either rearrangement of the [xs] must destroy the object, or else no rearrangement could destroy it (Van Inwagen, 1990, 77).

The former option, however, seems implausible – it implies that any arrangement of an object results in it ceasing to exist (for example, that when I shed some of my skin cells, I cease to exist). Given this, it seems that if Universalism is true, then if some things compose another

thing, they compose it for as long as they exist, and hence (assuming co-location is impossible), they can only compose one thing for as long as they exist.

Given all of this, then if the Ps compose Q now, they also composed Q ten years ago. But, the Ps composed *me* ten years ago. Hence, ten years ago, I must have been Q, and accordingly, I must be Q now. But I cannot be Q now, because Q is a radically scattered object, and I have never been a radically scattered object. Universalism, then, is false.

Van Inwagen's argument also highlights that Universalism is committed to DMC, and hence, is in tension with the existence of biological individuals. It seems to be committed to DMC because if a thing's particles compose it for as long as it exists, which we have seen, Universalists ought to accept, then a thing can never gain or lose parts. Hence, if Universalism is true, then there are no biological individuals. Regardless of van Inwagen's argument, then, Universalism would not be good news for the believer in biological individuals.⁶⁷

Someone might try to resist the argument by arguing that the particles that compose me now composed me ten years ago. On this suggestion, the particles that compose me now, arranged human-organism-wise, have always composed me, although ten years ago, when they were radically scattered, I was a scattered object. This suggestion holds, then, that I spent most of my career as a radically scattered object, but at some point, for an instant, my particles came to be arranged organism-wise, before immediately dispersing again. The same goes for all other living things. We have already seen in section 4.3. however, that if our careers are like this, we are not biological individuals, and given that Universalism generalises about all material

⁶⁷ Olson (2020) actually argues that philosophers of biology involved in the Problem of Biological Individuality seem to be committed to Universalism. If this is true, then philosophers of biology themselves seem to be committed to a view that in tension with the existence of biological individuals. I will not, however, consider Olson's argument here.

objects, it implies that nothing can be a biological individual. If this response is true then, there are no biological individuals.

Another solution is to deny that material objects are composed of particles. It might be that instead, we are composed of *temporal parts* of particles (Olson, 2007, 231).⁶⁸ This might be a good solution, but as I have argued, an ontology of temporal parts is in conflict with the existence of biological individuals, so would be no use to the believer in biological individuals.

4.4.3. Nihilism

Whilst Universalism holds that composition always occurs, Nihilism holds that it never occurs. According to Nihilism, the only material objects are things without proper parts, often referred to as ‘simples’ (Van Inwagen, 1990). Some authors have held a version of Nihilism according to which the entire world is one simple (Horgan & Matjaž, 2000; Schaffer, 2007). Another version holds that the world contains many simples, some of which are visible-sized objects. Lowe, for example, argues that we are human-sized objects without parts (Lowe, 1996). Most Nihilists, however, believe that simples are elementary particles like quarks or electrons, or even fields (Brenner, 2018; Caves, 2018; Cornell, 2017; Sider, 2013; Van Inwagen, 1990). This latter understanding of Nihilism is how I will be understanding it in this chapter.

According to Nihilism since the only material objects are elementary particles, there are no material objects such as stones, book shelves and cars. Nihilism does not hold that these objects are somehow *less real* or are *less fundamental* than particles. It simply holds that they don't exist (Van Inwagen, 1990, 99). Importantly, Nihilism implies that there are no *biological*

⁶⁸ The majority of universalists, such as David Lewis, in fact accept an ontology of temporal parts.

individuals, given that if there were to be such things, they would be things with parts. Nihilists will argue, then, that debates about biological individuals rest on a mistake. If there are no composite objects, then we cannot count biological individuals, or even biological individual-like things such as temporal parts of biological individuals or biological individual-stages. Furthermore there are no biological individual processes or biological individual-like processes. If there are good reason for believing in Nihilism, then, this would provide a clear challenge to debates about biological individuals in the philosophy of biology.

Nihilism seems hard to believe – surely if we know anything, we know that there are ‘medium-sized’ objects with parts. For one thing, we exist, and we are presumably objects with parts. Nihilists, however, don’t deny that there is physical matter (particles), and they agree with non-Nihilists that this matter is often arranged in complex ways. They just deny that in addition to the particles arranged in such ways, there are additional things composed of them (Cornell, 2017, 78). Nihilists do not deny that there are particles arranged in such a way that if they were to compose something, they would compose a table – they don’t deny that there are particles arranged *table-wise*. Furthermore, they accept that these particles jointly perform all the activities that we ordinarily take tables to do (Van Inwagen, 1990, 118), such as supporting my laptop (or better, supporting particles arranged laptop-wise). They just deny that in addition to particles arranged table wise, there is a further object that they compose. More generally, nihilists claim that all explanations that we ordinary take composite objects to configure in, both in the sciences and in ordinary life, are actually performed jointly by many particles (Brenner, 2018; Rosen & Dorr, 2002), and that as such, a nihilistic world is indistinguishable from a non-nihilist one (Sider, 2013, 238). Even though we don’t exist, according to the Nihilist, all the activities that would be performed if we existed still get done; it is just that they get done jointly by lots of particles, which jointly think, jointly yawn, and so on (Rosen &

Dorr, 2002, 159). Consider biological individuals. Nihilists will argue that even though there are no biological individuals, there are nonetheless particles that are immunologically or metabolically related. Furthermore, they need not deny that natural selection occurs; those of them who believe in natural selection would say that natural selection should be understood as being performed not by biological individuals, but rather by particles jointly – particles jointly bear traits, and jointly pass on these traits to other particles arranged biological-individual-wise, and so on (Brenner, 2018, 674-675).

Nihilists, therefore, do not take belief in biological individuals to be mistaken in the way that a belief in dragons is mistaken (Olson, 2007, 183). Someone who thinks there is a dragon in my front room is deluded. Nihilists do not think, however, that those who take there to be cats are deluded. They say that those of us who take there to be biological individuals, and other objects at least get *something* right about the world whilst those who take dragons to exist do not. My belief that there is cat in front of me gets something right about the world because there are particles arranged ‘cat-wise’– particles arranged in such a way that if they were to compose something, they would compose a cat. On the other hand, there doesn’t seem to be anything about the world that could make it the case that someone who believes that there is a dragon in front of them gets something right about the world.

The comments above might go some way in making Nihilism seem less implausible than it first seems, but it does not provide much of a reason for accepting it. There are, however, a number of main reasons for why philosophers have been attracted by Nihilism. Here are a few:

Firstly, Nihilism offers a neat and easy solution to all the usual metaphysical problems about material objects: if there are no composite material objects, then there can be no puzzles about

them. Consider the Paradox of Increase. If there are no material objects, there is no mystery about how they can gain parts. Some philosophers have worried that if there are composite objects, then they would be causally redundant (Merricks, 2001), given that we can understand everything that they do in terms of their parts. This problem would be avoided by eliminating composite objects.

Secondly, others have been attracted to Nihilism because of its simplicity (Horgan & Matjaž, 2000; Sider, 2013). Sider argues that Nihilism is ideologically more parsimonious than theories that take there to be composite objects (Sider, 2013, 238). A theory's ideology consists of its undefined notions. Sider argues that Nihilism is ideologically simpler than its non-nihilistic theories of composition because it does not contain the undefined notion of parthood, and ideologically simpler theories are more likely to be true (Sider, 2013, 239). Sider does not provide much argument for thinking that ideologically simpler theories are more likely to be true, but there is at least something to this thought: if nihilism can provide just as good an explanatory story of the world as a non-nihilist then we might think that there is little need for the notion of parthood, or of positing the existence of composites, which would complicate our understand of the world unnecessarily. In other words, Occam's Razor provides a motivation for Nihilism, as this passage by Ross highlights:

The Razor insists that we not grant existence to redundant entities: If we can explain and predict the etiologies, causal capacities, and dispositions of a composite entity entirely by reference to the etiologies, capacities, and dispositions of its components, then, from the point of view of scientific generalization, the composite is, at best, an anthropomorphically centred artifact, something to which we refer only for the

purposes of descriptive economy, perhaps because of our peculiar epistemic limitations (Ross, 2000, 151).

Thirdly, similarly to Universalism, it might be thought that taking some composites to exist but not others is arbitrary, and hence, if we want to believe that there are some particles that do not compose something, then we better believe that particles never compose something.

Finally, it might be thought that all other answers to SCQ are problematic, leaving Nihilism as our best option.

Nihilism, then, which is incompatible with the existence of biological individuals, is not as implausible as it first seems, and has some philosophical virtues.

4.4.4. Organicism

Finally, another answer to SCQ is van Inwagen's own answer, which can be called Organicism.⁶⁹ According to Organicism, whilst composition sometimes occurs (unlike Nihilism), it does not always occur (unlike Universalism). For van Inwagen, things compose something if and only if *their activity constitutes a life* (Van Inwagen, 1990, 82). What is a life? This is not obvious, and is something I will consider in more detail in the next chapter, but van Inwagen says it is the task of biologists to answer this question (Van Inwagen, 1990, 84). As I briefly mentioned in chapter 2, however, van Inwagen takes a life to be a self-maintaining biological event that maintains an organism's structure (Olson, 2007, 226). Like a

⁶⁹ This should not be confused with the anti-reductionist philosophical movement that emerged in Britain during the early half of the twentieth century, also called Organicism. See for example, (D. J. Nicholson & Gawne, 2015).

tornado, it is constantly taking in matter, organising it into structure, and expelling matter that is no longer required.

According to van Inwagen the only material objects are particles (which have no parts), and biological individuals. Whilst like Nihilism, it denies that there are artefacts and macroscopic natural objects, it is, therefore, compatible with the existence of biological individuals. In fact, it is the only answer to SCQ that I have considered so far that is not in tension with the existence of biological individuals, and therefore, causes the least amount of trouble for debates about biological individuals in the philosophy of biology.

Organicism is one of the most promising answers to SCQ. Like, Nihilism, it can respond to a number of puzzles about material objects. For example, it provides motivation for adopting the sparse ontology solution to the Paradox of Increase: when something, call it A, grows by gaining parts, the original particles that composed A cease to compose anything because their activities no longer constitute a life. Rather, after the growing event, it is the original things *plus the additional particles* whose activity constitutes a life, and now compose A.

Organicism might be especially appealing for proponents of the Physiological Approach of Biological Individuality because it provides them with a solution to the Foetus Problem discussed in chapter 1. Recall that the problem is that the Physiological Approach seems to imply that organisms were never foetuses (or early foetuses), so it is a mystery what happens to foetuses when organisms comes into existence. If foetuses are not organisms, however, then presumably the activities of particles arranged foetus-wise do not constitute a life. As such, if Organicism and the Physiological Approach are true, then particles arranged foetus-wise do not compose anything, and hence, foetuses do not exist. If foetuses do not exist, however, then

there is no question about what happens to them when organisms come into existence, and so the Foetus Problem does not arise.

Whether this provides proponents of the Physiological Approach with an attractive response to the Foetus Problem is up for debate. I imagine that many people won't find it plausible to think that whilst adult and young organisms exist, foetuses do not. At any rate, this may be the best avenue for proponents of the Physiological Approach to take, albeit one that has metaphysical consequences that may be hard to believe.

What is the motivation for accepting Organicism over Nihilism? Why think that composition only occurs when things compose an organism? Isn't it arbitrary to take organisms but not other composite objects to exist?

Van Inwagen argues that Nihilism is false because unlike artefacts and non-living objects, we are forced to grant our own existence and the existence of all other organisms. The argument is a Cartesian one. Descartes famously argued that he can be certain that he exists because he has the thought 'I exist', and he could only have this thought if he exists – an evil demon might be able to deceive him about whether he is dreaming or awake, but they could not deceive him of his own existence.

It might be argued, though, that there could be an instance of the 'thought', I exist', without anyone thinking the thought. In particular, just as particles arranged table-wise might jointly support other things without composing anything, particles arranged human organism-wise might jointly think, without composing anything. Van Inwagen, though does not think that this could be the case. As he says,

It is my conviction that mental predicates (like ‘is in pain’, or ‘is thinking of Vienna’) require a subject. In the case of any particular episode of thought or sensation, there must be a thing, one thing, that is doing the thinking and feeling (Van Inwagen, 1990, 7)

Van Inwagen does not provide an argument for why thinking could not be a joint activity, but takes this to be obvious. Suppose though, that he is right. Why think that other non-thinking organisms such as plants or bacteria exist? Van Inwagen thinks that whilst thinking activity signals that we exist, and hence that some composites exist, it is not what unifies the parts of a composite into a whole – he thinks that we would continue to exist (our parts would continue to be unified) even if we ceased to be thinking things (Van Inwagen, 1990:120-121). Rather, he thinks that since we are organisms, what unifies our parts into a whole is our *biological lives*. Because of this, however, he thinks that it would be arbitrary to only take particles arranged human-wise to be unified into a composite, and not particles arranged other organism-wise, for example, cat-wise or plant-wise. So if I exist because the activity of my particles constitutes a life, then other organisms exist because the activity of their particles constitutes a life (Van Inwagen, 1990, 121). Hence, van Inwagen arrives at the conclusion that Nihilism is false because he thinks that we are forced to grant that organisms exist.

Whether this provides a good reason for accepting Organicism over Nihilism depends on whether thinking could be a joint activity. This isn't entirely clear, but I don't share van Inwagen's conviction that thinking could not be a joint activity. As such, I'm not convinced that van Inwagen has provided a strong argument for accepting Organicism over Nihilism.

Nonetheless, it might be thought that accepting Organicism over Nihilism, despite not having a strong argument for this, is the most reasonable thing for us to do. As Olson says,

You can't argue for everything. There are some things, surely, that it is reasonable to believe without an argument. And that we exist might be as good a candidate as any for being one of them (Olson, 2007, 193).

One could be unconvinced by van Inwagen's view that thinking could not be a cooperative activity, but still find it impossible to deny their existence. As Olson says, the belief that we do not exist may even result in madness (Olson, 2007, 208-209). In particular, it might lead us to think that there are never any reasons to act or do anything. This is because usually we act in order to benefit *someone*, or to satisfy someone's desires. If Nihilism is true, however, then there aren't any people, including ourselves, and so there would be no reasons to act or do anything. It certainly seems plausible, though, that madness would result if we thought that there was never any reason to do anything.

This is not, however, a knockdown argument against Nihilism. Someone might argue for example, that collectively benefiting particles arranged person-wise provides reasons for acting. Furthermore, it might be that the correct answer to SCQ is one that would unfortunately lead to madness (Olson, 2007, 210).

In summary then, Organicism is in many ways an attractive answer to SCQ. It provides solutions to metaphysical puzzles including the Foetus Problem, it is compatible with our existence, and takes there to be biological individuals. There is, however, no knockdown argument for accepting Organicism over Nihilism, and we have seen that Nihilism has many

theoretical virtues. Nihilism, therefore, is surprisingly hard to dismiss, provides a serious challenge to the existence of biological individuals, and would cause problems for debates about biological individuality as they are currently understood.⁷⁰

4.5. Conclusion

We have seen that the view that there are no biological individuals is not absurd, but seems to follow from some serious views in metaphysics about material objects. One of these views – an ontology of temporal parts – is even accepted by some philosophers of biology. As such, there are some serious metaphysical views which cause problems for debates about biological individuals in the philosophy of biology such as those discussed in chapters 1-3. Some of these metaphysical views, in particular, Nihilism, are surprisingly hard to refute.

My intention in this chapter, however, was not ultimately to argue that there are no biological individuals. Rather, it was to demonstrate that debates about material objects in metaphysics are relevant to debates about biological individuals in the philosophy of biology. In particular, I hope to have demonstrated that answers to debates about biological individuals, as those answers and debates are currently understood, are dependent on the answers to more general metaphysical questions about the nature of material objects – questions which by no means have obvious answers.

⁷⁰ I have not considered every answer to SCQ in the literature. Some other notable answers are those by Markosian (1998), Pearce (2017) and what van Inwagen called a ‘series-style’ answer (1990, ch.7).

Chapter 5. When Do Things Compose Biological Individuals? Biological Individuality and the Special Composition Question

5.1. Introduction

The previous chapter considered whether there are biological individuals. This led to a discussion of the Special Composition Question, which asks: under what conditions do (material) things compose something? As we saw, providing a positive answer to the question is not easy. In particular, it is difficult to refute Nihilism, which holds that composition never occurs. Nihilism, however, is hard to believe, particularly because it suggests that we do not exist. In this respect, van Inwagen's answer to SCQ - Organicism - is more attractive. Like Nihilism, we saw that it provides solutions to metaphysical puzzles about material objects such as the Paradox of Increase. Furthermore, it provides philosophers of biology with a solution to the Foetus Problem. For these reasons, I take Organicism to be one of the best answers to SCQ for metaphysicians and philosophers of biology alike.

Despite this, Organicism has not been particularly popular. A tempting charge against it is that it is in conflict with our ordinary beliefs about material objects because it denies the existence of inanimate composite objects. I don't find this objection persuasive.⁷¹ Van Inwagen spends a good deal of time arguing that Organicism is compatible with our ordinary beliefs about the

⁷¹ Although not everyone agrees. See, for example Tye (1992), Korman (2009) Hirsch (1993) and Hawthorne and Michael (1996).

world (Van Inwagen, 1990, ch10). I don't have the space here to explain his argument here, but we saw some of it in the previous chapter. For example, even though there are no stones or cars, there are still particles arranged stone-wise and cat-wise which jointly do all the same things that stones and cars would do if they existed.

This chapter is concerned with two other criticisms of Organicism: 1) Organicism is too vague to provide an illuminating answer to SCQ and 2) van Inwagen's claim that lives are well-individuated events is false.

I will argue that turning to the philosophy of biology allows Organicists to respond to these criticisms. More specifically, solutions to the Problem of Biological Individuality provide Organicists with the resources for providing a clear and informative answer to SCQ which takes lives to be well-individuated.⁷²

There are, however, two important consequences of my argument for Organicism. Firstly, by turning to the Problem of Biological Individuality, we will end up with a version of Organicism which differs in some important respects from van Inwagen's original version. Secondly, turning to the philosophy of biology shows that Organicism faces a problem analogous to the Problem of Biological Individuality. It is not obvious how to respond to the problem, but I will present the options, and considerations in favour of each. The overall aim of this chapter is to demonstrate that the philosophy of biology is relevant to more general metaphysical debates about material objects.

⁷² My argumentative strategy has some similarities with one provided by Adam Ferner, who argues that the philosophy of biology can help flesh out Wiggins' Principle of Activity' (Ferner, 2016, ch6).

5.2. Organicism Again

As we saw in the previous chapter, van Inwagen holds that things compose something iff their activity constitutes a life. I have so far, however, said very little about what this means. In this section, I will say a bit more. There are three important aspects.

5.2.1. Lives are homeodynamic events

A life, according to van Inwagen, is an *event* that takes place exactly where an organism is, and goes on for as long as the organism remains alive.⁷³ Despite this, he does not think that an organism is identical to its life.⁷⁴ Rather, it is something that the organism does, or performs.

Van Inwagen does not have too much to say about the ontology of events, and is even open to the possibility that there, strictly speaking, are no events.⁷⁵ As he says,

If a philosopher wishes to maintain that sentences apparently about events are misleading expressions of facts that in reality only involve substances or continuants, I will not protest. I will simply ask him to understand those of my sentences that are apparently about events in the same way that he understands any other sentences that are apparently about events (Van Inwagen, 1990, 82).

Furthermore, he does not attempt to provide an account of what it means for the activity of things to constitute an event, leaving this ‘at the more or less intuitive level’. Rather, he

⁷³ I imagine that not all readers will find it immediately obvious that a life is an event.

⁷⁴ This might be something that separates the process view of organisms from the substance view – contrary to van Inwagen, process ontologists might say that the organism *just is* its life. This is what Meincke believes (2020, 266).

⁷⁵ In fact, in a later paper, van Inwagen explicitly favours the view that there are no events but only individuals and relations (Van Inwagen, 2007, 203).

provides examples which go some way to demonstrate the idea: the activity of the cattle constitutes the stampede, the activity of the cavalry constitutes the parade, and the activity of the water molecules constitutes the cooling of the water (Van Inwagen, 1990, 82).

Not any event, though, counts as a life, according to van Inwagen. A life, he says, is a *homeodynamic* or *self-maintaining* event – one that is constantly sucking in matter, incorporating it into an organism’s structure, and expelling matter that the organism no longer requires. Van Inwagen tries to help us understand the idea by asking us to imagine a god-like being who is able to directly observe atoms, and who describes their experience in coming across an organism:

What I am observing is an unimaginably complex self-maintaining storm of atoms. This storm moves across the surface of the world, drawing swirls and clots of atoms into it and expelling others, always maintaining its overall structure. One might call it a homeodynamic event (Van Inwagen, 1990, 87).

Van Inwagen thinks that things compose something when they interact in this way – when their activity constitutes a homeodynamic event. Furthermore, he thinks that something is a part of an organism when it is caught up in such a homeodynamic event. Using van Inwagen’s phrase, he says that something is a part of an organism when it is *caught up* in its life (Van Inwagen, 1990, 94-95). Suppose that I eat a sugary snack containing a carbon atom. The carbon atom will travel to one of my muscles, break down, and provide energy for muscle contraction before being expelled. Van Inwagen says that in this brief amount of time, the carbon atom is caught up in my life, briefly becoming a part of me (Van Inwagen, 1990, 94-95).

5.2.2. Lives are Reasonably Well-Individuated Events

Not all self-maintaining events, however, counts as lives. A flame is arguably a self-maintaining event, but unlike flames, lives, according to van Inwagen, are reasonably *well-individuated* events (Van Inwagen, 1990, 87). By this, he means that, unlike flames, there is usually a reasonably clear answer to the question of whether a life going on at one time and place is the same life as one going on at another time or place, or whether in a region, one life is occurring or many (or none). Consider the question of whether the flame of the careless smoker's match is the very same flame that caused the forest fire or, whether using a candle to light five other candles causes the flame to become a scattered object, or rather, causes five new flames to come into existence. Van Inwagen says that '[p]resumably, there are no answers to these questions' (Van Inwagen, 1990, 88).

It is important for van Inwagen that lives are reasonably well-individuated because if they were not, his answer to SCQ would be unilluminating or unhelpful. Using van Inwagen's phrase, if lives were not well individuated, his answer to SCQ would provide 'an explanation of the obscure through the no less obscure' (Van Inwagen, 1990, 87). If lives were like flames, then there would be no answers to questions about whether the activities of some particles constitute one life or many, or none at all, and therefore, whether some particles compose something (or how many things they compose).

5.2.3. Lives are Jealous Events

Finally, van Inwagen says that lives are *jealous events*. By this, he means that there are no circumstances where the activity of some things constitutes more than one life at the same time. Consider waves. Whilst these are reasonably well-individuated events, unlike lives, they are

not jealous because it seems possible that the activity of the very same particles could constitute two waves simultaneously, if, for example, two waves were to briefly pass through each other (Van Inwagen, 1990, 88-89).

Van Inwagen does think, however, that there are special circumstances where some things can be caught up in more than one life simultaneously (in other words, there are circumstances where lives overlap). Specifically, he thinks that there are circumstances where 1) the activities of some things, the xs, constitute a life, 2) the activity of some other things, the ys constitute a life, 3) the xs are not identical to the ys, yet 4) there are some things, the zs, that are among the xs and among the ys.⁷⁶ What are these circumstances? He says that this happens when one of the lives is *subordinate* to the other – when one life is regulated and coordinated, or ‘takes orders’, from the other. He takes an example to be the cells of a multicellular organism, which he says have their own lives, but whose lives are subordinate to the life of the organism they are part of. In this instance, the activity of particles arranged cell-wise constitutes the life of a cell, but they are also among some other things (particles arranged human organism-wise) whose activity constitutes the life of a human organism (Van Inwagen, 1990, 88-89).

Summarising, then, according to Organicism, material things compose something when their activity constitutes a biological self-maintaining, well-individuated, and jealous event, and something is a part of another thing when it is caught up in such an event. I will now turn to the two criticisms of Organicism.

5.3. Criticism 1: Organicism is vague

⁷⁶ z is among the xs and the ys =df z is one of the xs and z is also one of the ys (Van Inwagen, 1990, 27).

One criticism that some philosophers have raised about Organicism is that it is too obscure or unclear to be an adequate answer to SCQ. Hoffman and Rosenkrantz write,

Van Inwagen's conception of a life as a process is rather obscure...Van Inwagen's notion of a life stands in need of analysis, but he does not provide such an analysis: rather, he speculates that biologists will someday provide a more adequate explanation of the relevant conception of life. Nevertheless, until they do, it is difficult to fathom how our understanding of the concept of composition can be enhanced by appealing to a notion of life that is so incompletely understood. Thus, it seems that (C1*) [Organicism] lacks the explanatory power required for a satisfactory principle of composition (Hoffman & Rosenkrantz, 1997, 183).

Similarly, Jay Rosenberg complains,

I don't have an adequate grip on van Inwagen's notion of a life....van Inwagen suggests that one can count and identify composite things (that is, cells or organisms) by independently counting and identifying such lives. But that is something I have no idea how to do (Rosenberg, 1993, 707).

For a final example, Jack Wilson says,

Locke and van Inwagen are in good philosophical company when they treat the concept of a life as an intuitively clear idea that can be used to explain other more difficult concepts, such as identity through time or issues in mereology. But they have not provided a comprehensive description of living individuality. Assuming that we could

articulate necessary and sufficient conditions for being alive (and no one has), we still do not know whether a particular mass of living tissue is a living being. It may be, but it could also be several living things or a part of a more comprehensive life (Wilson, 1999, 4).

The complaint is that it isn't clear how to understand van Inwagen's notion of a life, and as a result, it doesn't provide a very illuminating account of when composition occurs (or how to count and distinguish organisms). Using van Inwagen's own phrase, it might be said that the worry is that Organicism provides an explanation of the obscure through the no less obscure.

Van Inwagen is aware that his notion of a life is somewhat vague, but he does not think it is the philosopher's job to make it any more precise. Rather, he thinks this is the biologist's job (Van Inwagen, 1990, 84). Will biologists, however, ever have an adequate understanding of what lives are? Some philosophers, at least, doubt that biologists will ever have a good definition or theory of *life* (Cleland, 2012; Cleland & Chyba, 2002). These philosophers are talking about the phenomenon of life in general as opposed to the life of a particular organism, but I think what they say applies to the lives of organisms as well. One worry is that life on earth represents a single example, reflecting particular chemical and physical properties that may not be representative of how life could have been on earth, or, how it might be on other planets. As Cleland says,

There are compelling scientific reasons for thinking that life as we know it on Earth today represents a single, potentially unrepresentative, example of life (Cleland, 2012, 129).

Our experience with life is limited to a single example that we have good scientific reasons for believing could have been at least modestly different (Cleland, 2012, 131).

Molecular biology, for example, has shown that all living things on earth are descended from a common ancestor, and hence, life on earth could have been, or non-earthly life may be different from how life actually is on earth (Cleland, 2012, 129). Cleland points out that all earthly life use a triplet coding scheme to store information on nucleic acids. On earth, the same triplet base always codes for the same amino acid. There is little reason, though, Cleland argues, to think that life couldn't have mapped the triplet bases to different amino acids, or used a different number of bases (Cleland, 2012, 131).

Similarly, just as it might be thought that we will never have a good account of the phenomenon of life, it might be argued, for similar reasons, that we will never have a good account of the lives of organisms, because the lives that we encounter are only representative of particular lives, namely, *earthly lives* as they actually are. Perhaps, however, lives on earth could have been very different from how they actually are (for example, if evolution worked differently), or perhaps there are lives on other planets that are very different from earthly lives. If this is true, then there is a danger that our theories of lives, which focus on earthly examples, will miss out important features of lives.

5.4. Criticism 2: Lives are Not Well-individuated

Organicists might argue, however, that even though it isn't entirely clear what a life is, and even though we may never have a good account of what a life is, this is not really a problem for metaphysicians, given that we have a *good enough* understanding of lives that is sufficient

for metaphysicians pursuing their interests (such as providing an answer to SCQ and providing solutions to metaphysical puzzles such as the Paradox of Increase). Metaphysicians, it might be argued, do not need to be concerned with the technical scientific details about lives. All that is required for the interests of metaphysicians is that lives are *reasonably well-individuated*; that we have a reasonably good understanding of when the activity of some particles can be said to constitute a life, and how to distinguish lives from each other. We do not have to know exactly what lives are to know when they occur, or how many are occurring. For example, whilst we may never know all the biological details about lives, we can all be reasonably sure about how many lives there are in a room containing just me and my cat (excluding the lives of our cells or microbes on surfaces and so on). Furthermore, there are no difficulties determining whether something is caught up in my life or the life of my cat - my cat's tail is clearly not caught up in my life!

Some philosophers of biology, however, have argued that real biological examples show that lives are not reasonably well-individuated (Meincke, 2020, 261). Consider my cat. She is host to a vast number of microbes, many of which are important for her biological activity such as her metabolism and immune system. As we have seen, some philosophers have taken this to show that despite hosts and their symbiotic microbes being genetically different, microbes are *parts* of their host organisms (Booth, 2014, 661; Pradeu, 2010, 261). Others argue that the host and its symbiotic microbes compose a further organism which has the host and microbes as parts. These objects are sometimes referred to as 'holobionts' (Booth, 2014; Gilbert, Sapp, & Tauber, 2012; Margulis, 1991; Roughgarden, Gilbert, Rosenberg, Zilber-Rosenberg, & Lloyd, 2018). What, then, is the correct thing to say about individuating lives with respect to my cat and its microbes? There are a number of options:

1. The cat and its microbes have their own lives, and are not caught up in another life (such as the life of a holobiont).
2. The cat and its microbes have their own lives, and their activity constitutes the life of another organism (such as a holobiont).
3. The cat and its microbes do not have lives (and so do not strictly speaking exist; recall that for van Inwagen, the only composites are those things with lives) but their activity (more precisely, the activity of particles arranged cat-wise plus particles arranged microbe-wise) constitutes the life of an organism.
4. The microbes are caught up in the life of the cat, but have their own lives.
5. The microbes are caught up in the life of the cat, but do not have their own lives (so don't strictly speaking exist).

The problem is that it is not obvious which of these options is right. If each option seems equally good, however, then we might wonder whether there could possibly be a right answer, and as such, whether the lives of cats and their microbes are well individuated. Cats, though, are not the only organisms that are hosts to microbes. In fact, all multicellular organisms are involved in symbiotic interactions with microbes (Dupré & O'Malley, 2009). It is equally not clear whether microbes are caught up in the lives of human beings (or hippos, cows, horses etc), or whether a human being and its microbes have their own entirely distinct lives, or even whether the activity of a human being and its microbes constitutes the life of another organism (a human-microbe holobiont). The worry, then, is that it is not clear whether the lives of *all* multicellular organisms and microbes actually are in fact reasonably well-individuated.

Next, consider colonies such as Portuguese man of wars and coral reefs. Whilst they resemble organisms, as we saw in chapter 1, some biologists have suggested that perhaps the individual

polyps that make them up are also organisms. How, then, should we count lives when it comes to colonies? Again, there are a number of options:

1. The individual polyps each have a life, and their activity does not constitute the life of a further object – a coral reef or Portuguese man of war. According to this option, coral reefs and Portuguese man of wars do not exist, or put differently, ‘coral reef’ and ‘Portuguese man of war’ do not refer to an object but to lots of objects (polyps) jointly.
2. The individual polyps do not each have a life, but their activity constitutes the life of the colony. If this option is true, then polyps strictly speaking do not exist (there are only particles arranged polyp-wise).
3. The individual polyps each have a life, but their activity also constitutes the life of a colony. By this option, both the polyps and the colony that the polyps compose exist.

The point is that it isn't clear whether in the region that we refer to as ‘coral reef’, or ‘Portuguese man of war’, there is only one life that spans the entire region, or only lots of smaller lives throughout the region, or both. Furthermore, we might wonder whether any principled improvement on the notion of life could make things any clearer.

Colonies also raise questions about whether lives are well-individuated over time. Consider slime molds. These are single celled eukaryotes that spend most of their existence spatially disconnected from each other, and I, believe, often have different genomes. When food becomes scarce, however, they can merge together to form a slug shape that can coordinate its movements, and which can also disperse again, going their separate ways. Suppose that

merging results in the activity of the bacteria constituting a life, and hence, composing a slug-like organism. Now consider some bacteria that form a slug at time t_1 , disperse, at t_2 and then form a slug again at t_3 . Should we say that the life of the slug existing at t_1 before dispersing is the same life as the slug existing at t_3 ? Furthermore, when the slug existing at t_1 disperses, does its life cease to exist, or does it continue to exist at t_2 , but as a scattered event?

Thirdly, consider eusocial insects such as termites and bees. Some researchers have argued that there are reasons for taking the colonies that they form to be organisms, sometimes referred to as 'super organisms', with the individual insects as parts (Wheeler, 1911). Some reasons for thinking this include the fact that there is reproductive and immunological activity at the level of the entire colony (Cremer, Armitage, & Schmid-Hempel, 2007; Pradeu, 2012, 250; Wheeler, 1911). Do the activities of the insects, such as bees, constitute the life of the colony or a hive, and if they do, do they also have their own lives (Meincke, 2020, 262)? Van Inwagen does say that he does not think this is the case. This is because he thinks that

[t]he haphazard and intermittently operative web of causation that binds together a hive of bees is not tight enough to make an organism of the hive (Van Inwagen, 1990, 150).

I don't think, however, that this is so obvious, given the organism-like properties had by the hive, and also because of the obscurity of the notion of a life.

Finally, consider the relationship between a pregnant mother and its foetus. How many lives are involved in this relationship, and what is the relationship between these lives? (Meincke, 2020, 262-263). Is a foetus caught up in its mother's life? If the answer is yes, does it also have its own life? Whilst a foetus has its own blood supply, metabolic activity and a premature

immune system, is this enough to establish that it has its own life? Alternatively, perhaps the activity of the mother and its foetus constitute the life of a third organism, which we might call a 'mother-foetus'. Evidence for the latter may be the phenomenon of *foeto-maternal chimerism*, where not only have maternal cells and other material been found to migrate across the placenta from the mother to the foetus (such as immune cells, oxygen and nutrients), but foetal cells have also been found to traverse across the foetal side of the placenta and enter the mother. Particularly interesting is the fact that foetal cells have been found around the sites of damaged maternal tissue, which may suggest that they play a role in maternal cell renewal and tissue repair (Pradeu, 2012, 115-116). Does this suggest that a foetus and its mother compose a single biological unit? Again, it isn't clear what to say here.

The worry here then, is that there are real biological examples which may suggest that lives are no better individuated than flames. Just as there are no answers to questions about how to count and distinguish flames at a time and over time, it might be argued that these real biological examples show that there are no answers about how to count and distinguish lives at a time and over time (or better, that these examples show that there are many different answers to questions about counting and distinguishing lives and it is impossible to say which the right answer is).

In summary, there are two criticisms of Organism. Firstly, the notion of a life is not clear, and secondly, there are reasons for thinking that lives are not well-individuated. If these criticisms are right, then Organicism explains the obscure through the no less obscure.

5.5. Brain Activity?

In response to these worries, van Inwagen might argue that it is easier to count and distinguish lives than these biological examples suggest. In particular, he argues that the lives of many organisms are often primarily regulated and coordinated by their *brain activity* (of course, van Inwagen does not take there to be brains because they are not organisms. It would be more accurate to say that the lives of these organisms are coordinated by the joint activity of *particles arranged brain-wise*). For van Inwagen, the brain is the control centre or organ of maintenance for many organisms, regulating and coordinating their biological processes with ‘a constant supply of instructions in the form of electrically transmitted information’ (Van Inwagen, 1990, 178). Van Inwagen does not discuss organisms without brains, but perhaps he thinks that these organisms have an alternative organ of maintenance.⁷⁷ It may be thought, for example, that the organ of maintenance for single-celled organisms is their nucleus (Hoffman & Rosenkrantz, 1997, 126).

To sharpen his notion of a life, then, van Inwagen might say that lives are homeodynamic events *whose activity is primarily regulated and coordinated by an organ of maintenance*.⁷⁸ With this clarification, it may be argued that lives are reasonably well-individuated. One might argue, for example, that my gut bacteria and I have entirely distinct lives because whilst the bacteria are involved in a number of my biological processes, their activity is not regulated and coordinated by my brain activity. The same may be said to be true of a foetus inside a pregnant maternal organism (although this is not so clear). Furthermore, one might argue that since bees have an organ of maintenance, but there seems to be no organ of maintenance had by the entire

⁷⁷ Hoffman and Rosenkrantz argue that each organism has a ‘master part’ which regulates and coordinates its living activity, and that this need not be the brain or nervous system (1997, 126).

⁷⁸ I am assuming here that lives can only have their activity regulated by one organ of maintenance.

hive, whilst individual bees have a life, the hive does not, and so the activity of the bees do not constitute the life of the hive. As such, the bees in a hive do not compose something.

One problem with this response is that it is not clear that organisms must have their activity regulated and coordinated by an organ of maintenance. Alan Shewmon has argued that the vital somatic functions of life, or more specifically, the vital function of human life such as respiration, nutrition, homeostasis, wound healing, and fighting off infections, can continue to be coordinated and regulated even in the absence of brain activity (Shewmon, 2001, 467). If this is right, then this may suggest that something can be caught up in an animal's life without having its activity regulated by brain activity, and hence, that the organ of maintenance for animals is not their brain. But if the organ of maintenance for animals is not the brain, then what else could it be? One conclusion that might be drawn from Shewmon's findings is that animals simply do not have an organ of maintenance, and so something can have a life without having an organ of maintenance (or put differently, these findings might suggest that the activity of things can constitute a life without their activity being coordinated and regulated by an organ of maintenance). If this is true, then we are no closer to providing answers to the difficult biological examples above. We could not say, for example, that the activity of the bees does not constitute the life of the hive because the hive does not have an organ of maintenance – if organisms do not require an organ of maintenance, then perhaps the hive has a life despite lacking an organ of maintenance.

5.6. Organicism and Metaphysical Puzzles

Here is another reason to be critical of van Inwagen's answer to SCQ, which follows if his critics are right that van Inwagen's notion of a life is obscure, and that lives are not well-individuated events.

Van Inwagen argues that his answer to SCQ suggests answers to a number of metaphysical puzzles about organisms. I will consider two of these puzzles. The first is to do with the persistence of human beings. Suppose that your head is removed from the rest of you, which we can call your 'body', and hooked up to a life support machine that allows all of the functions of your head to continue as normal. Suppose also that your body is hooked up to a computer which allows all of your body's biological functions to continue. Whilst such an operation is not possible at the moment given our current scientific knowledge and capabilities, it seems metaphysically possible. What happens to you in this scenario? There seem to be four options:

1. You cease to exist.
2. You continue to exist as a scattered object.
3. You continue to exist as the body.
4. You continue to exist as the severed head.

Van Inwagen goes for option 4. This is because he thinks the scenario would be (metaphysically) no different from your finger being cut off (more precisely for van Inwagen, particles arranged finger-wise – fingers are not organisms so do not exist according to van Inwagen). If your finger was cut off, you wouldn't cease to exist or become a scattered object. Rather, you would just get smaller, losing the finger as a part. Similarly, according to van Inwagen, if your head was severed, you would lose your body as a part, and be reduced to the

size of your head. More precisely, you would lose particles arranged body-wise as parts (Van Inwagen, 1990, 170). This follows from van Inwagen's view that an organism's life is coordinated by its brain activity. As he says,

Give the severed head the proper environment and it will maintain itself, but the headless body will need a constant supply of "instructions" in the form of electrically transmitted information. Unlike the head, it will not be able to coordinate its activities. A life-support machine for the head will be no more than an elaborate pump. A mechanical life-support machine for the headless body must involve the functional equivalent of a computer (Van Inwagen, 1990, 178).

In short, the [headless body] maintained by a life-support system is a virtual object the activities of the virtual parts of which must be coordinated by an external agency or *cybernetes*. The living severed head, however, is capable of holding itself together (Van Inwagen, 1990, 179).

Van Inwagen thinks that after the operation, you are reduced to the size of a severed head because your life is preserved and occurs in the region where the severed head is, being regulated and coordinated by brain activity. On the other hand, the body is unable to regulate and coordinate its living activities, relying on a complex computer to carry out its biological activities. The body, then, unlike the severed head, does not have a life and does not exist – there are only particles arranged body-wise.

The second puzzle is to do with zygote splitting. Van Inwagen considers the question of when we came into existence, in particular, the question of whether we were once zygotes. He argues

that his answer to SCQ strongly suggests that we were never zygotes because when a zygote, A, first splits into two genetically identical cells, B and C, B and C are not appropriately related to compose anything. He writes,

Why should we believe that there is something that B and C compose? They adhere to each other, but we have seen that that is no reason to suppose that two objects compose anything. The zygote was a single unified organism, the vast assemblage of metabolic processes that were its life having been directed by the activity of nucleic acid in its nucleus. No such statement can be made of the two-cell embryo. No event, I should say, is its life. The space it occupies is merely an arena in which two lives, hardly interacting, take place. Therefore, given our answer to the Special Composition Question, it does not exist. Or, better, the simples that compose B and the simples that compose C do not jointly compose anything. Moreover, B and C do not compose anything (Van Inwagen, 1990, 153).

Van Inwagen thinks that when a zygote splits, it ceases to exist and is replaced by two identical cells. Assuming, then, that nothing that ceases to exist can come back into existence, and that we exist now, we could never have been zygotes. Nor does he think that we were ever gastrulas - embryos around the third week of pregnancy. As he says, , '[i]ts growth is the sum of the uncoordinated growth and fission of its component cells' (Van Inwagen, 1990,157). According to van Inwagen, then, gastrulas do not exist, and so we came into existence no earlier than three weeks after conception.

What should we make of van Inwagen's responses to these puzzles? Well if the two criticisms raised against Organicism above are good, then it seems we should be sceptical about his responses. This is for two reasons. Firstly, without it being clear what the notion of life is, it is

not obvious whether his answers to these solutions are correct. Jay Rosenberg raises this worry. He writes,

Van Inwagen in fact devotes a good bit of his book to some ingenious proposals for dealing with puzzles regarding the unity of organisms and their persistence through time. Despite his Herculean efforts, however, I remain unclear about the cogency of van Inwagen's treatment of them. The reason for my hesitancy is that I don't have an adequate grip on van Inwagen's notion of *a life* (Rosenberg, 1993, 707).

Consider, the severed head scenario. We have already seen that there are empirical reasons for doubting that the living activity of organisms such as human beings is coordinated and regulated by brain activity (given that the vital somatic activity of an organism can continue even after brain death). If this is true, then it is not obvious that van Inwagen is right to say that after the operation, we survive as the severed head – his notion of life is not clear enough or detailed enough for him to argue for this claim. Perhaps instead we survive as the headless body, or don't survive at all. Consider the latter option. Firstly, it could be that the decapitation is actually a case of fission, such that we are left with two organisms; the severed head, and the headless body (Hershenov, 2002, 509). Given that each would be equally good candidates for being me, and it would be arbitrary to say that I am either one of them, it seems we ought to say that that after the operation, we cease to exist. Alternatively, perhaps after the decapitation, we are left with no organisms at all. Either way, the operation would cause me to cease to exist..

If the living activity of human organisms is not regulated and coordinated by brain activity, which, as we have seen, empirical research suggests, then without van Inwagen's notion of a life being clearer, it is far from obvious that we survive as the severed head as van Inwagen

thinks, rather than surviving as the headless body, or not surviving at all. Van Inwagen's notion of a life does not suggest that any of these answers is any better than any other.

Now consider van Inwagen's claim that we were never gastrulas because the activity of cells arranged gastrula-wise do not constitute a life. Without having a better grasp of his notion of life, it's is not clear whether this claim is right. As Meincke points out, there is at least some reason to think that the activity of the cells of the gastrula is coordinated and regulated in some sense – these cells are not entirely causally isolated from each other, and the way that they develop is conditional on the activity of their neighbouring cells (Meincke, 2020, 256).

Van Inwagen might respond that even though the activity of the cells is coordinated in some minimal way, their activity does not count as life-constituting activity. Without it being clear what activity counts as life-constituting activity, however, it is not clear whether van Inwagen would be justified in making this response.

The above worry stems from van Inwagen's notion of a life being unclear. There is, however, a more fundamental worry with van Inwagen's response to these puzzles. Suppose that the second criticism above is right that lives are not reasonably well-individuated. Then it seems reasonable to think that there are no answers to these metaphysical puzzles, just as there is no answer to the question of when the flame of my candle came into existence. Or at least, it would be reasonable to think that there are a number of putative solutions to these metaphysical puzzles, but none is any better than any other.

5.7. A Biologically-Informed Organicism

I have considered two criticisms of Organicism. I think, however, that the philosophy of biology can provide Organicism with the resources to respond to these worries. Whilst there is little discussion in the philosophy of biology about the notion of a life, we have seen that there is plenty of discussion in the philosophy of biology about when something counts as a biological individual. In this section, I will argue that the two main solutions to the Problem of Biological Individuality – the Physiological Approach and the Evolutionary Approach – provide two biologically-informed interpretations of Organicism which are clear and which take lives to be reasonably well-individuated, thereby allowing Organicists to respond to the two criticisms presented in this chapter.

5.7.1. An Immunological Understanding of Organicism

As we saw in chapter 1, the Physiological Approach says that something counts as a biological individual if it is a functionally integrated or coordinated whole. One of the clearest versions of this, which I will focus on, is the immunological account defended by Pradeu, which holds that a biological individual is something whose parts are *immunologically-related* (their parts are connected by strong biochemical interactions and undergo medium intensity immune interactions; see chapter 1 section 1.2 for the details). Furthermore, it holds that something is a part of an organism if and only if it is immunologically related to other parts of the organism – if it interacts with other parts of the organism with strong biochemical interactions and medium intensity immune interactions.

Even though the immunological account of biological individuality and Organicism are answers to different questions, it strikes me that they are similar with respect to how they

understand the nature of organisms. Van Inwagen, recall, says that a life is not identical to an organism, but is a special sort of activity that unifies an organism's parts. Similarly, according to Pradeu,

[T]he immune system is not the same thing as the organism, but it is a subsystem of the organism whose activity leads to the distinction between what is a part of an organism and what is not (Pradeu, 2012, 240).

The immune system also plays a number of roles that van Inwagen takes lives to play. The immune system, for example, does not simply offer protection to the organism but is also involved in a large number of biological processes including tissue repair, the clearing of debris, the workings of the metabolism, thermogenesis and the functioning of the nervous system. In arthropods and amphibians, the immune system even plays a role in the growing of new limbs (Pradeu, 2019, 9-10).

Immunological activity, therefore, does a good job at capturing van Inwagen's notion of a life as a self-maintaining biological event. One way of making van Inwagen's answer to SCQ less obscure, thereby responding to the first criticism, is by interpreting it immunologically. In particular, we can understand the notions of a life, and of the activity of things constituting a life in terms of immunological activity. We can call this the Immunological Understanding of Organicism (IUO). Here is what IUO might look like:

(\exists y the xs compose y) if and only if the xs are immunologically related

I should make one clarification. I don't take IUO to hold that for the xs to compose something, each of the xs must be immunologically related to every other x - cells in my left leg, for example, do not seem to be immunologically related to cells in my right arm. Rather, according to IUO, for the xs to compose something, each of the xs must undergo strong biochemical interactions with at least one of the other xs and medium intensity immune interactions with at least one of the other xs.

A worry with this understanding of IUO is that it seems to imply that there is such a thing as my left leg, which is something the Organicist wants to avoid saying (given that legs are not organisms). It seems to imply this because the cells in my leg are connected by strong biochemical interactions and medium intensity immune interactions. To avoid this, it seems that IUO should be reformulated with a maximality condition, which rules out the existence of legs, and organs more generally:

($\exists y$ the xs compose y) if and only if

the xs are immunologically-related *and none of the xs is immunologically related to things that do not overlap the xs.*

Consider, for example the cells in my left leg. Whilst they may be immunologically related, they do not compose anything, according to this understanding of IUO, because they are also immunologically related to other parts of the organism, such as other cells in my body.

Notice also that this version of IUO rules out organisms from having parts that are organisms. As such, it mirrors the version of the Physiological Approach which comes with the Exclusion

Principle, according to which organisms cannot have parts that are organisms, which as we saw in chapter 1, some philosophers of biology accept. Consider, for example, a cell of a multicellular organism. If it exists at all, whilst its parts are immunologically related, they are immunologically related to things that are not parts of the cell, such as other parts of the organism. As such, by this version of IUO, not only is the cell not an organism, but it also does not exist – its particles do not compose anything. Rather, there are only particles arranged cell-wise.

What is the difference between IUO, and the immunological account of biological individuality? Well, the immunological account of biological individuality provides conditions that must be satisfied if something is to count as a biological individual. It is, therefore, of the following form:

x is a biological individual iff x's parts are immunologically related (ignore the maximality condition for now so things are simpler).

In other words, it says that a *thing* (singular) is a biological individual if and only if its parts are immunologically related. On the other hand, IUO says that some *things* (plural) compose a new object if and only if those things are immunologically related. Here is another way to put the same point. In the immunological account of biological individuality, the value of 'x' is a putative biological individual, whilst in the immunological understanding of Organicism, the values of 'the xs' are putative *parts* of biological individuals.⁷⁹ IUO, then, is not the same as, or equivalent to, the immunological account of biological individuality. That being said, the

⁷⁹ See Olson (2020, 79-80), who nicely explains the difference between the questions, 'What is a biological individual?' and 'when do things compose a biological individual?'.

latter seems to follow from the former. This is because if IUO is true, and the xs compose y, then it follows that y is something whose parts are immunologically related. Furthermore, presumably if y is anything, it is a biological individual. Hence, if IUO is true, then there are things with immunologically related parts, and which are biological individuals; in other words, the immunological account of biological individuality is true.

IUO is less obscure than van Inwagen's original version of Organicism. It tells us what biological activity is responsible for things composing something (biochemical and immunological activity), and provides a clear account of what it takes for something to be a part of a composite (x is a part of y if and only if it undergoes strong biochemical interactions and medium intensity immune interactions with y). I think, then, that it allows Organicists to respond to the criticism that their answer to SCQ is too obscure.

IUO also does a good job at responding to the second criticism that lives are not well-individuated events. Consider marine invertebrate colonies. I suggested that by van Inwagen's original formulation of Organicism, it isn't clear whether we should say that each individual polyp has their own life, whether their activity constitutes the life of the colony, or both. According to IUO, however, we are often justified in saying that the activity of the polyps constitutes the life of the colony. Consider Pradeu's immunological account of biological individuality, and a colony such as *Botryllus Schlosseri*. Pradeu says,

My immunological criterion of individuation [biological individuality] says that in this case the organism (i.e, the physiological individual) is not each zooid [or polyp], but rather the colony, which is characterized by both biochemical interactions and by a unique immune system... (Pradeu, 2012, 250).

If IUO is true, then, we can say that the activity of the polyps constitutes the life of the colony by virtue of the polyps being immunologically related. What about each individual polyp, though? Do they also have their own lives? Notice that Pradeu in this passage specifies that each polyp is not an organism by his immunological account (he says that the organism is not each zoid but the colony). Similarly to Pradeu, then, we can say that according to IUO, each of the individual polyps in the colony does not have their own lives (because they are not organisms), and hence, strictly speaking do not exist. Rather, there are only particles arranged polyp-wise. In fact, it actually follows from the version of IUO that comes with a maximality condition (which it seems the Organicist ought to accept to avoid the implication that there are non-organism composites such as legs) that if the entire colony has a life, then the polyps do not have lives, and so do not exist.

Next consider eusocial insects such as bees. I said in section 5.4. that by van Inwagen's original presentation of Organicism, it is not clear whether the activity of the bees constitute the life of the hive. IUO makes things clearer. Pradeu says that if there is immunological activity at the level of the entire hive, which has been suggested by some authors (Cremer et al., 2007; Pradeu, 2012, 252), then

the “organism” is the colony *rather than each insect* (Pradeu, 2012, 252).⁸⁰

Similarly, if the Organicist accepts IUO, then they can say that if there is immunological activity at the level of the hive, then the activity of the bees constitutes the life of the colony and so the individual bees of the hive compose something. What about the individual bees? Do

⁸⁰ Italics are not in the original quotation.

they also have lives of their own? Pradeu seems to accept the Exclusion Principle and so holds that if the hive is an organism, then each of the individual bees of the hive is not. As he says in the passage above, if the hive has an immune system, then the organism is the colony ‘rather than each individual insect’. Similarly, if Organicism is understood immunologically, then the Organicist can say, perhaps counterintuitively, that if the entire hive has a life (which the activity of the bees constitute in virtue of the bees being immunologically related), then this rules out the individual bees from having lives of their own, and hence, strictly speaking the bees do not exist; there are only particles arranged bee-wise. And again, it seems to follow from the version of IUO that comes with the maximality condition that if the entire hive has a life, then the individual bees do not.

If IUO is true, then, it seems that life is reasonably well-individuated, given that IUO can provide verdicts about the tricky biological cases discussed in section 5.4.. if we interpret Organicism immunologically, then lives would not be like flames because there would often be a reasonably clear answer to questions about how to count and distinguish lives.

Furthermore, IUO can help us answer some of van Inwagen’s metaphysical puzzles about organisms, some of which were discussed in section 5.6. I’m not sure what verdict it gives in the severed head case, but IUO at least tells us how to go about answering the puzzle. Suppose that after decapitation, both the severed head and headless body have a functioning immune system and, therefore count as immunological wholes (things whose parts are immunologically related). In this case, it would seem arbitrary to say that I am either the severed head or the headless body, and so we should conclude that after the operation, I cease to exist, and that I am replaced by two organisms. Alternatively, perhaps only the severed head or the headless body is an immunological whole. Suppose it is the headless body. In that case, it seems that I

survive as the headless body. Or perhaps after decapitation, neither the severed head nor the headless body is an immunological whole. In that case, I would cease to exist. I don't know what the right answer to this is, but IUO at least provides criteria for how to answer this puzzle.

IUO does, however, suggest an answer to the question of when an organism comes into existence. In chapter 1, I argued that a foetus is a part of its mother according to the immunological account of biological individuality, and hence, if we accept the Exclusion Principle, is not an organism. Similarly, if we accept the version of IUO that comes with the maximality condition ($(\exists y$ the x s compose y) if and only if the x s are immunologically-related and none of the x s is immunologically related with any things that does not overlap one of the x s), then it follows that particles arranged foetus-wise do not compose anything. Strictly speaking, then, there are no foetuses but only particles arranged foetus-wise and so we could never have been foetuses. Rather, we came into existence some time after birth. Only then, do particles come to compose us.

Finally, IUO may help rescue van Inwagen's idea of the control centre or organ of maintenance of an organism. As we have seen in section 5.5, whilst van Inwagen takes the lives of animals to be coordinated by its brain activity, there are scientific reasons to be sceptical about this claim. IUO, however, suggests that the immune system is what primarily regulates and coordinates an organism's living activity. As we have seen, the immune system is involved in a number of biological processes such as tissue repair and the metabolism. Furthermore, it is thought that all putative organisms have an immune system, including plants and unicellular organisms (Pradeu, 2012, 22-32). The immune system, then, could be said to be the organ of maintenance for *all* organisms. Of course, the immune system is not strictly speaking an organ, or an object at all – 'immune system' plausibly just refers collectively to immune cells and

their products. What I mean, however, is that if we accept IUO, we can take it to be immunological activity that primarily regulates and coordinates the living activity of organisms.

IUO, then, is precise and biologically informed, takes lives to be reasonably well-individuated, can provide answers to metaphysical puzzles about organisms, and can make sense of the idea that organisms have a control centre or organ of maintenance that regulates and coordinates their living activity (and suggests that each organism has the same kind of organ of maintenance). IUO, then, allows Organicism to respond to the worries raised against it in this chapter.

5.7.2. Worries with IUO

There are at least two worries with IUO. Firstly, it might be thought that it collapses into Nihilism. Why would anyone think this? Well, according to IUO, things compose something only if they are immunologically related. Particles, however, it might be thought, are too small to be immunologically related. This is because, according to Pradeu, an immune interaction occurs when there is a special type of interaction between an antigen – a *molecule* capable of setting off an immune reaction – and the receptors on immune cells (Pradeu, 2012, 19-20). This would suggest, then, that only objects the size of molecules or larger can be immunologically related. But if this is the case, then it follows from IUO that particles can never be immunologically related, and so never compose anything. But if particles never compose anything, then there are no composites. As such, if IUO is true, then composition never occurs, and the account collapses into Nihilism.

I think the Organicist could respond to this worry by having an understanding of what it takes for things to be immunologically related which applies to particles. Specifying the details will be tricky, but this is the sort of thing I have in mind: a particular particle in my left is immunologically related to other particles in my body in virtue (at least partly) of being among particles arranged molecule-wise which jointly undergo immune interactions which particles arranged immune cell-wise. More detail will need to be added to this, but I hope that this should provide some idea of how we might understand ‘immunologically related’ at the level of particles.

Another worry is whether IUO is general enough to capture the notion of a life. Recall that Cleland and Chyba worry that the problem with providing a definition of theory of life is that we have only observed life on earth as it actually is, and that life may have been very different (or perhaps is different on other planets). Similarly, it might be argued that it seems possible that there could be living things without immune systems. Perhaps this is the case on other planets, or perhaps it could have been the case on earth if evolution by natural selection occurred differently.

In response, I don’t know whether this could have been the case or not, but it does not seem so implausible to me that all organisms must have some sort of immune system. That is not to say that organisms on other planets would have to have immune systems like ours. It seems plausible that non-earthly organisms would have very different immune systems from ours. Pradeu’s understanding of the immune system, however, is quite broad, and aims to capture the diversity of immune systems of organisms on earth, such as vertebrates, invertebrates, unicellular organisms and plant and genomes (Pradeu, 2012, 22-32). Perhaps, then, IUO is

broad enough to apply to non-earthly organisms, or to possible organism (if evolution by natural selection had acted differently, for example).

Someone might wonder, however, whether there could be organisms that could survive, perhaps very briefly, without an immune system, by being artificially shielded from pathogens. A real-life example of this may be David Vetter, whose immune system was so compromised that he spent his entire life (12 years) inside a protective bubble.

In response, I don't know whether it is possible for an organism to survive without any kind of immune system, particularly because, as mentioned above, the immune system's role is not simply to fight off pathogens, but it also performs a number of other important roles within the organism. In the case of Vetter, it is also not clear whether his immune system was comprised to the extent that we should say that his parts are not immunologically related. At any rate, proponents of IUO may simply have to bite the bullet and say that there can be no organisms without immune systems or severely comprised immune systems. In other words, they might have to say that a putative example of an organism without an immune system, or a severely comprised immune system, is actually a case of there being many particles that are related in complex ways, but which do not compose anything.

5.7.3. An Evolutionary Understanding of Organicism

Just as we can understand Organicism physiologically by appealing to the Physiological Approach to the Problem of Biological Individuality, we could also understand Organicism

evolutionarily by drawing on the Evolutionary Approach. We can call this the Evolutionary Understanding of Organicism (EUO).

Recall that the Evolutionary Approach to the Problem of Biological Individuality says that an organism is a unit of selection. What exactly this amounts to is up for debate. We saw in chapter 1 that Godfrey-Smith takes (multicellular) units of selection to be reproducing things that have three features— a bottle lifecycle, germ-soma separation and functional integration of parts. Similarly, we saw that Clarke takes units of selection to be things that possess individuating mechanisms (policing and demarcation mechanisms) for participating in evolution by natural selection, examples of these including the three features identified by Godfrey-Smith, but might also include skin or cells walls, or pre-programmed cell death.

What would EUO look like? Well, presumably something is a unit of selection (at least partly), by virtue of the way that its parts, such as its particles, are related to one another.⁸¹ Whatever this relation involves, we can say that the parts of a unit of selection must be *evolutionarily related*. What exactly must be the case for particles to be evolutionary related is up for debate, but drawing on evolutionary accounts of biological individuality such as Godfrey-Smith's and Clarke's, this will presumably typically involve a number of things. For example, it will often involve germ-soma separation – some of an organism's particles will contribute to reproductive activity, whilst others will contribute to non-reproductive bodily activity. It will typically involve particles being involved in the working of mechanisms discussed by Clarke, for example, immunological activity, pre-programmed cell death, and other mechanisms for limiting genetic variation. It will also normally require some of those particles forming a

⁸¹ It should be noted that I am not using the term 'particle' in the same way that Okasha does. Okasha uses the term to refer to lower-level units of selection – units of selection that are parts of larger units of selection (2006, 47). I am using it in the more traditional way, to refer to fundamental objects of physics.

physical barrier such as the skin or cell walls. It will also involve particles interacting in such a way as to maintain and reproduce heritable information along lineages over time.

With the notion of things being evolutionary related, we can present EUO as follows:

($\exists y$ the x s compose y) if and only if the x s are evolutionarily-related

(Alternatively we might present it like this: ($\exists y$ the x s compose y) if and only if the x s *jointly act as a unit of selection*)

When is something a part of a composite object, according to EUO? We can say that something x is a part a composite object when there are y s that are evolutionary related, and x is one of the y s. Can we say anything more illuminating that this? I think so. We can say, for example, that a muscle cell is a part of a composite object such as a human being, according to EUO, by virtue of the cell's evolutionary fate being tied to the rest of the human being. What I mean by this is that the ability of the cell to undergo natural selection has been suppressed by the organism it is a part of, and the lineage of that cell will die when the multicellular organism dies. Crucially, the cell also contributes to the transmission of the same heritable information (such as genes) as the rest of the body. Furthermore, it might be thought that according to EUO, in some circumstances, symbiotic bacteria are parts of their multicellular organism hosts. The bacteria of aphids, *Buchnera aphidicola*, can be said to be parts of their aphid host (or perhaps that the aphid and its bacteria compose a third organism) because they are passed on to the aphid's offspring, and so the aphid and its bacteria lineages are aligned – the aphid's offspring will contain the bacteria or the offspring of bacteria that were inside the parent aphid. In contrast, something won't be a part of a composite, according to EUO, if it is in evolutionary

conflict with the composite or if it, along with an organism, do not act as a single unit of selection. Cells from selfish lineages, then, such as tumour cells, will not count as parts of a composite according to EUO – their ability to undergo natural selection is not suppressed by the organism they reside in, and they do not contribute to the transmission of the heritable information to the organism’s offspring. The same is true of the gut bacteria inside a human being.

I take EUO to be less obscure than van Inwagen’s original version of Organicism, given that it tells us that for the activity of particles to constitute a life, the relevant activity is to do with evolutionary processes and mechanisms. Furthermore, EUO takes lives to be reasonably well individuated. It might not always be entirely clear what parts an organism has by EUO, but it can say something about the difficult biological examples provided in section 5.4. For example, it tells us that whether the activity of the hive constitutes the life of the colony depends on whether the individual bees jointly act as a single unit of selection. Evidence that this is the case might be that the hive as a whole has mechanisms that allow it to participate in natural selection. The hive, for example, may be thought to have germ-soma separation, given that only the queen bee reproduces, whilst the worker bees do not (Godfrey-Smith, 2013, 21). The hive may also have other individuating mechanisms for participating in natural selection, such as a colony-level immune system (Cremer et al., 2007).

Similarly, the activity of symbiotic partners constitutes a life if and only if the symbionts are evolutionary related, which will involve parent-offspring lineages of the symbionts being aligned. As we have seen, this is unlikely to be the case for many symbiotic relationships, such as a human organism and its gut bacteria, but it might be the case for organisms where

symbionts are transmitted vertically from parent to offspring, as is the case with aphids and *Buchnera aphidicola*.

What can EUO say about van Inwagen's metaphysical puzzles? Consider first the severed head case. What does EUO say would happen to you? Well, it tells us that the severed head and the headless body exist if they are units of selection. Suppose, then, that after the operation, both the severed head and the headless body count as units of selection. Then given that it would be arbitrary to say that you are either the severed head or the headless body (you couldn't be both), then it seems that we should say that you cease to exist.

Someone might argue that the severed head would not count as a unit of selection because it would lack the ability to reproduce. If this is right, then particles arranged severed head-wise would not be evolutionarily related and so would not compose anything. Contra van Inwagen, then, you would not survive as the severed head.

Does the headless body count as a unit of selection, and hence, could you survive as the headless body? This is not so clear. Perhaps the headless body, if it was connected to a life support machine, would count as a unit of selection. Perhaps, for example, it would still be able to reproduce and have other mechanisms for participating in evolution by natural selection.

I don't know what the right thing to say here is. EUO, then, does not provide a clear verdict on the severed head puzzle. It does, however, at least provide considerations for how we might answer the puzzle.

What about the question of when we came into existence? Presumably by EUO (and assuming Animalism is true), I came into existence when a unit of selection appeared in my mother's womb – when particles arranged foetus or embryo-wise became evolutionary-related. I suggested in chapter 1 that this would be quite early on during pregnancy, perhaps even as soon as fertilisation has taken place given that a foetus in the early stages of pregnancy has mechanisms for participating in evolution by natural selection, such as developing from a bottleneck, having its own genome, and having mechanisms for inhibiting mutations.

Finally, one other benefit of EUO is that it provides a way of understanding van Inwagen's claim that one organism can be a part of an organism if the former's life is *subordinate* to the latter's. Van Inwagen, himself, does not go into much detail about what he means when he says that one life is subordinate to another, but with EUO, we can understand this evolutionarily. As we have seen, Clarke takes organisms to be things with mechanisms that suppress natural selection occurring at the level of their parts, for example, by pre-programmed cell death or the immune system (Clarke, 2013). Godfrey-Smith calls this suppression *de-Darwinization* (Godfrey-Smith, 2009, 101). We can, therefore, understand van Inwagen's claim about subordination in terms of de-Darwinization. We can say that the life of a cell is subordinate to the life of the multicellular organism it is a part of in the sense that the cell's ability to participate in natural selection has been suppressed by the multicellular organism it is a part of. This is not to say that the cell is not itself an organism, and hence, does not have a life. The cell could be a unit of selection, whilst nonetheless having its ability to act as a unit of selection suppressed (although not completely) by the multicellular organism it is a part of.

5.8. Objection to EUO

One objection someone might have to EUO is that it seems to imply that composition is an *extrinsic relation*, against popular opinion, including van Inwagen's own.⁸² Composition is normally thought to be an intrinsic relation, meaning that it is usually thought that whether some things compose something depends on nothing other than the intrinsic properties of the individual things and the internal relations that the things bear to one another. As van Inwagen says,

Whether certain objects add up to or compose some larger object does not depend on anything besides the spatial and causal relations they bear to one another. If, for example, someone wants to know whether the bricks in a certain brickyard make up a composite object, he need not attend to anything outside the brickyard, for no information gathered from that quarter could possibly be relevant to his question (Van Inwagen, 1990, 12).⁸³

My deepest instincts tell me that composition is an internal relation... (Van Inwagen, 1990, 138).

The question of whether certain things constitute a life is a question about the relations they bear to one another and nothing else (Van Inwagen, 1990, 138).

⁸² Vander Laan, for a different reason, argues that van Inwagen's account of composition implies that composition is extrinsic (Vander Laan, 2010).

⁸³ See Markosian (2015, 680) who also takes composition to be intrinsic.

Why think that it follows from EUO that composition is extrinsic? Well, according to Lewontin's traditional understanding of evolution by natural selection, for natural selection to occur, there must be a population of things that 1) vary with respect to their traits 2) differ in their reproductive success and 3) offspring resemble parents. A unit of selection is something that is a member of such a population. Whether something is a unit of selection, then, depends, not just on how it is in itself, but also on how it relates to other things (other members of a population) in its environment.⁸⁴ Suppose, then, that I am exactly as I am now with respect to my intrinsic properties (such as my shape, mass, and arrangement of matter), but that I am the only living thing in existence – there are no other organisms. Given that there are no other living things in my population, there can be no variation of traits within my population. As such, the Evolutionary Approach, it might be argued, implies that I could be exactly as I am now, with respect to my intrinsic properties, but fail to be a unit of selection, and as such, fail to be an organism.

Now consider EUO. It might similarly be argued that whether particles are evolutionarily related, and hence, whether they compose something, is not simply dependent on the spatial and causal relations between the xs, but also on how the xs relate to other things that are not any of the xs. Suppose, for example, that EUO is true, the only particles that exist are those that currently compose me, and furthermore, those particles are arranged in the exact same way as they actually are now. According to EUO, those particles would not compose a unit of selection, and so would not compose anything. If they would not compose anything, however, then they would not compose me, and so I would not exist. Given this, EUO, it might be argued,

⁸⁴ Okasha (Okasha, 2002) similarly argues that species membership is extrinsic – whether something belongs to a species depends not just on its intrinsic properties, but also on how it relates to things in its surroundings, such as its environment and other organisms.

implies that my particles could be arranged in the exact same way as they are now, but that I fail to exist.

Furthermore, EUO, it might be argued, implies that I could cease to exist due to activity that is not the activity of any of my parts. Suppose, for example, that as I write this sentence, the matter of every other living being is suddenly destroyed, but that my matter, and the way it is arranged, is entirely unaffected. According to EUO, this would cause me to cease to exist. This is so, even though particles arranged Will Morgan-wise, are arranged exactly the way that they were moments before the destructive event, and despite the fact that these particles will jointly continue to write this chapter, jointly drink a mug of coffee and jointly think about what is for dinner. I can be destroyed then, purely by virtue of something that happens to neither me nor any of my parts. This is all, I think, quite hard to believe. Whilst it may be plausible to think that the existence of artefacts is extrinsic, depending on the creative intention of a maker, or the intention of someone who uses it (Baker, 2007, 52; Evnine, 2016; Korman, 2015, 24 & 153; Rosenberg, 1993; Thomasson, 2014) it seems less plausible that the existence of organisms is extrinsic, and that I could cease to exist by virtue of something that happens to neither me nor any of my parts. In particular, it seems implausible that particles could be arranged just like mine, without composing anything whatsoever. I think, then, that if this is indeed an implication of EUO then it is a big cost of the view.

It is not obvious, though, that EUO must take composition to be extrinsic. Whilst some philosophers of biology take 'being a unit selection', or 'being a biological individual' (according to the Evolutionary Approach) to be extrinsic because they think that Lewontin's three conditions must actually be satisfied, not everyone does. Most notably, according to Clarke's version of the Evolutionary Approach to the Problem of Biological Individuality, a

biological individual is something that has the *capacity* to participate in evolution by natural selection. A biological individual, then, according to Clarke, need not *actually* participate in natural selection, and it might be argued that what gives something the capacity to participate in natural selection is simply to do with intrinsic facts, such as the arrangement of a thing's matter. According to Clarke's view, then, it might be argued that if I was the only existing living thing, I would still be a biological individual because I would still have the capacity to participate in evolution by natural selection; I would just be unable to exercise that capacity.

EOU, then, need not take composition to be extrinsic – whether some particles are arranged evolutionary-wise can be taken to be purely a matter of the intrinsic properties of those particles and the internal relations they bear to one another. Suppose that there are some particles, the *x*s, that are evolutionary-related, and there are no other particles. If the *x*s were to compose something, *y*, even though *y* would not actually participate in evolution by natural selection, it would nonetheless have the capacity to participate in evolution by natural selection by virtue of having individuating mechanisms such as an immune system, germ soma separation, and so on. The *x*s, then, could compose something, according to EUO, purely in virtue of the relations that the *x*s bear to one another.

If Organicism is to be understood evolutionarily, then, to avoid taking composition (and our existence) to be extrinsic, it is best understood by appealing to an account of biological individuality such as Clarke's.

5.9. The Problem of Biological Individuality and the Special Composition Question

We have seen that the two main solutions to the Problem of Biological Individuality provide two ways of understanding Organicism – IUO and EUO - which are less obscure than van Inwagen’s original version, and which take lives to be reasonably well-individuated, thereby allowing Organicists to respond to the two criticisms discussed at the start of this chapter. IUO and EUO have other virtues too. IUO, as we saw, suggests an alternative to the brain for being the ‘control centre’ or ‘organ of maintenance’ for organisms, whilst EUO, provides a biologically informed way of understanding the view that one life can be subordinate to another in terms of de-Darwinization. Furthermore, both IUO and EUO suggests ways of answering some of van Inwagen’s metaphysical puzzles about human beings.

That being said, it should be clear now that Organicists face a difficult question: which understanding of Organicism should they adopt? Should they accept IUO or EUO? Whether Organicists accept IUO or EUO makes a metaphysical difference, because they provide different criteria for composition and parthood, and suggest different answers to the question of when we came into existence. IUO, for example, takes gut bacteria to be parts of a human being whilst EUO does not, and EUO plausible takes us to have been foetuses that existed at the early stages of pregnancy, whilst IUO does not. The Organicist, then, faces an analogous problem to the Problem of Biological Individuality: should it be understood immunologically or evolutionarily?

I take this to be an interesting result – it shows that the question of how to count organisms in the philosophy of biology is relevant to the more general question of when composition occurs

in metaphysics. In the remainder of the chapter, I will discuss the different options for Organacists.

One option for the Organacist is to adopt a pluralist answer to SCQ, in a similar way that some (or many) philosophers of biology adopt the Pluralist Approach to the Problem of Biological Individuality. Just as proponents of the Pluralist Approach hold that something counts as a biological individual either if it is a physiological whole (such as an immunological whole) or if it is a unit of selection, the Organacist could adopt a pluralist understanding of Organicism (PUO). This would look like the following:

$(\exists y \text{ the } x\text{s compose } y)$ if and only if

The $x\text{s}$ are (maximally) immunologically related or the $x\text{s}$ are evolutionary related.

PUO would have some interesting consequences. One of these is that there would be real-life cases where something can be caught up the life of two organisms without one of those biological individuals being subordinate to the other. Recall that according to van Inwagen, there are special circumstances when something can be caught up in two distinct lives, but this is normally only when one of those lives is subordinate to the other, such as when a cell is a part of a multicellular organism. Van Inwagen does suggest that perhaps it is possible for something to be caught up in two lives without one being subordinate to the other, but his example is a science fiction case (suppose that an evil surgeon was to amputate the hands of some twins, Alice and Beatrice, and fuse their stumps together such that there is no discernible boundary between them. He thinks this may be a case of some particles around the site of the

operation being caught up in the lives of Alice and Beatrice, but where neither of the lives of Alice and Beatrice are subordinate to the other (Van Inwagen, 1990, 89)).

Suppose, though, that PUO is true. Recall from chapter 1, that if the Pluralist Approach is true, Physiological and Evolutionary individuals must be distinct (given that they have different parts or could have different parts, and what it takes for something to be a part of each biological individual is different). Nonetheless they share many of their parts. If PUO is true, then, in the rough region where I am, there is a Physiologically individual and an Evolutionary individual who are distinct but share many parts. Consider, then, one of the particles in my brain. This would be caught up in the lives of both a Physiologically individual and an Evolutionary individual. Given, however, that neither the lives of the Physiologically or Evolutionary individual would be subordinate to the other, this would be a real-life case of something being caught up in the lives of two organisms without one being subordinate to the other.

We saw in chapter 3, though, that the Pluralist Approach to the Problem of Biological Individuality faces some difficult questions or concerns to do with personal identity, and these questions would also apply to PUO. In particular, if PUO is true, then I can never know, what kind of biological individual I am – I could never know whether I am something whose parts are immunologically related, or whether I am something whose parts are evolutionary related. This is because there would be two distinct individuals with the same mental properties. Perhaps I am not in fact a biological individual at all, as chapter 3 shows (I may instead be constituted by a biological individual, for example), but it should be clear from chapter 3 that PUO is also in tension with all the usual accounts of what we are in the personal identity

literature such as Animalism, the Constitution View, and the Temporal Parts View. For this reason, I don't take PUO to be attractive.

Secondly, the Organicist might accept IUO. As we saw, IUO is in the spirit of van Inwagen's original version of Organicism, is precise and biologically informed, suggests answers to van Inwagen's metaphysical puzzles, and provides a candidate for the 'organ of maintenance' for all organisms (the immune system).

A drawback of IUO, however, is that it has some metaphysical consequences that are hard to swallow (see section 5.7.1), namely that whilst young and adult organisms exist, foetuses do not exist (at least if we take IUO to come with a maximality condition). Furthermore, and as a result of this, it implies that we were never foetuses. Hence, IUO implies that we, and other mammalian organisms, come into existence much later than we ordinary think we do. Some may also find IUO to be problematic because, as we have seen, it may imply that organisms with severely compromised immune systems do not exist. Furthermore, we also saw that trying to spell it out IUO at the level of particles – specifying what it is for particles to be immunology related – is difficult.

Finally, perhaps the Organicist should accept EUO. An attraction of this is that evolution by natural selection is arguably the most powerful biological theory (Boden, 1999, 243; Guay & Pradeu, 2016a, 6). Furthermore, unlike IUO, EUO seems to be compatible with the existence of foetuses and other macroscopic objects such as cells that are parts of multicellular organisms, given that these can qualify as units of selection.

We saw that one drawback of EUO may be that some versions of it imply that composition is extrinsic. We also saw, however, that this implication can be avoided if we accept a version of EUO modelled on Clarke's version of the Evolutionary Approach to the Problem of Biological Individuality.

Perhaps more seriously is the implication that EUO has for sterile living things, namely, that they don't exist. This is because there are reasons, I think, for thinking that sterile organisms do not count as units of selection. Consider, Godfrey-Smith's version of the Evolutionary Approach to Biological Individuality, which takes organisms (or Evolutionary individuals) to be reproducers. Sterile organisms, however are unable to reproduce. Similarly consider Clarke's evolutionary account, which takes organisms to be things that have individuating mechanisms that provide them with the capacity to participate in evolution by natural selection. Whilst a sterile organisms has some individuating mechanisms, such as an immune system and an external boundary such as the skin, I don't think that sterile organisms can be said to have the ability to participate in evolution by natural selection. If this is true, then the parts of a sterile organism are not evolutionary related – they do not jointly act as a unit of selection. If this is the case, however, then it seems that by EUO, sterile organisms do not exist. It is quite difficult to believe, however, that horses and donkeys exist, but mules do not.

5.10. Conclusion

I have argued that appealing to solutions to the Problem of Biological Individuality can allow Organicists to respond to the charges that 1) the notion of a life is obscure, and 2) Organicism is unhelpful because lives are not reasonably well-individuated events. I argued that by appealing to solutions to the Problem of Biological Individuality, biologically-informed

versions of Organicism can be formulated which avoid these worries, and which have other virtues too. By doing so, however, Organicism will in some ways look quite different from the original version presented by van Inwagen.

A difficulty for the Organicist is deciding which understanding of Organicism to adopt, and so Organicism, therefore, faces a problem analogous to the Problem of Biological Individuality. It is not obvious how to answer this problem, but I provided some considerations in favour and against the different versions of Organicism. More generally, though, I hope in this chapter to have shown that a debate about biological individuality in the philosophy of biology is relevant to more general questions about material objects in metaphysics.

Chapter 6. Does It Matter Whether There Are Biological Individuals?

6.1. Introduction

So far in this thesis, we have seen that there are a number of metaphysical challenges to views about biological individuals in the philosophy of biology. Here is a recap:

In considering the Problem of Biological Individuality, we saw that two popular solutions to the problem face metaphysical challenges: chapter 1 showed that the Physiological Approach faces a problem to do with early mammalian development (the Foetus Problem), whilst chapter 3 showed that the Pluralist Approach to the problem is in conflict with the view that we are biological individuals, and more generally, is in conflict with all the usual accounts of what we are in the personal identity debate. Chapter 2 argued that there is little motivation for taking biological individuals to be process rather than substances. In light of my arguments in these first few chapters, I suggested that if there are any biological individuals, then there are good reasons for taking them to be units of selection (in other words, we should accept Evolutionary Approach to biological individuality) and substances.

But as we saw in chapter 4, there some serious metaphysical reasons for thinking that there are no biological individuals at all. The most obvious challenge comes from Nihilism, which denies that there are any composite objects. If Nihilism is true, then even the view that biological individuals are units of selection and substances is problematic. More generally, if eliminativist views about biological individuals are true, then, all the usual answers to the

Problem of Biological Individuality and the Substance-or-Process Question would be false. This would seem to be bad news for debates about biological individuals in the philosophy of biology.

This chapter ends the thesis by considering what philosophers of biology should make of these metaphysical challenges discussed in this thesis, and suggests one way in which they might avoid them entirely. I will do this primarily by considering the Nihilist-challenge (although what I say also applies to the other eliminativist views discussed in chapter 4), and asking the following: are philosophers of biology required to reject Nihilism before they can get on with their debates?

Focussing on the Problem of Biological Individuality, and drawing on tools from metaphysics, I argue that philosophers of biology involved in this debate need not worry about whether Nihilism is true. This is because whilst the Problem of Biological Individuality and its solutions, *as they are currently understood*, are in conflict with Nihilism, the debate and its solutions *can be* understood in a Nihilistic-friendly way, which is sufficient for the main aims of the majority of philosophers of biology involved in this debate. This is because rather than asking how to count biological individuals, I argue that philosophers of biology need only ask *what the most useful way to count biological individuals is*. I call this view *Agnostic Fictionalism about Biological Individuality* (or simply ‘Agnostic Fictionalism’). By accepting Agnostic Fictionalism, then, philosophers of biology involved in the Problem of Biological Individuality need not worry about what the correct answer to the Special Composition Question is.

Furthermore, and perhaps more importantly, I argue that adopting Agnostic Fictionalism would also allow philosophers of biology involved in the Problem of Biological Individuality to entirely side-step the *all* of the difficult metaphysical challenges facing accounts of biological individuality discussed in this thesis, such as the Foetus Problem and issues about personal identity, whilst still allowing them to receiving the benefits of these accounts. Even if we reject Nihilism, then, I think, that there are good reasons for philosophers of biology involved in the Problem of Biological Individuality to adopt Agnostic Fictionalism.

The structure of the chapter is as follows. In section 6.2, I distinguish between the main aims of metaphysicians, and philosophers of biology involved in the Problem of Biological Individuality, highlighting that philosophers of biology involved in this debate are primarily interested in explanatory power and usefulness in biology. In section 6.3 and 6.4, I argue that this motivates interpreting the Problem of Biological Individuality and its solutions in a Nihilistic-friendly way (Agnostic Fictionalism) and furthermore, would allow philosophers of biology to avoid many of the metaphysical difficulties facing their accounts. In section 6.5, I suggest how Agnostic Fictionalism might be applied to the question of whether organisms are substances or processes. I end the chapter by considering an alternative to Agnostic Fictionalism, but argue that Agnostic Fictionalism is preferable.

6.2. The Problem of Biological Individuality and Explanatory Power

Central to my argument is the claim that philosophers of biology involved in the Problem of Biological Individuality, and metaphysicians involved in debates about material objects, often have different philosophical aims.

As we have seen a number of times in this thesis, one of the main interests of metaphysicians is in providing solutions to metaphysical puzzles about a kind of thing. We have seen that metaphysicians writing about material objects, for example, are often interested in solving difficult puzzles or paradoxes about material objects. Van Inwagen, for example, says that one of the main reasons for providing an answer to the Special Composition Question is because he thinks that the right answer will help us solve intractable problems about material objects (Van Inwagen, 1987, 21, 1990, 18). As he says,

I believe...that most of the great, intractable metaphysical puzzles about material objects could be seen to have quite obvious solutions by one who had a clear understanding of what it was for one material objects to be a part of another (Van Inwagen, 1987, 21).

Organicism, Nihilism, and Universalism, have all been adopted for this reason. We also saw that solving metaphysical puzzles is also often the main motivation for adopting an ontology of temporal parts and the Constitution View.

Philosophers of biology often have different motivations than this. When it comes to the Problem of Biological Individuality, they are primarily concerned with *usefulness* and *explanatory power* in biology. This explains why the Evolutionary Approach has until recently been the dominant approach, given that many of the main problems in biology tend to be about evolutionary biology.⁸⁵ Philosophers of biology have found the Evolutionary Approach appealing because it has been said to be useful for distinguish between growth and reproduction

⁸⁵ This can easily be seen by considering some of the main texts in the philosophy of biology which are mostly about evolutionary biology such Sterelny's and Griffiths' (1999) Sober's (2000) Godfrey Smith's (2009, 2014), Okasha's (2006) and Sober's and Wilson's (1998).

(DiFrisco, 2019, 846; Godfrey-Smith, 2009, 70-72; O'Malley, 2021), for allowing biologists to generate predictions about the spread of a trait in a population and about other evolutionary process (Clarke, 2013, 2016, 2021, 109; Clarke & Okasha, 2013; DiFrisco, 2019, 869; Sterner, 2015, 613), for explaining evolutionary transitions (Clarke, 2013, 2014; Godfrey-Smith, 2009, 8-9; Pepper & Herron, 2008, 622; Queller & Strassmann, 2009; Sterner, 2015, 614-615),⁸⁶ for guiding correct choice of evolutionary models (Sterner, 2015, 614), and for explaining how biological individuals suppress evolutionary conflict among their parts (Clarke, 2013; Godfrey-Smith, 2009, 199-103).

Consider, for example, Clarke's version of the Evolutionary Approach. Clarke argues that we should accept her version of the Evolutionary Approach, rather than the Physiological Approach, such as O'Malley's metabolic version, because she takes her approach to be more useful. As she says,

I accept that O'Malley's claim that her metabolic individuals are distinct from my evolutionary individuals – but I deny that the concept she defines is useful enough to be worth holding onto (Clarke, 2021, 108).

In contrast, the Physiological Approach has been said to be useful for predicting lifespan (DiFrisco, 2019; O'Malley, 2021), explaining the synthesis of proteins (Waters, 2018, 107-108), understanding cancer (Pradeu, 2019, 37), understanding an organism's control of lower-level selection and the suppression or selfish cell lineages such as tumours (Pradeu, 2010, 263) and determining transplant outcomes (DiFrisco, 2019, 846; Pradeu, 2010, 253).

⁸⁶ This refers to the phenomenon where previously independent simple organisms such as cells, come to cooperate, and as a result of evolution, result in the formation of multicellular organisms.

More generally, it has been thought that accounts of individuality should allow us to make inductive generalisations about individuals (DiFrisco, 2019, 846; Pepper & Herron, 2008; Sterner, 2015, 614).

That philosophers of biology are interested in explanatory power and usefulness in biology also explains why so many philosophers of biology accept the Pluralist Approach to Biological Individuality, given that there are lots of explanatory aims in biology, and it is often thought that different accounts of biological individuality are best suited to different biological aims (DiFrisco, 2019, 864; Pepper & Herron, 2008). O'Malley, for example, says that if one is interested in making evolutionary predictions, then one should focus on the Evolutionary individual, but if one is interested in predicting lifespan, then one should focus on the Physiological individual (O'Malley, 2021).

One of the main differences between metaphysicians and philosophers of biology, when it comes to questions about individuals, therefore, is that metaphysicians are often primarily interested in solving metaphysical puzzles about material objects, whilst philosophers of biology are more concerned with usefulness and explanatory power in biology. In the rest of the chapter, I will now argue that this provides motivation for providing a new interpretation of the Problem of Biological Individuality, and the answers to it, that are compatible with Nihilism, and which avoid the metaphysical worries discussed earlier in the thesis.

6.3. Nihilism and Particles Arranged Biological Individual-wise

Suppose that Nihilism is true. This would cause a problem for the usual approaches to the Problem of Biological Individuality. Consider, for example, the Evolutionary Approach. If there are no composites, then there are no units of selection, and so the Evolutionary Approach would be false.

Nihilists, however, do not deny that natural selection occurs – no nihilist is required to think that Darwin’s influential theory is wrong. Rather, Nihilists believe that natural selection is something that occurs to lots of particles *jointly*. They believe that whilst there are no units of selection, there are nonetheless many particles which jointly act as a unit of selection (Brenner, 2018). If Nihilism is true, for example, then whilst there are no zebras with traits such as ‘tallness’, there are nonetheless particles arranged *zebra-wise* which are arranged such that if they were to compose something, what they would compose would be a tall zebra. Similarly, if Nihilism is true, then reproduction is not performed by biological individuals. Nonetheless, there would still be particles arranged in complex ways (particles arranged ‘biological individual-wise’) that would jointly give rise to other particles arranged in complex ways. Furthermore, whilst if Nihilism is true, there are no composite objects with germ-soma separation, there would nonetheless be particles that are arranged in complex ways, some of which contribute to reproductive activities, whilst others contribute to non-reproductive living activity such as immunological functioning and digestion.

It seems, then, that all the usual explanations that evolutionary biologists understand in terms of individuals could in theory be understood in terms of the joint interactions of many particles without those particles composing anything, such as a biological individual. From the

perspective of evolutionary biology, therefore, it does not seem to be particularly important whether Nihilism is true. Evolutionary processes would still occur, albeit being performed by many particles jointly.

Similarly, consider the Immunological Account, which holds that a biological individual is something whose parts are immunologically related. If Nihilism is true, then there are no biological individuals and so immunologically related things do not compose anything. Nonetheless, there would still be lots of particles arranged in complex ways that are involved in immunological interactions. There would be no antigens, for example, but there would still be particles arranged *antigen-wise*. There would be no T cells, but there would still be particles arranged *T cell-wise* that jointly perform all the same activities that T cells would perform if they existed. There would be no gut bacteria that interact with a human organism's immune system, but there would still be particles arranged human organism wise and particles arranged gut bacteria wise that are immunologically related.⁸⁷ Furthermore, there would be no kidney transplants, but there would still be particles arranged kidney-wise that can be jointly transplanted (by being made to be among particles arranged human organism-wise). Regardless, then, of whether particles that are immunologically related compose a biological individual, there are still particles arranged in complex ways that jointly figure in immunological explanations. Whether in addition to particles that are immunologically related, there are further objects composed of these particles, does not, therefore, seem particularly important for biologists, given that immunological activity would still occur.

⁸⁷ Recall that in chapter 5, I suggested that there is a liberal understanding of 'immunologically related' which can be applied to particles.

Given, then, that philosophers of biology are mostly concerned with usefulness and explanatory power in biology rather than metaphysical issues, and biological explanations can in theory be understood in terms of the joint interactions of particles, it does not seem particularly important to the main interests of philosophers of biology whether there are biological composites that are involved in biological processes, or whether there are simply lots of particles which jointly participate in biological processes but which do not compose anything. As such, it seems that the Problem of Biological Individuality, and answers to it, can be understood in a Nihilist-friendly way, without loss of explanatory power.

How would this work? Well, recall that the Problem of Biological Individuality asks how to count biological individuals. If Nihilism is true, there are no biological individuals to count. Nonetheless, there are particles arranged in complex ways which are involved in biological explanations and that are collectively of interest to biologists and philosophers of biology – particles that if they were to compose something, would compose biological individuals. Whilst we could not count biological individuals, then, we could do something similar: we could count *sets of particles arranged biological individual-wise*, where for particles to be arranged ‘biological-individual-wise’ is for them to jointly figure in biological explanations (for example, in evolutionary biology and immunology) and are such that if they were to compose something, they would compose a biological individual.⁸⁸

If Nihilism is true, then, instead of asking the Problem of Biological Individuality, we could instead ask a Nihilistic analogue of the question, which I call the Problem of Biological Arrangement:

⁸⁸ I am assuming here that sets are abstract objects, and hence, not the sort of thing that biological individuals could be.

The Problem of Biological Arrangement: how should we count sets of particles arranged biological individual-wise?

Corresponding to the usual approaches of biological individuality, such as the Immunological Approach and the Evolutionary Approach, we can distinguish between an immunological and an evolutionary solution to the Problem of Biological Arrangement. According to the former, for particles to be arranged biological individual-wise is for particles to be immunologically related, whilst according to the latter, for particles to be arranged biological individual-wise is for them to be evolutionary related (or jointly act as a unit of selection).

Consider, then, the usual question of whether the Portuguese Man O War is a single biological individual, or is rather a colony of distinct biological individuals. If Nihilism is true, then this is a bad question. We can, however, ask a similar question, which is not bad in the same way: do particles arranged Portuguese Man O War-wise all belong to one set of particles arranged biological individual-wise? According to the immunological solution, the answer is 'yes' if particles arranged Portuguese Man O War-wise are immunologically related. In contrast, according to the evolutionary solution, the answer is 'yes' only if those particles are evolutionarily related.

The question of when something is a part of a biological individual can be understood in a Nihilist-friendly way too. Instead of asking when something is a part of a biological individual, we can instead ask when some things are *among* particles arranged biological individual-wise, where, following van Inwagen, the xs are among the ys, by definition, if everything that is one of the xs is also one of the ys (Van Inwagen, 1990, 27). For example, particles arranged heart-

wise are among particles human organism-wise, particles arranged leg-wise are among particles arranged table-wise and so on. Suppose then that Nihilism is true, and hence, gut bacteria cannot be parts of a human organism (there are no gut bacteria or human organisms). Nonetheless, there is still the question of whether particles arranged gut bacteria-wise are among particles arranged human-organism-wise. According to the immunological solution to the Problem of Biological Arrangement, the answer is yes, given that particles arranged human organism-wise, along with particles arranged gut bacteria-wise, are immunologically related. On the other hand, according to the evolutionary solution to the Problem of Biological Arrangement, the answer is no because particles arranged human organism-wise plus particles arranged gut bacteria-wise do not jointly act as a unit of selection. Hence, this disagreement between proponents of the Evolutionary Account about whether gut bacteria are parts of a human organism can be understood in a Nihilist-friendly way.

In summary so far, we can see that there are Nihilist-friendly ways of understanding the Problem of Biological Individuality and its solutions which are just as good as their original counterparts if one's aims are primarily to do with explanatory power in biology rather than metaphysical interests about biological individuals. Hence, if it turns that that Nihilism is true, philosophers of biology involved in this debate can continue more or less as they were by replacing questions about biological individuality with questions about particles arranged biological individual-wise. Nihilism, then, need not be a problem for philosophers of biology involved in this debate.

6.4. Agnostic Fictionalism about Biological Individuality

Despite it being possible in theory to understand the Problem of Biological Individuality and answers to it in a Nihilistic-friendly way, without losing explanatory power, doing so, however, will probably prove to be impractical and difficult. Talking about ‘particles arranged biological individual-wise’ and ‘sets of particles arranged biological individual-wise’ is a mouthful, and understanding immunological and evolutionary processes in terms of the joint interactions particles won’t always be easy in practice, and perhaps impossible given our current scientific knowledge. I don’t really know, for example, how to translate the sentence ‘this biological individual has a bottleneck lifecycle’, into a sentence about particles.

As a result, if Nihilism is true, it may still be useful to think and act *as if* there are biological individuals. Put differently, if Nihilism is true, it may nonetheless be useful to take the existence of biological individuals to be a *useful fiction*.

6.4.1. Fictionalism in Philosophy

Philosophers have often adopted fictionalism about a number of different subject matters in philosophy such as ethics, mathematics and unobservable scientific entities.⁸⁹ According to Fictionalism about a subject matter or discipline, we should take the existence of entities posited by that subject matter or discipline to be a fiction. The idea of truth according to a fiction is familiar when it comes to films and novels. When I say, ‘Hermione is a witch’, what I say is not literally true.⁹⁰ Rather it is true according to the fiction of JK Rowling’s Harry Potter universe. Philosophers often accept fictionalism about certain entities because it has

⁸⁹ See Kroon (2011) for a good discussion of fictionalism in metaphysics.

⁹⁰ Admittedly, there is some controversy about how to understand the truth of fictional sentences. See, for example, Thomasson (1999) and Van Inwagen (2003) who take fictional sentences to often be literally true.

been thought that a theory that postulates the existence of a particular sort of entity does not have to be true to be good (Kalderon, 2005). In other words, postulating the existence of particular entities can be useful, regardless of whether those entities exist.

Philosophers of biology have sometimes recommended fictionalism about certain biological phenomena. One example is fictionalism about species, which is motivated by the difficulties in providing an account of the nature of species (Godfrey-Smith, 2014, 107). Arnon Levy has also argued for fictionalism about informational phenomena in biology, such as talk of cell ‘communication’ and ‘messages’, taking such talk to be a useful fiction for talking about underlying causal processes (Levy, 2011).

An important example of fictionalism in metaphysics, which will be useful for our purposes, is Rosen and Dorr’s Agnostic Fictionalism about composition (Rosen & Dorr, 2002). Rosen and Dorr argue that faced with the difficulty of determining the right answer to the Special Composition Question, and the real possibility that Nihilism may be true, we should suspend our judgement about whether there are any composites. Nonetheless, for the purposes of everyday life and scientific practice, we should take the existence of composites such as buses, maps, human beings and molecules, to be a useful fiction. As they say,

It is possible to regard the idea of composition as a fiction to live by. We speak as if composite things were ubiquitous. But we need not, in so speaking, take on a commitment to this hypothesis. We may take a light-hearted stance toward our discourse about composition...so far as we can see, nothing of scientific or practical importance is thereby lost (Rosen & Dorr, 2002, 169).

Similarly, Dorr says,

It is just too obvious that most of our purposes would be worse served if we had to go around saying things like ‘the things arranged chair-wise are under the things arranged table-wise’ instead of ‘the chair is under the table (Dorr, 2005, 255).

Suppose, for example, that there are no maps, because Nihilism is true. Nonetheless, it would probably be useful to pretend that there are maps for the purpose of finding our way to our destination. The same may be true in the sciences too. Suppose a chemist has become interested in the Special Composition Question and now is unsure about whether there are any composites such as molecules and atoms. Adopting fictionalism about composition, they may say the following:

I don’t know if it really is the case that a water molecule is made of two atoms of hydrogen and one of oxygen, because Nihilism might be true. Nonetheless, if there were composites such as molecules, then it is true that a water molecule is made of two atoms of hydrogen and one of oxygen.⁹¹

It is important to note that Rosen and Dorr are not suggesting that the existence of composite objects is a matter of convention.⁹² Rather, their view is that even if composites do not exist, it is nonetheless useful to think and act as if they do.

⁹¹ This example is from Rosen and Dorr (2002, 169-70).

⁹² For a view like this, see Pierce (2017).

6.4.2. Agnostic Fictionalism about Biological Individuality

Drawing on Rosen's and Dorr's Agnostic Fictionalism about composition, I suggest that in a similar way that philosophers of biology are sometimes fictionalists about entities such as species and information, philosophers of biology involved in the debate about biological individuality need only be Agnostic Fictionalists about biological individuals.⁹³ According to Agnostic Fictionalism about biological individuality, we need not be concerned with whether answers to the Problem of Biological individuality are true, but only with whether they are useful for the biological sciences.⁹⁴ Instead of asking how to count biological individuals, as the Problem of Biological individuality asks, according to Agnostic Fictionalism, philosophers of biology need only ask what the most useful way to count biological individuals is.⁹⁵

Agnostic Fictionalism is compatible with Nihilism (and the other eliminativist views discussed in chapter 4, such as an ontology of temporal parts and the Stage View) whilst preserving the usefulness of solutions to the Problem of Biological Individuality as they are currently understood. Consider the Evolutionary Approach, which is false if Nihilism is true. Agnostic Fictionalism, however, says that this does not matter. Rather, what matters is whether the

⁹³ Demarest and Wolfe (2017) ask whether organisms are real or a fiction, but their idea of organisms as fictions is different from mine. They, for example, do not deny that there are organisms. As they say, 'Organisms exist in a trivial sense, since the things we traditionally recognize as organisms such as a fly...are...as real as tables and chairs' (Demarest & Wolfe, 2017, 2). As I understand it, when they ask whether organisms are real or a fiction, they are asking whether organisms have irreducible properties, their fictionalist view being the view that it is useful to act as if organisms have irreducible properties when they in fact do not (Demarest & Wolfe, 2017, 2-3). Unlike Demarest and Wolfe's fictionalism, mine does not take the existence of organisms or biological individuals for granted, but is open to the possibility that there aren't any at all.

⁹⁴ A view along these lines has actually also been suggested and then rejected by Martens and Guay (Martens & Guay, 2020).

⁹⁵ My suggestion here seems somewhat similar to Kenneth Water's approach to questions about biological individuality. According to Waters, philosophers of biology should not ask the question, 'what is a biological individual?'. Rather, he argues that they should consider which accounts of biological individuality best serve those purposes. As he says, 'I am not interested in joining the debate about whether this or that kind of biological entity is a "real individual". My interest is to advance pragmatism' (Waters, 2018, 103). As I understand it, though, the reason for this is because he thinks that the question of how the biological world is divided up into distinct biological individuals does not have an objective answer. In this chapter, I remain silent on that issue.

account is useful, which may well be the case if one is interested in making predictions about evolutionary processes, such as measuring the spread of a trait in a population. Suppose, for example, that in a region there are particles arranged aphid-wise, and particles arranged *Buchnera aphidicola*-wise. If Nihilism is true, there are no composite objects in this region. Nonetheless, for making predictions in evolutionary biology, it may be useful to think of all these particles as parts of a single biological unit, and hence to take there to be one biological individual in that region. The proponent of the Evolutionary Approach, then, who has dipped into the metaphysics literature about composition might say the following:

I don't know whether an aphid and its *Buchnera aphidicola* are parts of a single biological individual because ultimately, I don't know what the right answer to the Special Composition Question is. Perhaps composition never occurs, or perhaps it always occurs. Nonetheless, it is useful to think and act as if they do compose a single biological individual when thinking about evolutionary transitions and parent-offspring lineages, and that is all that matters for my purposes. I will leave questions about composition to metaphysicians.

6.4.3. Avoiding Other Metaphysical Issues

Regardless of Nihilism, Agnostic Fictionalism would also allow philosophers of biology to entirely side-step the other metaphysical questions and worries discussed in earlier chapters.

Firstly, it would allow proponents of the Physiological Approach to avoid the Foetus Problem. We saw that proponents of the Physiological Approach face the difficult question of explaining what happens to a foetus when an organism comes into existence. We saw that perhaps

proponents of the Physiological Approach can respond to this problem by accepting van Inwagen's account of composition, but, as I argued, it is questionable whether this solution is a particularly nice one, and furthermore, whether there is a good enough reason for accepting van Inwagen's over Nihilism. At any rate, by adopting Agnostic Fictionalism, philosophers of biology do not need to worry about any of this. Even though the Physiological Approach may face metaphysical problems such as the Foetus Problem, for some biological purposes, it may nonetheless be useful to take biological individuals to be physiological wholes.

Secondly, adopting Agnostic Fictionalism would allow proponents of Pluralist Approach to avoid worries to do with personal identity. As we saw, the Pluralist Approach is not just in conflict with Animalism, but with many other of the usual accounts of what we are in the personal identity debate such as the Constitution View and the Temporal Parts View. The problem arises because the Pluralist Approach takes there to be at least two distinct kinds of biological individuals which are equally good candidates for being the beings that we are. Perhaps proponents of the Pluralist Approach can respond to this problem by accepting a view such as Relativism About What We Are, but we saw that this is controversial. At any rate, by adopting Agnostic Fictionalism, philosophers of biology can stay away from these difficult questions. Regardless of whether there really are two distinct but overlapping biological individuals – a metaphysical issue - philosophers of biology could take the existence of these distinct individuals to be a useful fiction. For example, when thinking about transplants, perhaps it is useful to take there to be Immunological individuals, but when doing evolutionary biology, perhaps it is useful to take there to be Evolutionary individuals. By adopting Agnostic Fictionalism, then, philosophers of biology could receive the benefits of the Pluralist Approach, but without incurring controversial metaphysical commitments to do with personal identity.

More generally, by adopting Agnostic Fictionalism philosophers of biology need not worry about what the right answer to the Problem of Biological Individuality is. If one's main aims are explanatory power and useful in biology, then philosophers of biology need not worry about which approach to biological individuality is the 'right one', but only about which approach or approaches are the most useful for a given purpose. Adopting Agnostic Fictionalism will probably mean that many philosophers of biology will prefer the Pluralist Approach, given that it is mostly thought that different approaches to biological individuality are useful for different purposes. There is, however, still a debate to be had about this. It may be the case that adopting a monistic approach is more useful, being simpler than the Pluralist Approach. This would be the case if a monistic account can serve the diverse needs of philosophers of biology. Clarke (2013), for example, argues that her monistic version of the Evolutionary Account captures what many different accounts of individuality have in common. Some philosophers, however are sceptical of this claim, and have argued that the Pluralist Approach is more useful (DiFrisco, 2019; Sterner, 2015). There is still a debate to be had, then, about whether a monist or pluralist approach to the Problem of Biological Individuality is the most useful, or about which approach is the most useful for a particular context.

Finally, Adopting Agnostic Fictionalism allows philosophers of biology to avoid another difficult question, which I have not yet discussed, but will do so now briefly. As we have seen in this chapter, it is generally agreed among philosophers of biology that we should answer the Problem of Biological Individuality by considering which solution (or solutions) is the most useful for our biological interests or purposes. One question, though, is why we should think that the right solution (or solutions) to the Problem of Biological Individuality is the one that is the most useful. That is, why should we think the right account of how to count organisms, or the right way to characterise organisms (when something counts as an organism, what parts

they have, and so on) should be related to our biological interests? Perhaps, it might be thought, the right solution to the Problem of Biological Individuality is one that is not particularly useful.⁹⁶

There are a number of responses that the philosopher of biology could give to this worry. They might argue, for example, that a solution being useful for our interests is an indication that it is true – that it tracks the truth. Or perhaps they might argue that the questions of how to count organisms, or of when something counts as an organism, are somehow mind-dependent or interest-relative, so will inevitably be tied up with our interests.

These responses may have some appeal, but they raise a number of tricky metaphysical questions about how our interests are related to the structure of the world. By adopting Agnostic Fictionalism, philosophers of biology need not be concerned about these issues. This is because the Agnostic Factionalist about biological individuality is not concerned about which solution or solutions to the Problem of Biological Individuality are true, but only about which are the most useful for our biological purposes and interests.

In summary, then, adopting Agnostic Fictionalism allows philosophers of biology to side-step metaphysical questions facing their accounts, such as the Foetus Problem, problems about personal identity, composition, and difficult questions about the relationship between objective reality and our biological interests, all whilst preserving the benefits of their usual approaches

⁹⁶ Franklin-Hall (2015, 934) has raised a similar worry for realism about natural kinds – the view that natural kinds are not mind dependent or interest relative. As she says, realists usually determine which kinds are natural by considering which kinds have predictive or explanatory power. Why though, she asks, should we think that our scientific interests are coordinated with how the mind dependent world is? That is, why think that when a putative kind is useful for our scientific interests, this is a guide to the kind being mind dependent? The worry is that the realist may have to say that ‘we were lucky that we developed interests that lined up so well with the mind-independent natural kinds’.

to Biological Individuality. I think, then, that this is a good reason for philosophers of biology involved in the Problem of Biological Individuality to adopt Agnostic Fictionalism.

6.5. Agnostic Fictionalism and Process Ontology

Can Agnostic Fictionalism be applied to the Substance-or-Process Question? That is, would philosophers of biology be happy for the claim that biological individuals are process to be a useful fiction?

It seems to me that the majority of process philosophers would not be happy to accept Agnostic Fictionalism. This is because whilst some philosophers in this debate think that taking biological individuals to be processes may be important for biology (Dupré & Nicholson, 2018, 4), the debate is primarily a debate about the metaphysical nature of biological individuals. In other words, philosophers in this debate want to know whether biological individuals *really* are substances or processes. Most of them, then, would not be happy with the weaker position which takes the view that biological individuals are processes (or substances) to be a useful fiction.

There are, however, some philosophers, who think that it is useful to take biological individuals to be process, and who are less interested in the ontological question of whether biological individuals are ‘really’ substances or process. As Pradeu says,

I do not think that it is possible to prove the ontological claim that the world is ‘really’ made of processes; and, if this is indeed the claim that process philosophers of biology want to make, then they must give an argument for it. However, it is possible to give good

arguments in favour of the adoption of an *epistemological* process view and to show that, from the epistemological point of view, the decision to interpret the world in terms of processes (rather than of already individualized things) makes an important difference to scientific work, because it leads to different perspectives and potentially to different experimental programs (Pradeu, 2018, 105).

Chapter 2 should have shown that it is doubtful that taking biological individuals to be processes is any more useful than taking them to be substances. At any rate, we could still apply Agnostic Fictionalism to the Substance-or-Process Question. Rather than asking whether biological individuals are substances or processes, we can instead ask whether it is more useful to take biological individuals to be substances or processes. This understanding of the Substance-or-Process Question won't satisfy those philosophers of biology who are interested in the metaphysical question of whether biological individuals 'really' are substances or process, but it might satisfy those philosophers, such as Pradeu, whose interests in the Substance-or-Process Question are mostly epistemological rather than metaphysical.

Since, however, I think that Agnostic Fictionalism is more appropriate when applied to the Problem of Biological Individuality, I will focus on this in the remainder of the chapter.

6.6. How Agnostic Fictionalism about Biological Individuality Differs from Promiscuous Realism

Some readers might be wondering how Agnostic Fictionalism differs from Dupré's *Promiscuous Individualism*, which I discussed at the end of chapter 2. As a recap, according to Promiscuous Individualism, there are many equally legitimate ways of counting biological individuals, and how we decide to do so is dependent on our interests. This is not because he thinks that it is up to us, or a matter of convention, which biological individuals exist. Rather,

he thinks that there are a vast number of different kinds of biological individuals, and which ones we decide to focus on is dependent on our interests. Given Dupré's Promiscuous Realism, I imagine that, similar to Agnostic Fictionalism, he would say that rather than asking how to count biological individuals, we should instead ask what the most useful way to count biological individuals is.

The difference, however, is that Promiscuous Individualism takes there to be many different kinds of biological individuals. It holds that which ones we decide to focus on, or count, will be based on our interests. In contrast, Agnostic Fictionalism is not committed to the existence of biological individuals at all, leaving it open whether there are any. It simply holds that regardless of whether there are any biological individuals, or how many there are, it is useful to think and act as if there are biological individuals, and to count them in certain ways. Agnostic Fictionalism, then, is much less metaphysically controversial than Promiscuous Individualism. Given, for example, that Promiscuous Individualism takes there to be many kinds of distinct biological individuals, it suffers from the same worries facing the Pluralist Approach regarding personal identity discussed in chapter 3. Adopting Agnostic Fictionalism, as we have seen, would allow philosophers of biology to avoid this worry

6.7. Objection: Emergence

I have argued that the existence of biological individuals does not seem particularly important for philosophers of biology involved with the Problem of Biological Individuality given that biological activity can be understood in terms of the collective activity of particles.

It might be argued, however, that the activities of organisms cannot even in principle be explained in terms of the joint activity of particles. In particular, some philosophers have argued that some composite objects have *emergent* properties – their properties cannot be understood or explained in terms of the properties of their parts, even jointly. This view has been called ‘Emergentism’.⁹⁷ Consider, for example a composite thing’s mass. This is not an emergent property because it can be understood simply as a summation of the individual masses of its particles. On the other hand, mental properties have been said by some philosophers to be emergent, given the difficulty of understanding how consciousness could be explained in terms of the joint activity of lots of particles or neurons firing (Chalmers, 2006; Merricks, 2001).

If biological individuals did have emergent properties, this would cause trouble for my claim that the activity of organisms could be entirely understood in terms of the activity that lots of particles jointly perform. It would suggest that particles only jointly figure in many biological explanations insofar as they compose *composites* things (biological individuals) that figure in biological explanations. For this reason, Martens and Guay reject Nihilism. As they write,

In the case of organisms, however, our prospects for a reductive explanation are almost nil. For, unlike storms, the description of their structure necessarily involves a *functional* dimension that is completely alien to the language of physics (Martens & Guay, 2020, 35).

⁹⁷ There are a number of ways of understanding Emergentism. See Wilson (2015) for an in-depth discussion of this.

It is not entirely clear what Martens and Guay mean by this passage, but perhaps they mean that organisms have properties such as ‘having a metabolism’, which cannot be understood as being performed by an organism’s particles jointly.

I see no reason, however, why such properties could not be understood in terms of the properties that many particles have jointly. Of course, if there are no biological individuals, then metabolic activity does not maintain the organism through the constant gaining and losing of matter, but I don’t see why we could not understand such activity as being activity performed jointly by many particles. Rather than, saying, for example, that metabolic activity expels matter from an organism, we could say that metabolic activity, which is collectively performed by many particles, collectively expels particles that are among particles arranged biological individual-wise.

Dupré has also argued that organisms, or part of organisms, have emergent properties (Dupré, 2012b). Here are two of his examples. Firstly he argues that the activities of the cells of multicellular organisms cannot be understood simply in terms of the activity of the cell’s parts, but also depend on the interaction that the cell has with other things in its environment, such as other parts of an organism (Dupré, 2012d, 95-96). Secondly, he argues that the activity of DNA often depends on environmental conditions of DNA. He takes methylation to be such an example, the process where environmental conditions result in the modification of the cytosine molecule - a base in a sequence of DNA (Dupré, 2012c, 82-83, 2012e, 108). One such environmental condition is maternal care, which can affect the coding sequence of offspring DNA (Dupré, 2012c, 82-83).

I think, however, that Dupré's examples only establish that living things (if they exist) have causal powers that are extrinsic; that is, he only establishes that the activities of living things is often dependent on their interactions with their surroundings. If this is true, then two intrinsically identical cells which had different surroundings would have different properties, or perform different activities. It does not establish, however, that the activities of cells cannot be understood entirely in terms of the joint activities of particles. It may be the case that what a cell does often depends on its interactions with its environment, and hence understanding what a cell does requires more than simply observing the activities of particles arranged cell-wise. But we can nonetheless understand what is going on with cells entirely in terms of particles rather than cells or organisms. For example, if Nihilism is true, we should say that the collective activity of particles arranged cell-wise is often dependent on the interactions that those particles (or some of those particles) have with some other particles not arranged cell-wise, or particles arranged other cell-wise. There is no immediate reason, then, why such examples show that organisms or cells have properties or activities that cannot be understood as being activity performed by many particles jointly.

6.8. Are Philosophers of Biology and Metaphysicians Speaking Different Languages?

I have argued that the Problem of Biological individuality and its solutions can be reframed in a Nihilistic-friendly way. It might be argued instead, however, that the problem and its solutions, as they are currently understood, are already compatible with Nihilism, and more generally, with any answer to the Special Composition Question.

Why should we think this? Well, it might be thought that metaphysicians are philosophers of biology (involved in the Problem of Biological Individuality) are not actually in disagreement because they are speaking different languages. As such, when the philosopher of biology says, ‘there are five biological individuals in this region’, what they say is compatible the Nihilist’s use of the sentence, ‘there are no biological individuals in this region’.

More specifically, it might be thought that there are at least two different meanings of ‘exist’, one used by metaphysicians, which we can call *exist-m* and one used by philosophers of biology, which we can call *exist-b*.⁹⁸ When the philosopher of biology says that there are five biological individuals in a region, what they mean is that in a region, there *exist-b* five biological individuals in a region, whilst when the nihilist says that there are no biological individuals in a region, what they mean is that there *exist-m* no biological individuals in a region. Given that *exist-b* and *exist-m*, have different meanings, then philosophers of biology (who provide solutions to the Problem of Biological Individuality) and Nihilists are not actually in disagreement. The philosopher of biology could agree with the Nihilist, for example, that biological individuals not do *exist-m*, whilst holding that they do *exist-b*. Similarly, the Nihilist could agree with philosophers of biology that biological individuals *exist-b* whilst consistently denying that they *exist-m*.

It might be argued that in the language of the philosophy of biology, particles being arranged biological individual-wise is sufficient for a sentence of the form ‘biological individuals exist’ to come out as true (where proponents of the Physiological Approach and the Evolutionary Approach disagree about what it is for particles to be arranged biological individual-wise). On the other hand, in the language of metaphysics, it is debatable whether particles being arranged

⁹⁸ This draws on Hirsch’s idea of ‘Quantifier Variance’ (2002). See also Putnam (1987).

biological individual-wise is sufficient for a sentence of the form ‘biological individuals exist’ to come out as true. The Nihilist, at least, will say that it is not.

Why should it be thought that metaphysicians and philosophers of biology mean different things by exist? One reason, it might be thought, is because metaphysicians and philosophers of biology have different interests. As we have seen, philosophers of biology are more concerned with explanatory power and usefulness in biology, whilst metaphysicians are more concerned with solving metaphysical puzzles.

The view that philosophers often mean different things by exist in metaphysical disputes and so are not really in disagreement is a topic that would require much more space to discuss properly. I don’t however, find the idea plausible. It seems as appealing as saying that despite appearances, atheism and theism are compatible because atheists and theists are speaking different languages. Furthermore, it is far from clear that because philosophers have different interests, they must mean different things by ‘exist’.

Furthermore, even if philosophers of biology and metaphysicians are speaking different languages, some of the metaphysical puzzles facing views in the philosophy of biology that I discussed earlier in this thesis (or at least analogous versions of these problems) will still arise. It still seems, for example, that proponents of the Physiological Approach will face a version of the Foetus Problem, even if they are using exist-b. Similarly, even if proponents of the Pluralist Approach are using exist-b, it still seems that in their language, they will face a version of the Too-Many-Thinkers Problem. Unlike adopting Agnostic Fictionalism, then, this solution will not help philosophers of biology avoid some of the worries facing their accounts discussed earlier in the thesis.

6.9. Conclusion

I have presented a novel way of understanding the Problem of Biological Individuality and its solutions. This would allow philosophers of biology to avoid the metaphysical challenges facing their views that were discussed in this thesis, whilst allowing them to keep the explanatory benefits of their preferred theories of biological individuals. Agnostic Fictionalism won't be appealing to everyone. It won't, for example, be appealing to those philosophers of biology who are more metaphysically-inclined and who want to know what biological individuals are *really like*. For this reason, many philosophers of biology involved in the Substance-or-Process Question will probably not want to adopt Agnostic Fictionalism about their debate. As I hope to have shown, though, most philosophers of biology interested in the Problem of Biological Individuality have more pragmatic concerns, and are primarily interested in the debate because of its usefulness for biology. I think, then, that there are good reasons for them to accept Agnostic Fictionalism.

Conclusion

This thesis has been concerned with the metaphysics and philosophy of biology of biological individuals (or organisms). Whilst metaphysicians and philosophers of biology rarely engage in each other's work, I hope to have shown that each can contribute to the others' discipline.

On the one hand, I hope to have shown in the early chapters that metaphysics is important to the philosophy of biology. By doing some metaphysics, we see that some popular views about biological individuals in the philosophy of biology have worrying metaphysics implications, for example, to do with early mammalian development and personal identity. Some metaphysical views, as we saw, are even in tension with the very existence of biological individuals. Metaphysics, however, also plays a more positive role in the philosophy of biology. As we saw in the final chapter, tools of metaphysics, such as fictionalism, can allow philosophers of biology to entirely avoid metaphysical worries, whilst allowing them to keep all the benefits of their preferred accounts of biological individuality. Furthermore, a serious consideration of metaphysics shows that at least one view in the philosophy of biology – the view that biological individuals are processes rather than substances – has not yet been persuasively argued for, and suggests what a radical processual view may look like.

On the other hand, I argued that the philosophy of biology can contribute to debates in metaphysics. In particular, I showed that the philosophy of biology can allow metaphysicians to provide a scientifically-informed and clear answer to the Special Composition Question, and that debates about biological individuals are relevant to theories of personal identity.

Despite philosophers of biology and metaphysicians often having different interests, the philosophy of biology and metaphysics should not, therefore, be done independently of each other; progress can be made in each discipline when philosophers of biology and metaphysicians interact. I hope, therefore, that this thesis has contributed to the ambitious aim of determining how metaphysics and the philosophy of biology are related, and how they should be related.

There are a number of leftover questions in this thesis. For example, whilst I argued that there are reasons for thinking that the Evolutionary Approach to the Problem of Biological Individuality avoids the Foetus Problem if we accept Clarke's version of the approach, there may be versions of the Evolutionary Approach which do not avoid it. Furthermore, I did not focus too much on the metabolic version of the Physiological Approach because in its current form, it is too vague. Perhaps, however, there is a way of making it more precise. One question, then, is whether it is possible to formulate a more precise metabolic version of the Physiological Approach which avoids the Foetus Problem.

Another question is whether the Massy Process View I discussed at the end of chapter 2 has anything going for it. As I said, I can't imagine that many will find it attractive, but there may be some arguments in its favour. If there are, then there may be some good reasons for abandoning an ontology of substances for the living world, and embracing a version of process ontology. Furthermore, I said that the Massy Process View would have important implications for debates in biology and the philosophy of biology, such as the Problem of Biological Individuality. It would be interesting to see, however, what other implications it might have, for example, for debates about personal identity.

An important conclusion of chapter 6 was that the Problem of Biological Individuality, once reformulated, can be conducted relatively independently of metaphysical questions about material objects. One further question is whether this conclusion applies to other questions in the philosophy of biology too, for example, about the nature of genes and species, or the conflict between reductionists and non-reductionists. Can these debates also be performed independently of metaphysical debates?

Finally, the majority of this thesis has been concerned with how metaphysics can contribute to debates about biological individuals in the philosophy of biology. Apart from questions about composition and personal identity, how else might the philosophy of biology contribute to debates in metaphysics? These are all questions for another time.

References

- Aristotle. (1963). *Categories and De Interpretatione*. Translated with notes by J. Ackrill. Oxford: Oxford University Press.
- Aristotle. (1994). *Metaphysics, Books Z and H (Clarendon Aristotle Series)*. Translated with commentary by D. Bostock. Oxford: Clarendon Press.
- Baker, L. R. (2000). *No Persons and Bodies: A Constitution View*. Cambridge: Cambridge University Press.
- Baker, L. R. (2007). *The Metaphysics of Everyday Life*. Cambridge: Cambridge University Press.
- Baptiste, E., & Dupré, J. (2013). Towards a processual microbial ontology. *Biology and Philosophy*, 28(2), 379–404.
- Bertolaso, M., & Dupré, J. (2018). A Processual Perspective on Cancer. In *Everything Flows : Towards a Processual Philosophy of Biology* (pp. 321–336). Oxford: Oxford University Press.
- Blatti, S. (2020). Animalism. In E. N. Zalta (Ed.), *The Stanford Encyclopedia of Philosophy* (Fall 2020).
- Boden, M. A. (1999). Is metabolism necessary? *British Journal for the Philosophy of Science*, 50(2), 231–248. <https://doi.org/10.1093/bjps/50.2.231>
- Booth, A. (2014). Symbiosis, selection, and individuality. *Biology and Philosophy*, 29(5), 657–673. <https://doi.org/10.1007/s10539-014-9449-8>
- Bouchard, Frédéric. (2018). Symbiosis, Transient Biological Individuality, and Evolutionary Processes. In Dupré, John & D. Nicholson (Eds.), *Everything Flows : Towards a Processual Philosophy of Biology*. Oxford: Oxford University Press.
- Boyle, A. (2020). Conjoined twinning & biological individuation. *Philosophical Studies*, 177(8), 2395–2415. <https://doi.org/10.1007/s11098-019-01316-x>
- Brenner, A. (2018). Science and the special composition question. *Synthese*, 195(2), 657–678. <https://doi.org/10.1007/s11229-016-1234-6>
- Brigandt, I., & Love, A. (n.d.). Reductionism in Biology. In E. N. Zalta (Ed.), *Encyclopedia of Philosophy*.
- Bueno, O., Chen, R.-L., & Fagan, M. (2018). Individuation, Process, and Scientific Practices. In O. Bueno, R.-L. Chen, & M. Fagan (Eds.), *Individuation, Process, and Scientific Practices* (pp. 1–18). Oxford: Oxford University Press.
- Campbell, R. (2015). *The Metaphysics of Emergence*. Palgrave Macmillan.
- Campbell, T., & McMahan, J. (2010). Animalism and the varieties of conjoined twinning. *Theoretical Medicine and Bioethics*, 31(4), 285–301. <https://doi.org/10.1007/s11017-010-9150-0>
- Carter, W. R. (1988). Our bodies, our selves. *Australasian Journal of Philosophy*, 66(3), 308–319.
- Caves, R. L. J. (2018). Emergence for Nihilists. *Pacific Philosophical Quarterly*, 99(1), 2–28. <https://doi.org/10.1111/papq.12148>
- Chalmers, D. (2006). Strong and weak emergence. In P. Clayton & P. Davies (Eds.), *The Re-Emergence of Emergence: The Emergentist Hypothesis From Science to Religion*. Oxford: Oxford University Press.
- Chisholm, R. (1976). *Person and Object*. Abingdon Oxon: George Allen & Unwin Ltd.
- Clarke, E. (2010). The Problem of Biological Individuality. *Biological Theory*, 5(4), 312–

- Clarke, E. (2011). Plant Individuality and Multilevel Selection Theory. In B. Calcott & K. Sterelny (Eds.), *The Major Transitions in Evolution Revisited*. Cambridge Massachusetts: MIT Press.
- Clarke, E. (2012). Plant individuality: A solution to the demographer's dilemma. *Biology and Philosophy*, 27(3), 321–361. <https://doi.org/10.1007/s10539-012-9309-3>
- Clarke, E. (2013). The Multiple Realizability of Biological Individuals. *Journal of Philosophy*, 110(8), 413–435. <https://doi.org/10.5840/jphil2013110817>
- Clarke, E. (2014). Origins of evolutionary transitions. *Journal of Biosciences*, 39(2), 303–317. <https://doi.org/10.1007/s12038-013-9375-y>
- Clarke, E. (2016). A levels-of-selection approach to evolutionary individuality. *Biology and Philosophy*, 31(6), 893–911. <https://doi.org/10.1007/s10539-016-9540-4>
- Clarke, E. (2021). Is evolution fundamental when it comes to defining biological ontology? yes. In S. Dasgupta & B. Weslake (Eds.), *Current Controversies in philosophy of science*. Routledge.
- Clarke, & Okasha, S. (2013). Species and Organisms: What are the problem? In P. Huneman & F. Bouchard (Eds.), *From Groups to Individuals: evolution and emerging individuality*. MIT Press.
- Cleland, C. E. (2012). Life without definitions. *Synthese*, 185(1), 125–144. <https://doi.org/10.1007/s11229-011-9879-7>
- Cleland, C. E., & Chyba, C. F. (2002). Defining 'life.' *Origins of Life and Evolution of the Biosphere.*, 32, 387–393.
- Cleland, C. E., & Chyba, C. F. (2007). Does "life" have a definition? In W. Sullivan & J. Baross (Eds.), *Planets and Life: The Emerging Science of Astrobiology*. Cambridge: Cambridge University Press.
- Cornell, D. (2017). Mereological nihilism and the problem of emergence. *American Philosophical Quarterly*, 54(1), 77–87.
- Cremer, S., Armitage, S. A. O., & Schmid-Hempel, P. (2007). Social Immunity. *Current Biology*, 17(16), 693–702. <https://doi.org/10.1016/j.cub.2007.06.008>
- Crowther, T. (2018). Processes and Continuants and Process as Stuff. In R Stout (Ed.), *Process, Action, and Experience* (pp. 58–81). Oxford: Oxford University Press.
- Demarest, B., & Wolfe, C. T. (2017). The organism as reality or as fiction: Buffon and beyond. *History and Philosophy of the Life Sciences*, 39(1), 1–16. <https://doi.org/10.1007/s40656-016-0128-8>
- Descartes, R. (1985). *The Philosophical Writings of Descartes. Translated by J. Cottingham, R. Stoothoff, and D. Murdoch*. Cambridge: Cambridge University Press.
- DiFrisco, J. (2018). Biological Processes: Criteria of Identity and Persistence. In D. Nicholson & J. Dupré (Eds.), *Everything Flows : Towards a Processual Philosophy of Biology* (pp. 76–95). Oxford: Oxford University Press.
- DiFrisco, J. (2019). Kinds of Biological Individuals: Sortals, Projectibility, and Selection. *The British Journal for the Philosophy of Science*, 70(3), 845–875. <https://doi.org/10.1093/bjps/axy006>
- Dorr, C. (2005). What we disagree about when we disagree about ontology. In M. Kalderon (Ed.), *Fictionalism in Metaphysics* (pp. 234–286). Oxford: Oxford University Press.
- Dorsey, J. E. (2016). On The Grounding-Reduction Link. *American*, 53(4), 411–422.
- Dupré, J. (2012a). Emerging Science and New Conceptions of Disease: Or, Beyond the Monogenomic Differentiated Cell Lineage. In *Processes of Life: essays in the philosophy of biology*. Oxford: Oxford University Press.
- Dupré, J. (2012b). It is not possible to reduce biological explanations to explanations in chemistry and/or physics. In *Processes of Life: essays in the philosophy of biology* (pp.

- 128–142). Oxford: Oxford University Press.
- Dupré, J. (2012c). The Constituents of Life 1: Species, Microbes, and Genes. In J. Dupré (Ed.), *Processes of Life: essays in the philosophy of biology* (pp. 69–84). Oxford.
- Dupré, J. (2012d). The Constituents of Life 2: Organisms and Systems. In J. Dupré (Ed.), *Processes of Life: essays in the philosophy of biology* (pp. 85–99). Oxford: Oxford University Press.
- Dupré, J. (2012e). Understanding Contemporary Genomics. In *Processes of Life: essays in the philosophy of biology*. Oxford University Press: Oxford University Press.
- Dupré, J. (2017). The metaphysics of evolution. *Interface Focus*, 7(5).
<https://doi.org/10.1098/rsfs.2016.0148>
- Dupré, J. (2020). Processes within Processes. In A. S. Meincke & J. Dupré (Eds.), *Biological identity: Perspectives From Metaphysics and the Philosophy of Biology* (pp. 149–166). Oxford: Routledge.
- Dupré, J., & Nicholson, D. (2018). A Manifesto for a Processual Philosophy of Biology. In D. Nicholson & J. Dupré (Eds.), *Everything Flows : Towards a Processual Philosophy of Biology* (pp. 1–46). Oxford: Oxford University Press.
- Dupré, J., & O'Malley, M. (2009). Varieties of Living Things: Life at the Intersection of Lineage and Metabolism. *Philosophy, Theory, and Practice in Biology*, 1.
- Evnine, S. (2016). *Making Objects and Events*. Oxford: Oxford University Press.
- Ferner, A. (2016). *Organisms and Personal Identity: Individuation and the Work of David Wiggins*. Oxford: Routledge.
- Fine, K. (1995). Ontological Dependence. *Proceedings of the Aristotelian Society*, 95, 269–290.
- Folse, H. J., & Roughgarden, J. (2010). What is an individual organism? A multilevel selection perspective. *Quarterly Review of Biology*, 85(4), 447–472.
<https://doi.org/10.1086/656905>
- Franklin-Hall, L. R. (2015). Natural kinds as categorical bottlenecks. *Philosophical Studies*, 172(4), 925–948. <https://doi.org/10.1007/s11098-014-0326-8>
- French, S. (2014). *The Structure of the world. Metaphysics and Representation*. Oxford: Oxford University Press.
- French, S., & McKenzie, K. (2012). Thinking Outside the Toolbox: Towards a More Productive Engagement Between Metaphysics and Philosophy of Physics. *European Journal of Analytic Philosophy*, 8(1), 42–59.
- Furth, M. (1978). Transtemporal Stability in Aristotelian Substances. *Journal of Philosophy*, 75(11), 624–646.
- Furth, M. (1988). *Substance, Form and Psyche: An Aristotelian Metaphysics*. Cambridge: Cornell University Press.
- Gallois, A. (1990). Occasional identity. *Philosophical Studies*, 58(3), 203–224.
- Galton, A., & Mizoguchi, R. (2009). The water falls but the waterfall does not fall: New perspectives on objects, processes and events. *Applied Ontology*, 4(2), 71–107.
- Gilbert, S. F. (2014). A holobiont birth narrative: The epigenetic transmission of the human microbiome. *Frontiers in Genetics*, 5(AUG), 1–7.
<https://doi.org/10.3389/fgene.2014.00282>
- Gilbert, S. F., Sapp, J., & Tauber, A. I. (2012). A Symbiotic View of Life : We Have Never Been Individuals. *The Quarterly Review of Biology*, 87(4), 325–341.
- Godfrey-Smith, P. (2009). *Darwinian Populations and Natural Selection*. Oxford: Oxford University Press.
- Godfrey-Smith, P. (2010). David Hull. *Biology and Philosophy*, 25(5), 749–753.
<https://doi.org/10.1007/s10539-010-9238-y>
- Godfrey-Smith, P. (2013). Darwinian Individuals. In F Bouchard & P. Huneman (Eds.),

- From Groups to Individuals: evolution and emerging individuality* (pp. 17–37). Cambridge, MA: MIT Press.
- Godfrey-Smith, P. (2014). *Philosophy of Biology*. Princeton: Princeton University Press.
- Godfrey-Smith, P. (2016). Individuality and Life Cycles. In A Guay & T. Pradeu (Eds.), *Individuals Across the Sciences* (pp. 85–102). Oxford: Oxford University Press.
- Gorman, M. (2006). Substance and identity-dependence. *Philosophical Papers*, 35(1), 103–118.
- Grose, J. (2020). How many organisms during a pregnancy? *Philosophy of Science*, 87(5), 1049–1060. <https://doi.org/10.1086/710542>
- Guay, Alexandre, & Pradeu, T. (2016a). Introduction to “Individuals Across the Sciences.” In Alexandre Guay & T. Pradeu (Eds.), *Individuals Across the Sciences*. Oxford: Oxford University Press.
- Guay, Alexandre, & Pradeu, T. (2016b). To be continued: The Genidentity of Physical and Biological Processes. In A Guay & T. Pradeu (Eds.), *Individuals Across the Sciences 2* (pp. 317–347). Oxford.
- Guay, Alexandre, & Pradeu, T. (2020). Right out of the box: how to situate metaphysics of science in relation to other metaphysical approaches. *Synthese*, 197(5), 1847–1866. <https://doi.org/10.1007/s11229-017-1576-8>
- Haber, M. (2016). The biological and the mereological: Metaphysical implications of the individuality thesis. In Alexandre Guay & T. Pradeu (Eds.), *Individuals Across the Sciences*. Oxford: Oxford University Press.
- Hawley, K. (2001). *How Things Persist*. Oxford: Oxford University Press.
- Hawthorne, J. (1995). The Bundle Theory of Substance and the Identity of Indiscernibles. *Analysis*, 55(3), 191–196.
- Hawthorne, J., & Michael, M. (1996). Compatibilist semantics in metaphysics: A case study. *Australasian Journal of Philosophy*, 117–134.
- Heller, M. (1990). *The Ontology of Material Objects: Four Dimensional Hunks of Matter*. Cambridge: Cambridge University Press.
- Hershenov, D. (2002). Olson’s Embryo problem. *Australasian Journal of Philosophy*, 80(4), 502–511. <https://doi.org/10.1080/713659533>
- Hestevold, S. (1981). Conjoining. *Philosophy and Phenomenological Research*, 41(3), 371–385.
- Hirsch, E. (1993). van Inwagen’s Material Beings. *Philosophy and Phenomenological Research*, 53, 687–691.
- Hirsch, E. (2002). Quantifier Variance and Realism. *Philosophical Issues*, 12, 51–73.
- Hoffman, J., & Rosenkrantz, G. (1997). *Substance: Its Nature and Existence*. Oxford: Routledge.
- Horgan, T., & Matjaž, P. (2000). Blobjectivism and Indirect Correspondence. *Facta Philosophica*, 2, 249–270.
- Hornsby, J. (2012). Actions and Activity. *Philosophical Issues*, 22(1), 233–245.
- Howes, M. (2007). Maternal Agency and the Immunological Paradox of Pregnancy. In H. Kincaid & J. McKittrick (Eds.), *Establishing Medical Reality: Essays in the Metaphysics and Epistemology of Biochemical Science* (pp. 179–198). Dordrecht: Springer.
- Hudson, H. (2001). *A Materialist Metaphysics of the Human Person*. Ithaca: Cornell University Press.
- Hull, D. (1976). Are Species Really Individuals? *Systematic Zoology*, 25, 174–191.
- Hull, D. (1978). A Matter of Individuality. *Philosophy of Science*, 45(3), 335–360. <https://doi.org/10.4324/9780203133972>
- Hull, D. L. (1980). Individuality and Selection. *Annual Review of Ecology and Systematics*, 11, 311–332.

- Hull, D., & Ruse, M. (2008). Preface. In D. Hull & M. Ruse (Eds.), *The Cambridge Companion to the Philosophy of Biology*. Cambridge University Press.
- Hume, D. (1978). *A Treatise of Human Nature* (Selby-Brigge, Ed.). Oxford: Oxford University Press.
- Huneman, P. (2014). Individuality as a Theoretical Scheme. I. Formal and Material Concepts of Individuality. *Biological Theory*, 9(4), 361–373. <https://doi.org/10.1007/s13752-014-0192-9>
- Huneman, P. (2020). Biological individuals as “weak individuals” and their identity. In Meincke, Anne Sophie & J. Dupré (Eds.), *Biological identity: Perspectives From Metaphysics and the Philosophy of Biology* (pp. 40–62). Oxford: Routledge.
- Jaeger, J. (2018). Foreword to 'Everything Flows: Towards a Processual Philosophical of Biology. In D. Nicholson & J. Dupre (Eds.), *Everything Flows : Towards a Processual Philosophy of Biology*. Oxford: Oxford University Press.
- Janzen, D. (1977). What Are Dandelions and Aphids? *The American Naturalist*, 111(979), 586–589.
- Kaiser, M. (2018). Individuating Part-Whole Relations in the Biological World. In O. Bueno, R.-L. Chen, & M. Fagan (Eds.), *Individuation, Process and Scientific Practices*. Oxford: Oxford University Press.
- Kalderon, M. E. (2005). Introduction. In M. E. Kalderon (Ed.), *Fictionalism in Metaphysics* (pp. 1–13). Oxford: Clarendon Press.
- Kingma, E. (2018). Lady Parts: The Metaphysics of Pregnancy. *Royal Institute of Philosophy Supplement*, 82, 165–187. <https://doi.org/10.1017/s1358246118000115>
- Kingma, E. (2019). Were You a Part of Your Mother? *Mind*, 128(511), 609–646. <https://doi.org/10.1093/mind/fzy087>
- Kingma, E. (2020a). Biological Individuality , Pregnancy , and (Mammalian) Reproduction. *Philosophy of Science*, 87, 1037–1048.
- Kingma, E. (2020b). Pregnancy and Biological Identity. In A. S. Meincke & J. Dupré (Eds.), *Biological identity: Perspectives From Metaphysics and the Philosophy of Biology* (pp. 200–2013). Oxford: Routledge.
- Korman, D. Z. (2009). Eliminativism and the challenge from folk belief. *Nous*, 43(2), 242–264.
- Korman, D. Z. (2015). *Objects: Nothing Out of the Ordinary*. Oxford: Oxford University Press.
- Koslicki, K. (2008). *The Structure of Objects*. Oxford: Oxford University Press.
- Koslicki, K. (2018). *Form, Matter, Substance*. Oxford: Oxford University Press.
- Kripke, S. (1980). *Naming and Necessity*. Cambridge, MA: Harvard University Press.
- Kroon, F. (2011). Fictionalism in Metaphysics. *Philosophy Compass*, 6(11), 786–803. <https://doi.org/10.1111/j.1747-9991.2011.00442.x>
- Ladyman, J., & Ross, D. (2007). *Every Thing Must Go: Metaphysics Naturalized*. Oxford: Oxford University Press.
- Ledford, H. (2017). Eye-opening picture of the fetal immune system emerges. *Nature*, 546, 335–336. <https://doi.org/doi:10.1038/546335a>
- Leibniz. (1991). *Discourse on Metaphysics, Translated by Daniel Garber and Roger Ariew*. Indianapolis: Hackett Publishing Company.
- Léśniewski, S. (1927). O Podstawach Matematyki [On the Foundations of Mathematics. *Przegląd Filozoficzny*, 30, 164–206.
- Levy, A. (2011). Information in biology: A fictionalist account. *Nous*, 45(4), 640–657. <https://doi.org/10.1111/j.1468-0068.2010.00792.x>
- Lewis, D. (1986). *On the Plurality of Worlds*. Oxford: Basil Blackwell.
- Lewontin, R. (1970). The Units of Selection. *Annual Review of Ecology and Systematics*,

- 1(1970), 1–18.
- Lidgard, S., & Nyhart, L. (2017). The Work of Biological Individuality: Concepts and Contexts. In S. Lidgard & L. Nyhart (Eds.), *Biological Individuality: Integrating Scientific, Philosophical, And Historical Perspectives* (pp. 17–52). Chicago: University of Chicago Press.
- Loux, M. (1991). *Primary Ousia: An Essay on Aristotle's Metaphysics Z and H*. New York: Cornell University Press.
- Lovelock, J. E., & Margulis, L. (1974). Atmospheric homeostasis by and for the biosphere: the gaia hypothesis. *Tellus*, 26(1–2), 2–10. <https://doi.org/10.3402/tellusa.v26i1-2.9731>
- Lowe, E. Jonathan. (1996). *Subjects of Experience*. Cambridge: Cambridge University Press.
- Lowe, E.J. (1998a). Substance and Dependence. In E.J Lowe (Ed.), *The Possibility of Metaphysics*. Oxford University Press: Oxford University Press.
- Lowe, E.J. (1998b). *The Possibility of Metaphysics: Substance, Identity, and Time*. Oxford: Oxford University Press.
- Mackie, D. (1999). Animalism Verses Lockeanism: No Contest. *The Philosophical Quarterly*, 49(196).
- Margulis, L. (1991). Symbiogenesis and Symbiogenesis. In L. Margulis & R. Fester (Eds.), *Symbiosis as a Source of Evolutionary Innovation*. Cambridge: MIT Press.
- Markosian, N. (1998). Brutal Composition. *Philosophical Studies*, 92(3), 211–249.
- Markosian, N. (2015). The Right Stuff. *Australasian Journal of Philosophy*, 93(4), 665–687. <https://doi.org/10.1080/00048402.2014.999001>
- Martens, J., & Guay, A. (2020). Physiological and evolutionary individuals: a metaphysical perspective. *Hal-03089620*.
- Maudlin, T. (2007). *The Metaphysics within Physics*. New York: Oxford University Press.
- McGovern, N., Shin, A., Low, G., Low, D., Duan, K., Yao, L. J., ... Ginhoux, F. (2017). Human fetal dendritic cells promote prenatal T-cell immune suppression through arginase-2. *Nature*, 546(7660), 662–666. <https://doi.org/10.1038/nature22795>
- Meincke, A. S. (2018). Persons and Biological Processes: A Bio_Processual Way out of the Personal Identity Dilemma. In D. Nicholson & J. Dupré (Eds.), *Everything Flows : Towards a Processual Philosophy of Biology2* (pp. 357–378). Oxford: Oxford University Press.
- Meincke, A. S. (2019). Autopoiesis, biological autonomy and the process view of life. *European Journal for Philosophy of Science*, 9(1), 1–16.
- Meincke, A. S. (2020). Processual animalism. In *Biological identity: Perspectives From Metaphysics and the Philosophy of Biology* (pp. 251–278). Oxford: Routledge.
- Meincke, A. S., & Dupré, J. (Eds.). (2020). *Biological Identity: Perspectives and Metaphysics and the Philosophy of Biology*. Oxford: Routledge.
- Merricks, T. (2001). *Objects and Persons*. New York: Oxford University Press.
- Morgan, W. (2021). Are Organisms Substances or Processes ? Are Organisms Substances or Processes ? *Australasian Journal of Philosophy*, 1–15. <https://doi.org/10.1080/00048402.2021.1931378>
- Morganti, M. (2013). *Combining Science and Metaphysics: Contemporary Physics, Conceptual Revision and Common Sense*. Basingstoke: Palgrave Macmillan.
- Nicholson, D. (2013). Organisms≠Machines. *Studies in History and Philosophy of Science Part C :Studies in History and Philosophy of Biological and Biomedical Sciences*, 44(4), 669–678. Retrieved from <http://dx.doi.org/10.1016/j.shpsc.2013.05.014>
- Nicholson, D. (2018). Reconceptualizing the Organism: From Complex Machine to Flowing Stream. In D. Nicholson & J. Dupré (Eds.), *Everything Flows: Towards a Processual Philosophy of Biology* (pp. 139–166). Oxford: Oxford University Press.
- Nicholson, D. (2019). Is the cell really a machine? *Journal of Theoretical Biology*, 477, 108–

126. Retrieved from <https://doi.org/10.1016/j.jtbi.2019.06.002>
- Nicholson, D. J., & Gawne, R. (2015). Neither logical empiricism nor vitalism, but organicism: what the philosophy of biology was. *History and Philosophy of the Life Sciences*, 37(4), 345–381. <https://doi.org/10.1007/s40656-015-0085-7>
- Nolan, D. (2011). Categories and Ontological Dependence. *The Monist*, 94(2), 277–301.
- O'Malley, M. (2021). Is Evolution Fundamental when it comes to biological ontology? In S. Dasgupta & B. Weslake (Eds.), *Current Controversies in philosophy of science*. Routledge.
- Oderberg, D. (2020). Siphonophores: A metaphysical case study. In A. S. Meincke & J. Dupré (Eds.), *Biological Identity: Perspectives From Metaphysics and the Philosophy of Biology* (pp. 22–39). Oxford: Oxford University Press.
- Okasha, S. (2002). Darwinian metaphysics: Species and the question of essentialism. *Synthese*, 131(2), 191–213. <https://doi.org/10.1023/A:1015731831011>
- Okasha, S. (2006). *Evolution and the Levels of Selection*. Oxford: Oxford University Press.
- Okasha, S. (2019). *Philosophy of Biology: A Very Short Introduction*. Oxford: Oxford University Press.
- Olson, E. (1997a). *The Human Animal: Personal Identity Without Psychology*. Oxford: Oxford University Press.
- Olson, E. (1997b). Was I Ever a Fetus? *Philosophy and Phenomenological Research*, 57(1), 95–110. Retrieved from <https://www.jstor.org/stable/2953779>
- Olson, E. (2001). Biological Individuality: The Identity and Persistence of Living Entities by Jack Wilson (Review). *The Philosophical Quarterly*, 51(203), 264–266.
- Olson, E. (2006). The Paradox of Increase. *The Monist*, 89(3), 390–417.
- Olson, E. (2007). *What Are We?: A Study in Personal Ontology*. Oxford: Oxford University Press.
- Olson, E. (2020). What is the problem of biological individuality? In A. S. Meincke & J. Dupré (Eds.), *Biological identity: Perspectives From Metaphysics and the Philosophy of Biology* (pp. 63–85). Oxford: Routledge.
- Olson, E. (2021). Personal Identity. In E. Zalta (Ed.), *Stanford Encyclopedia of Philosophy* (Spring 202).
- Olson, E. T. (1997). Relativism and persistence. *Philosophical Studies*, 88(2), 141–162. <https://doi.org/10.1023/A:1004210103213>
- Parfit, D. (2012). We are not human beings. *Philosophy*, 87(1), 5–28. <https://doi.org/10.1017/S0031819111000520>
- Pearce, K. (2017). Mereological Idealism. In T. Goldschmidt & K. Pearce (Eds.), *Idealism: New Essays in Metaphysics* (pp. 200–216). Oxford: Oxford University Press.
- Pemberton, J. (2019). Individuating Processes. In O. Bueno, R.-L. Chen, & F (Eds.), *Individuation, Process, and Scientific Practices* (pp. 39–62). Oxford: Oxford University Press.
- Pepper, J. W., & Herron, M. D. (2008). Does biology need an organism concept? *Biological Reviews*, 83(4), 621–627. <https://doi.org/10.1111/j.1469-185X.2008.00057.x>
- Pradeu, T. (2010). What is an organism? An immunological answer. *History and Philosophy of the Life Sciences*, 32(2–3), 247–268.
- Pradeu, T. (2012). *The Limits of the Self: Immunology and Biological Identity*. Oxford: Oxford University Press.
- Pradeu, T. (2016). Organisms or biological individuals? Combining physiological and evolutionary individuality. *Biology and Philosophy*, 31(6), 797–817. <https://doi.org/10.1007/s10539-016-9551-1>
- Pradeu, T. (2018). The Genidentity of Biological Processes. In D. Nicholson & J. Dupré (Eds.), *Everything Flows : Towards a Processual Philosophy of Biology* (pp. 96–112).

- Oxford: Oxford University Press.
- Pradeu, T. (2019). *Philosophy of Immunology*. Cambridge: Cambridge University Press.
- Pradeu, T., & Guay, A. (Eds.). (2015). *Individuals Across the Sciences*. Oxford: Oxford University Press.
- Puccetti, R. (1973). Brain Bisection and Personal Identity. *British Journal for the Philosophy of Science*, 24, 339–355.
- Putnam, H. (1987). Truth and Convention : On Davidson ' s Refutation of Conceptual Relativism Conceptual Relativism. *Dialectica*, 41(1), 69–77.
- Queller, D. C., & Strassmann, J. E. (2009). Beyond society: The evolution of organismality. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 364(1533), 3143–3155. <https://doi.org/10.1098/rstb.2009.0095>
- Queller, D. C., & Strassmann, J. E. (2016). Problems of multi-species organisms: endosymbionts to holobionts. *Biology and Philosophy*, 31(6), 855–873. <https://doi.org/10.1007/s10539-016-9547-x>
- Quine, W. (1948). On What There Is. *Review of Metaphysics*, 2, 21–38.
- Redhead, M. (1995). *From Physics to Metaphysics*. Cambridge: Cambridge University Press.
- Robinson, H. (2018). Substance. In E. N. Zalta (Ed.), *The Stanford Encyclopedia of Philosophy* (Winter 201). Retrieved from <https://plato.stanford.edu/archives/win2018/entries/substance/>
- Rosen, G., & Dorr, C. (2002). Composition as a Fiction. In R. Gale (Ed.), *The Blackwell Guide to Metaphysics*. Oxford: Blackwell Publishers Ltd.
- Rosenberg, J. F. (1993). *Review : Comments on Peter van Inwagen ' s Material Beings Reviewed Work (s) : Material Beings by Peter van Inwagen Published by : International Phenomenological Society Comments on Peter van Inwagen ' s Material Beings*. 53(3), 701–708.
- Ross, D. (2000). Rainforest Realism. In D. Ross, A. Brook, & D. Thompson (Eds.), *Dennett's Philosophy: A Comprehensive Assessment* (pp. 147–168). Cambridge, MA: MIT Press.
- Roughgarden, J., Gilbert, S. F., Rosenberg, E., Zilber-Rosenberg, I., & Lloyd, E. A. (2018). Holobionts as Units of Selection and a Model of Their Population Dynamics and Evolution. *Biological Theory*, 13(1), 44–65. <https://doi.org/10.1007/s13752-017-0287-1>
- Rudder Baker, L. (2000). *Persons and Bodies: A Constitution View*. Cambridge: Cambridge University Press.
- Ruse, M. (1989). Do Organisms Exist. *American Zoologist*, 29, 1061–1066.
- Sarkar, S. (1992). Models of reduction and categories of reductionism. *Synthese*, (91), 167–194.
- Scales, H. (2021). *The Brilliant Abyss*. London: Bloomsbury.
- Schaffer, J. (2007). From Nihilism to Monism. *Australasian Journal of Philosophy*, 85(2), 175–191. <https://doi.org/10.1080/00048400701343150>
- Seibt, J. (1990). *Towards Process-ontology: A Critical study of Substance-Ontological Premises: Ph.D Thesis at the Department of Philosophy, University of Pittsburgh*.
- Seibt, J. (1997). Existence in Time: From Substance to Process. *Boston Studies in Philosophy of Science*, 189, 143–187.
- Seibt, J. (2010). Particulars. In J. Poli, Roberto, Seibt (Ed.), *Theory and Applications of Ontology: Philosophical Perspectives* (pp. 23–57). New York: Springer Publishing Company.
- Seibt, J. (2018). Ontological Tools for the Process Turn in Biology: Some Basic notions of General Process Theory. In D. Nicholson & J. Dupré (Eds.), *Everything Flows : Towards a Processual Philosophy of Biology* (pp. 113–136). Oxford: Oxford University Press.
- Shewmon, D. A. (2001). *The Brain and Somatic Integration: Insights Into the Standard*

- Biological Rationale for Equating Brain Death With Death. *The Journal of Medicine and Philosophy*, 26(5), 457–478. <https://doi.org/10.1076/jmep.26.5.457.3000>
- Sidelle, A. (2002). Is There a True Metaphysics of Material Objects? *Philosophical Issues*, 12, 118–145.
- Sider, T. (1996). All the world's a stage. *Australasian Journal of Philosophy*, 74(3), 433–453. <https://doi.org/10.1080/00048409612347421>
- Sider, T. (1997). Four-Dimensionalism. *The Philosophical Review*, 106(2), 197–231.
- Sider, T. (2000). The Stage View and Temporary Intrinsic. *Analysis*, 60(1), 84–88.
- Sider, T. (2001a). Criteria of Personal Identity and the Limits of Conceptual Analysis. *Philosophical Perspectives*, 15, 189–209.
- Sider, T. (2001b). *Four-Dimensionalism: An Ontology in Persistence and Time*. Oxford: Clarendon Press.
- Sider, T. (2013). Against Parthood. In K. Bennett & D. Zimmerman (Eds.), *Oxford Studies in Metaphysics* (Vol. 8). Oxford: Oxford University Press.
- Snowdon, P. (1990). Person, Animals, and Ourselves. In C. Gill (Ed.), *The Person and the Human Mind* (pp. 85–107). Oxford: Oxford University Press.
- Snowdon, P. (1991). Personal Identity and Brain Transplants. *Royal Institute of Philosophy Supplement (Proceedings of the Conference on Human Beings)*, 109–126. <https://doi.org/10.4324/9781315708652>
- Snowdon, P. (2014). *Persons, Animals, Ourselves*. Oxford: Oxford University Press.
- Snowdon, P. (2020). The Nature of Persons and the Nature of Animals. In A. S. Meincke & J. Dupré (Eds.), *Biological identity: Perspectives From Metaphysics and the Philosophy of Biology* (pp. 233–250). Oxford: Routledge.
- Sober, E. (2000). *Philosophy of Biology* (2nd ed.). Colorado: Westview Press.
- Sober, E., & Wilson, D. S. (1998). *Unto Others*. Cambridge, MA: Harvard University Press.
- Spinoza. (1996). *Ethics*. London: Penguin Books.
- Sterelny, K., & Griffiths, P. (1999). *Sex and Death*. Chicago: The University of Chicago Press.
- Sterner, B. (2015). Pathways to pluralism about biological individuality. *Biology and Philosophy*, 30(5), 609–628. <https://doi.org/10.1007/s10539-015-9494-y>
- Steward, H. (2013). Processes, continuants, and individuals. *Mind*, 122(487), 781–812.
- Steward, H. (2020). Substances, agents and processes. *Philosophy*, 95(1), 41–61.
- Stone, J. (2005). Why There Still Are No People. *Philosophy and Phenomenological Research*, 70, 174–192.
- Stout, Rowland. (1997). Processes. *Philosophy*, 72(279), 19–27.
- Suárez, J., & Triviño, V. (2020). What Is a Hologenomic Adaptation? Emergent Individuality and Inter-Identity in Multispecies Systems. *Frontiers in Psychology*, 11(March). <https://doi.org/10.3389/fpsyg.2020.00187>
- Swinburne, R. (1984). Personal Identity: The Dualist Theory. In S. Shoemaker & R. Swinburne (Eds.), *Personal Identity*. Oxford: Blackwell.
- Swinburne, R. (2019). *Are We Bodies or Souls?* Oxford: Oxford University Press.
- Tahko, T. E., & Lowe, E. J. (2016). Ontological Dependence. In *The Stanford Encyclopedia of Philosophy* (Winter 201).
- Takeshita, C. (2017). From Mother/Fetus to Holobiont(s): A Material Feminist Ontology of the Pregnant Body. *Catalyst: Feminism, Theory, Technoscience*.
- Tauber, A. (1994). The immune self: theory or metaphor? *Immunology Today*, 15(3), 134–136.
- Thomasson, A. (1999). *Fiction and Metaphysics*. New York: Cambridge University Press.
- Thomasson, A. (2007). *Ordinary Objects*. Oxford: Oxford University Press.
- Thomasson, A. (2014). Public Artifacts, Intensions, and Norms. In M. Franssen, P. Kroes, T.

- Reydon, & P. Vermaas (Eds.), *Artefact Kinds* (pp. 45–62). Springer International Publishing.
- Thornton, A. K. (2019). Disembodied Animals. *American Philosophical Quarterly*, 56(2), 203–217.
- Toner, P. (2008). Emergent substance. *Philosophical Studies*, 141(3), 281–297.
- Toner, P. (2011a). Hylemorphic animalism. *Philosophical Studies*, 155(1), 65–81. <https://doi.org/10.1007/s11098-010-9522-3>
- Toner, P. (2011b). Independence accounts of substance and substantial parts. *Philosophical Studies*, 155(1), 37–43.
- Triviño, V., & Suárez, J. (2020). Holobionts: Ecological communities, hybrids, or biological individuals? A metaphysical perspective on multispecies systems. *Studies in History and Philosophy of Science Part C :Studies in History and Philosophy of Biological and Biomedical Sciences*. <https://doi.org/10.1016/j.shpsc.2020.101323>
- Tye, M. (1992). Material Beings. *The Philosophical Review*, 101, 881–884.
- Tye, M. (2003). *Consciousness and Persons*. Cambridge, MA: MIT Press.
- Unger, P. (1979). I do not Exist. In *Perception and Identity*. London: Macmillan.
- van Inwagen, P. (2003). Existence, Ontological Commitment and Fictional Entities. In M. Loux & D. Zimmerman (Eds.), *The Oxford Handbook of Metaphysics* (pp. 131–157). Oxford: Oxford University Press.
- Van Inwagen, P. (1987). When are objects parts? *Philosophical Perspectives*, 1, 21–47.
- Van Inwagen, P. (1990). *Material Beings*. Ithaca: Cornell University Press.
- Van Inwagen, P. (2007). A Materialist Ontology of the Human Person. In P. Van Inwagen & D. Zimmerman (Eds.), *Persons: Human and Divine* (pp. 199–215). Oxford: Oxford University Press.
- Van Inwagen, P. (2015). *Metaphysics* (4th ed.). Oxford: Routledge.
- Van Inwagen, P., & Sullivan, M. (2020). *Metaphysics* (Spring 202; E. Zalta, Ed.).
- Vander Laan, D. (2010). A relevance constraint on composition. *Australasian Journal of Philosophy*, 88(1), 135–145. <https://doi.org/10.1080/00048400902941299>
- Waters, K. (2018). Ask Not “What Is an Individual?”.” In O. Bueno, R.-L. Chen, & M. Fagan (Eds.), *Individuation, Process, and Scientific Practices*. Oxford: Oxford University Press.
- Wheeler, W. . (1911). The Ant Colony as an Organism. *Journal of Morphology*, 22(1), 307–325.
- Wiggins, D. (1967). *Identity and Spatio-Temporal Continuity*. Oxford: Basil Blackwell.
- Wiggins, D. (1968). On Being in the Same Place at the Same Time. *The Philosophical Review*, 77(1), 90–95.
- Wiggins, D. (1980). *Sameness and Substance*. Cambridge, Mass: Cambridge University Press.
- Wiggins, D. (2001). *Sameness and Substance Renewed*. Cambridge: Cambridge University Press.
- Wiggins, D. (2012). Identity, individuation and substance. *European Journal of Philosophy*, 20(1), 1–25.
- Wiggins, D. (2016). Activity, Process, Continuant, Substance, Organism. In *Continuants: Their Activity, Their Being, and Their Identity* (pp. 211–220). Oxford: Oxford University Press.
- Wilson, D. S., & Sober, E. (1989). Reviving the superorganism. *Journal of Theoretical Biology*, 136(3), 337–356.
- Wilson, D. S., & Sober, E. (1994). Reintroducing group selection to the human behavioral sciences. *Behavioral and Brain Sciences*, 17(4), 585–608. <https://doi.org/10.1017/S0140525X00036104>

- Wilson, J. A. (2000). Ontological butchery: Organism concepts and biological generalizations. *Philosophy of Science*, 67(3 SUPPL.). <https://doi.org/10.1086/392827>
- Wilson, Jack. (1999). *Biological individuality: The Identity and Persistence of Living Entities*. Cambridge: Cambridge University Press.
- Wilson, Jessica. (2015). Metaphysical emergence: Weak and Strong. In T. Bigaj & C. Wuthricj (Eds.), *Metaphysics in Contemporary Physics*. (pp. 251–306). Brill.
- Zhivaki, D., & Lo-Man, R. (2017). In utero development of memory T cells. *Seminars in Immunopathology*, 39(6), 585–592. <https://doi.org/10.1007/s00281-017-0650-0>
- Zilber-Rosenberg, I., & Rosenberg, E. (2008). Role of microorganisms in the evolution of animals and plants: The hologenome theory of evolution. *FEMS Microbiology Reviews*, 32(5), 723–735. <https://doi.org/10.1111/j.1574-6976.2008.00123.x>