



Exploring the philosophical concept of *my* death in the context of biology: the scholarly significance of the unknown

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Abstract

Contemplating one's own death is a core aspect in the history of Western philosophy. In the modern era, existential philosophy has inherited this tradition and established unique discussions on the concept of "*my* death," resting on the premise that this concept is unapproachable via scientific inquiry. Conversely, biological research is essentially conducted within the scope of life phenomena, with death being referred to in the sense of lifespan; thus, death is not among its inherent themes, which automatically excludes the concept of *my* death from its scope. To establish a dialogue between the two fields, this study questions the widely held premise that *my* death is unrelated to science and is best examined by philosophy. I consider the movement between continuity and discontinuity as foundational to scientific development, and integrate it with the relationship between the unknown and known. Furthermore, I extend this to the concepts of consciousness and body, and subsequently clarify and define the unknown divisions. Finally, I examine the kinds of unknowns that science confronts to interpret philosophically how an aspect of reproductive theory has unwittingly revealed a completely new dimension of life: *my* death. Overall, I argue that *my* death is an essential point of contact between philosophy and biology that reveals the scholarly significance of the unknown.

Keywords Death · Biology · Reproductive Theory · Consciousness · Body · Continuity

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1 Introduction

“True philosophers make dying their profession.”¹ As this statement of Socrates via Plato indicates, gazing upon and contemplating one’s own death has formed a core aspect in the history of Western philosophy. After being mentioned by the pre-Socratics and eventually Plato, death has been eloquently discussed by several Western philosophers—from Epicurus, the founder of the Epicurean school, to the stoics Cicero, Seneca, and Aurelius.² Over time, moralists such as Montaigne and Pascal have left behind discourses that squarely confront human death.³ With the advent of modernity, the main works of existential philosophers, such as Kierkegaard, Heidegger, Jaspers, Sartre, and Jankélévitch, also revolve around the question of death, inheriting from and further developing the Western philosophical tradition’s preoccupation with one’s own death.⁴

Although existential philosophers’ attitudes toward death show some key differences, they share a common trait: They do not address the outcomes of science in their philosophies of death.⁵ Their perspectives are based on the premise that “*my* death,” which cannot be replaced by anything else, is unapproachable via science and, therefore, is a theme peculiar to philosophy, as exemplified by Heidegger’s definition

¹ Plato (2003, p. 129).

² Aurelius (2003); Cicero (1923); Epicurus (2012); Freeman (1948); Seneca (2004); Waterfield (2000).

³ Montaigne (1993); Pascal (1910).

⁴ Heidegger (1962); Jankélévitch (1966); Jaspers (1969); Kierkegaard (1980a, 1980b); Sartre (1956). This study uses “existential philosophy” as it has generally been used in the history of philosophy without addressing such issues as the differences and relationships between existential philosophy and phenomenology and the philosophers’ positioning of their own philosophies.

⁵ The discussion here is whether existential philosophers or those in proximate fields have addressed the outcomes of biology and other sciences in their pursuit of the theme of death, not whether they were indifferent to science itself. Heidegger (1996) was especially interested in the relationship between philosophy and the sciences, under the considerable influence of Husserl (1970, 1973, 2012), the founder of phenomenology, who tried to lay the foundation for science. In terms of the concrete results of science, Merleau-Ponty (1963, 2012) closely intertwined philosophy, psychology, and physiology. In his early days, Sartre (1986, 2014) also developed his philosophy under the guidance of psychological findings. The insights of these philosophers have been inherited by contemporary philosophers interpreting the outcomes of cognitive science and neuroscience. For example, see Varela et al. (1991), Noë (1991), and Gallagher and Zahavi (2008). See Gallagher and Schmicking (2010) for a comprehensive representation of various achievements.

of the scholarly nature of biology.⁶ *My* death is a common theme in existential philosophy and has generally not been explored in the philosophy of science.⁷

By contrast, this study aims to elucidate that *my* death is an important point of contact between biology and philosophy. To this end, in Sect. 2, I discuss the movement between continuity and discontinuity as foundational to the history of science by associating it with the relationship between the unknown and the known. In Sect. 3, I delve deeper into this movement by discussing consciousness and body to clarify the concept of “*my* rearview,” and subsequently explain the three categories of the unknown. As such an investigation prompts us to question the kind of unknown that scientific activities confront, Sect. 4 overviews the relationship

⁶ Heidegger defines biology as an “ontical exploration,” distinguishing it from ontological or existential Interpretation. For him, “the existential Interpretation of death takes precedence over any biology” (1962, p. 291). He regarded the scholarly nature of biology and medicine, among others, as fundamentally different from philosophy, and, based on this distinction, he established a philosophy-specific problem sphere on the theme of death. However, Heidegger does not regard ontical exploration as inferior to existential Interpretation, and while he himself does not address the results of biology, he does not declare them irrelevant to the philosophy of death. The following sentence may well illustrate his stance: “Medical and biological investigation into ‘demising’ can obtain results which may even become significant ontologically if the basic orientation for an existential Interpretation of death has been made secure” (1962, p. 291).

⁷ To derive an accurate philosophical definition of *my* death, I must first define the concept of “Self” and “Other,” and clarify their relationship, a task that philosophers, including Hegel (1969) and Husserl (1973), have tackled in their own ways. Discussing the nature of this task, various historical arguments and my own stance exceed the scope of this study. Therefore, here, I only outline *my* death-related issues by providing an overview of the conflict between Heidegger (1962) and Sartre (1956). Heidegger emphasizes that *I* will surely die, no one can escape that fate, and in principle, *I* face this fate at all times: “No one can take the Other’s dying away from him. Of course someone can ‘go to his death for another.’ But that always means to sacrifice oneself for the Other ‘in some definite affair.’ Such ‘dying for’ can never signify that the Other has thus had his death taken away in even the slightest degree. Dying is something that every Dasein itself must take upon itself at the time. By its every essence, death is in every case mine, in so far as it ‘is’ at all. And indeed death signifies a peculiar possibility-of-Being in which the very Being of one’s own Dasein is an issue” (Heidegger, 1962, p. 284). He uses the term “Dasein” to refer to human beings, and defines their being as “Being-towards-death” (1962, p. 279). Sartre thoroughly criticizes this definition: “Death, far from being my peculiar possibility, is a contingent fact which as such on principle escapes me and originally belongs to my facticity” (1956, p. 697). Sartre emphasizes that *my* death has an unexpected character because we do not know when it will come, and that it can never be experienced: “Death is never that which gives life its meanings; it is, on the contrary, that which on principle removes all meaning from life” (1956, p. 690). This study does not delve into the validity of Sartre’s criticism of Heidegger, the true difference between the two, and the potential of their integration. Rather, it centers on the notion of “*I* cannot experience *my* death,” which underpins Sartre’s arguments. I return to Sartre in Sect. 4. Existential philosophers have not solely been concerned with *my* death. For instance, Jaspers (1969) emphasizes consideration of the death of the person closest to us, and Jankélévitch (1966) divides death into first-person, second-person, and third-person deaths to examine their mutual relationship closely. By contrast, in philosophy of biology, a school of philosophy of science, death is a fairly peripheral topic that automatically excludes the concept of *my* death from its scope (Godfrey-Smith, 2014; Hull and Ruse, 2007; Mahner and Bunge, 1997; Okasha, 2019; Rosenberg and McShea, 2008; Sober, 2000; Sterelny and Griffiths, 1999). As long as *my* death has not been addressed in biology, one can assume that *my* death has not been addressed in philosophy of biology. In this sense, *my* death can be seen as a milestone that highlights the large gap between existential philosophy and philosophy of science. This study’s attempt to intersect *my* death with science must essentially focus on the relationship between the two philosophies, but the current state of conflict or mutual indifference between the two and the possibility of their proximity are issues too extensive for this study to discuss even in part.

between biology and death, and examines the intersection between the philosophical arguments concerning *my* death and reproductive theory. Consequently, this study concretely demonstrates that the connection between biology and philosophy lies in the universal unknown in the sense that every *I* has an unknown that can be known to Others but remains unknown only to *me*, rather than relative unknown, which is usually considered in science. Finally, I suggest that the universal unknown of *my* death, which completes *my* rearview, forms the basis of science.

I note in advance that interpreting *my* death as a point of contact between biology and philosophy is an epistemological project, which does not cover all the aspects of the issues that might be involved in *my* death in general.⁸

2 Continuity and the unknown in science

2.1 Relationship between continuity and discontinuity

Physicist de Broglie's ideas from his book *Matter and Light*, written more than 80 years ago, still provide us with endless suggestions for understanding the relationship between science and philosophy:

In Physics, as in every other branch of knowledge, the problem of continuity and discontinuity has existed at all times: for in this science, as elsewhere, the human mind has always manifested two tendencies at once antagonistic and complementary. On the one hand, there is the tendency which tries to reduce the complexity of phenomena to the existence of simple elements indivisible, and capable of being counted; a tendency whose analysis of Reality seeks to reduce it to a dust-cloud of individuals. On the other hand, there is the tendency based on our intuitive notion of Time and Space, which observes the universal interaction of things and regards every attempt to disengage definite individual entities from the flux of natural phenomena as artificial. The conflict between the continuous view in Physics, and its opposite, has existed through many centuries with varying fortunes, each gaining an advantage over the other in turn, and neither winning a definite victory. For the philosopher there is nothing surprising in this, since the development of theory in every sphere of intellectual activity shows him that, if pushed to an extreme and opposed to each other, the concepts of both the continuous and the discontinuous are unable to give a correct rendering of Reality, which requires a subtle and almost indefinable fusion of the two terms of this antinomy.⁹

Although scientific activity can be characterized in various ways, following de Broglie's emphasis on continuity and discontinuity in physics, I organize its progress in terms of "divisions" that make a continuum discontinuous. For example, in

⁸ This study italicizes the individual in the universal sense (e.g., "*I*," "*my*," and "*me*") to avoid confusion with the author of this paper.

⁹ de Broglie (1939, p. 217).

physics, attempts to identify the ultimate minimum unit have revealed atoms as constituents of matter, electrons and nuclei as constituents of atoms, protons and neutrons as constituents of nuclei, and quarks as constituents of protons and neutrons. In other words, discovering a new element involves dividing something that has been considered indivisible (e.g., an atom into an electron and a nucleus). Similarly, studies in biology have discovered that a body comprises various organs (brain, heart, lungs, intestines, etc.), nerves, blood vessels, blood, bones, and so on. One organ, the brain, comprises the cerebrum, diencephalon, midbrain, cerebellum, and medulla oblongata. These components consist of cells, which consist of organelles, and one organelle, the cell nucleus, contains chromosomes. Chromosomes are made up of proteins and nucleic acids, and nucleotides, the structural units of deoxyribonucleic acid (DNA), consist of sugars, phosphates, and bases. These molecules are further made up of atoms.¹⁰

In addition, the identification of substances that cause a certain life phenomenon—for example, identifying the existence, function, and structure of DNA—has been achieved through the division process. Many biological discoveries have stemmed from trial-and-error attempts to demarcate the boundaries of living organisms accurately. Divisions are also crucial for medicine, which closely affects daily life. The structure of the human body has been clarified through anatomy, which etymologically means “cutting up.” Moreover, increased visual capacity, enabled by microscopes and diagnostic imaging equipment, has revealed the subtle mechanisms and abnormalities of small body parts, including those invisible to the naked eye, further advancing our understanding through divisions.

2.2 Relationship between the unknown and the known

As mentioned above, division that makes a continuum discontinuous yields new knowledge for science. For instance, the division of atoms is integrated with the discovery of electrons and nuclei. Before we could divide atoms, their interiors were continuous and unknown. Similarly, in biology, cells, chromosomes, nucleic acids, and other constituents comprised unknown components before they were divided and their components were revealed through their interiors' discontinuity. The pursuit of discontinuity has never ceased. Presently, every base in the human genome has been sequenced. Furthermore, research on bacteria and viruses, based on isolation and culturing, demonstrates that the discontinuity of what was previously seen as continuous is essentially a conversion of the unknown into the known. The unknown in question here is one that is not considered unknown. For example, before the discovery of electrons, atoms were considered the fundamental unit of matter, and before the discovery of *Helicobacter pylori*, bacteria were considered incapable of surviving in gastric acid.

In the schematic relationship between the unknown and known, the unknown is unified with continuity and the known with discontinuity. If science aims to replace all unknowns with knowns, then scientific activity involves clarifying the ultimate

¹⁰ Viewing this as a question of the relationship between disciplines reveals that biology becomes its own discipline by being separated from chemistry and physics while also bordering them.

discontinuity that can no longer be advanced in each research area by maximizing the discontinuity of continuity. However, mastering the known by reaching ultimate discontinuity in science can only be seen as artificial. In fact, the atom, once considered the minimum unit, was divided into almost infinitely smaller particles, illustrating that continuity emerged yet again from the discontinuity that was relentlessly pursued at the time, which beckoned scientists toward a new discontinuity. Thus, the history of science can be seen as a continuous movement between the unknown and the known: When an unknown becomes known, a new unknown emerges in its place, which is displaced by the new known in which the unknown is latent.¹¹

The emergence of continuity from discontinuity and new unknowns from previously supposed definitive knowledge is not solely evident in the pursuit of the components of matter. For example, diseases that once appeared to have been suppressed by humankind, such as tuberculosis and measles, have regained power and once again pose a threat. Thus, in principle, there can be no ultimate suppression method that can prevent the proliferation or mutation of diseases, implying that the known cannot completely cover diseases, as their persistence triggers the reemergence of the unknown. In addition, controlling one malignant disease cannot guarantee that a new disease will not emerge to threaten humankind. Thus, there is no ultimate medical perspective that can disrupt the continuity of diseases, and the unknown that overcomes the perspective constantly reemerges. Accordingly, it is impossible for human cognition to fully recognize an object and replace its unknowns with knowns. Even familiar objects always contain unknowns, indicating that our recognition has the scope to exceed apparent limits. Thus, in principle, our recognition of an object can continue indefinitely and there can be no ultimate recognition that disrupts its continuity. If this also applies to scientific recognition, mastering the known in science will always be artificial.

3 Continuity and the unknown in *my* rearview

3.1 The continuity of *my* consciousness

The previously discussed matter of continuity is not solely a problem for science. As de Broglie wrote, the problem of continuity and discontinuity is an aporia that philosophy pursued long before the natural sciences emerged. In the earliest days of Western philosophical history, Parmenides and his disciple Zeno meticulously discussed the crux of this problem.¹² Without delving into the details of the historical arguments, I present the following passage from Plato's *Apology of Socrates*, which initially may seem wholly unrelated to this problem. However, Socrates's death-like dreamless sleep can reflect the problem of continuity and discontinuity in light of our daily understanding and help elucidate the close relationship between this problem and death.

¹¹ See the next section for a discussion on the importance of examining the kind of the unknown in scientific activities.

¹² Waterfield (2000).

Death is [...] annihilation, and the dead have no consciousness of anything [...] Now if there is no consciousness but only a dreamless sleep, death must be a marvellous gain. I suppose that if anyone were told to pick out the night on which he slept so soundly as not even to dream, and then to compare it with all the other nights and days of his life, and then were told to say, after due consideration, how many better and happier days and nights than this he had spent in the course of his life—well, I think that the Great King himself, to say nothing of any private person, would find these days and nights easy to count in comparison with the rest. If death is like this, then, I call it gain; because the whole of time, if you look at it in this way, can be regarded as no more than one single night.¹³

In other words, there is nothing that disrupts *my* stream of consciousness while sleeping soundly without dreaming. Even if *I* do something in this state, *I* am not aware of it, or, at least, have no memory of it upon awakening. In reality, no matter how deep *my* sleep is, *I* remain gently connected to *my* waking state. However, when undergoing general anesthesia, such as before surgery, *my* stream of consciousness ensures perfect continuity, such that *I* am unaware of *my* loss of consciousness. In such cases, *I* have no way of knowing how long *I* was unconscious for, whether an hour or a day, or whether *I* screamed or was silent. There is no room for discontinuity in the continuity of *my* consciousness.¹⁴

The continuity of *my* consciousness remains, so to speak, an inner nothingness for *me* and is never revealed to *me* of its own accord—inserting discontinuities into this continuity necessarily requires the intervention of Others.¹⁵ For example, a doctor's testimony that "you kept screaming while you were unconscious" would be an intervention that would lead *me* to a discovery. What we ordinarily do to reestablish our continuity of consciousness—for example, confirming our actions with Others or viewing ourselves through the eyes of Others when we briefly lose sight of ourselves—is also an insertion of discontinuity into the continuity of consciousness, even though the dimensions are different. Such an insertion does not stop after one instance. In fact, no matter how unquestionable a doctor's testimony might seem, its accuracy is not guaranteed. There is always the possibility that someone might contradict it and if the accuracy is to be proven, the testimony of Others must be relied upon. The continuity of the doctor's consciousness also depends on Others' consciousness. Although we do not tend to notice this characteristic of consciousness, except under special circumstances, such as after the loss of consciousness described above, the fact that *my* consciousness cannot show *me* its complete continuity of its own accord corresponds to any person's consciousness.

Therefore, discontinuity is endlessly introduced into the continuity of *my* consciousness from *my* consciousness. In fact, even if no one else can question

¹³ Plato (2003, p. 69).

¹⁴ I omit references to the issues regarding *my* consciousness, such as altered consciousness or a vegetative state, which are indirectly related to the theme of this study, limiting my discussion to clarifying the relationship between *my* death and science.

¹⁵ This study makes no philosophical consideration of "Others." For more on this point, see note 7.

a doctor's testimony, no one can justify it in a way that would end the argument on its own. One testimony could confirm another, while simultaneously calling on a subsequent testimony to confirm itself. This circle of testimony expands sequentially and in principle, extends to the entire world. In this way, the continuity of *my* consciousness encompasses innumerable discontinuities. Paradoxically, *my* consciousness is revealed to *me* as continuous by incorporating innumerable discontinuities. By contrast, discontinuity intervenes in *my* consciousness by letting the continuity emerge from within it.

As discussed in Sect. 2, in the case of science, the emergence of continuity within discontinuity implies a constant emergence of the unknown within the known. This also applies to the case of consciousness, because as the aforementioned discussion on testimony indicates, *my* consciousness cannot complete *my* knowledge by itself. Rather, the unknown connects *my* consciousness to other consciousnesses. Therefore, there exists a correspondence between the known and discontinuity, and the unknown and continuity with regard to consciousness.

3.2 Dividing the unknown

It is possible to confirm the above assertion by changing the perspective from *my* consciousness to *my* body. *I* am *my* consciousness, but simultaneously, *I* am *my* body: *My* consciousness is the foundation of *my* body, and *my* body is the foundation of *my* consciousness. The relationship between the two has inspired numerous points of discussion in the history of philosophy.¹⁶ Here, I focus only on the following point: As *I* am *my* body, seeing *myself* is an event of crucial significance to *me*. *I* can see the outside world, but *I* cannot see *my* own eyes. *I* also cannot see other significant parts of *my* body, such as *my* face, head, and back, except when using a mirror. This means that they only appear to *me* indirectly through an "Other." If this "Other" has significantly enhanced vision, such as a medical device (e.g., endoscope), it can help *me* see parts of *myself* that *I* have not specifically discerned as *me* or *mine*, such as polyps in the folds of *my* internal organs.

This visual characteristic is closely related to the division between *my* frontal view, which *I* can directly see before *me*, and *my* rearview, which contains what would otherwise escape *my* sight and could endanger *me*. This reflects the fate of not only human beings but also of other organisms, as in the eat-or-be-eaten relationship. The division occurs because *my* body has a material thickness, but it does not correspond to the division between the front and rear of the physical body. As discussed above, *my* face and *my* polyps, for example, are located in *my* rearview.

My rearview becomes a crucial concern for *me* during some stages of development and remains so throughout *my* life. The gaze of a particular individual that captures *my* appearance and behavior; the public gaze that eyes *my* educational background, status, and property; and the gaze of doctors or medical devices that tell *me* about *my*

¹⁶ For example, Merleau-Ponty (2012), who developed the original philosophical theory of the body and revealed the importance of *one's own body*, examined the meaning of lived perceptual experience, discussing our incarnations in the world by *my body*, which is neither an object nor a consciousness, but the so-called medium of both. This medium is characterized as an ambiguity, distinct from the traditional Cartesian view of *cogito ergo sum*, "I think, therefore I am" (Descartes 1998, p. 18).

illness or remaining lifespan are extremely important, because *my* rearview, which is *mine*, but never seen directly by *me*, can be directly accessed by Others, at least more directly than by *me*. *My* acknowledgment of Others' perspectives is an event integrated with the division of *my* frontal view and rearview.

This division occurs for everyone, such that there can be no situation in which one person's perspective is more privileged than that of Others. *I* am simultaneously the one who sees and the one who is seen. *I* am the subject as well as the object. No matter how powerful people might be, they cannot solely be subjects who see Others unilaterally without being seen by them. Similarly, no matter how weak people might be, they cannot solely be objects seen unilaterally by Others without seeing them. Even if *I* am completely indifferent to how *I* appear to Others, *I* am forced to expose to Others *my* face, back, and other parts that *I* can only see indirectly, leaving these parts at their disposal.¹⁷ As the division of *my* frontal view and rearview does not depend on a particular person, this disposal is endlessly chained.

Although *my* rearview is both threatened and guaranteed by Others, it cannot be revealed to *me* directly. The unknowns of *my* rearview can, in principle, be known to any Other, but will remain directly unknown only to *me*. Therefore, the unknown in question here is neither "pure" unknown, completely disconnected from the known, nor relative unknown in the sense that some others know and some do not.¹⁸ It can be described as universal unknown considering that every *I* has an unknown that can be known to Others but remains unknown only to *me*.

Thus far, I have distinguished between *my* consciousness in everyday life and *my* consciousness in a dreamless sleep or under general anesthesia. The former is a normal waking consciousness that involves entrusting to Others what *I* cannot perceive alone (a continuity that is unified with discontinuity), while the latter is a consciousness that can never be revealed of its own accord (a continuity that can have no relationship with discontinuity), except to be subsequently recreated as *unconsciousness* in consciousness.¹⁹ Thus, continuity has a division that corresponds to the unknown divisions.

3.3 Perspective of the universal unknown

Applying the above considerations to science, I ask, "What unknowns does science confront?" Scientists usually confront relative unknowns. Today, fierce competition for scientific discoveries has arisen, because the unknowns in question are relative unknowns that are not yet known to anyone, but we assume that they will eventually be known to someone. The same can be said of the state of scientific progress. There has been tremendous progress in scientific inquiry since the scientific revolution of the 17th century, opening up vast areas of the known within what was previously

¹⁷ Sartre (1956) developed his own theory of the Other through an in-depth consideration of the *I* that is gazed upon by the Other. His thoughts on death, which are examined in Sect. 4, also concern this *I*.

¹⁸ Examples of pure unknowns are provided in note 22.

¹⁹ The latter is revealed to us only indirectly through the former. Clarifying this meaning leads us to consider the extremely important process of unifying or integrating the two. See also notes 22 and 23 on this point.

unknown. Although its momentum remains unabated, science has not replaced all unknowns with knowns. When considering this state as the unknown outpacing current scientists' abilities, we assume that scientists confront relative unknowns regardless of whether we believe that the unknown will come to an end in the future or that it will continue forever.²⁰

By contrast, science does not seem to be concerned with “pure” or “universal” unknowns, both of which will never be directly knowable to *me*. However, within the natural sciences, reproductive theory is one area of biology that seeks to pursue the universal unknown in depth, without being aware of doing so. In the following section, I clarify this claim by examining reproductive theory in conjunction with *my* death, a theme unique to philosophy.²¹ Connecting *my* death with my interpretation of continuity and discontinuity through the dialogue between biology and philosophy can greatly deepen our understanding of this theme.²²

4 Continuity and the unknown in reproductive theory

4.1 Death and science

We cannot experience “*I* died.” The dreamless sleep that Socrates equates with death is an experience one cannot have if one never wakes up again.²³ Based on the disconnection between *my* life and death, it is understandable that unlike life, *I* cannot experience *my* death. As Epicurus noted, “so long as we are existent death is not present and whenever it is present we are non-existent.”²⁴ The only way we can gauge the experience of death is through the death of Others. The distinction between

²⁰ This is one consideration that is supposed to be implicit for most scientists. A proper understanding of scientific progress is closely related to understanding “the continuous movement between the unknown and the known,” which is discussed in 2.2. I argue that considering the universal unknown can deepen our understanding of scientific progress, even though this must be embodied in the future.

²¹ Questions related to how science can deal with themes such as death in the first place are part of the larger question: What unknowns does science confront?

²² This study concentrates on questioning the relationship between the universal unknown and science, not the associations between the pure unknown and science, as the latter is a difficult task that can only be accomplished by examining the former. The consciousness of which *I* am unaware while in a particular state is an example of a pure unknown. As another example, “here” and “now” embody the same unknown, because no matter how much we try to capture them as they are, they always end up as “there” and “then.” In this respect, it seems self-evident that some concepts (e.g., *my* consciousness, here, and now) cannot be specific themes in science. Concerning *my* death, no matter how much we try to capture it as it is, we can only capture it as the moment just before death—that is, as life. Nevertheless, as I reveal, from the perspective of the universal unknown, science can indeed approach and ponder *my* death. *My* death can be assumed to be the pure *and* universal unknown (see note 36). This assumption should allow the possibility of finding, scientifically, a certain relationship between death and the pure unknown. To provide support for this assumption, I must clarify the details of the differences and the relationships between the pure and universal unknowns to explore the possibility of unifying or integrating them.

²³ I can connect this fact to the proposition that continuity never appears to us as continuity in itself, which has been fundamental to philosophy throughout its history since Heraclitus and Parmenides (Waterfield, 2000).

²⁴ Epicurus (2012, p. 157).

my death and the death of Others has a decisive meaning in converting unknown death into the known.

Science's conception of death relies on the recognition of the death of Others and death as discontinuity as two sides of the same coin. In biology, death is defined as "the point at which the processes that maintain an organism alive no longer function."²⁵ This definition of a cessation of continuous functioning, a separation from life, is derived from the death of Others, not *my* own.²⁶ In anatomy, a branch of science that depends on divisions, the scientific definition of death also focuses on discontinuity. Moreover, biology has made several important discoveries regarding the death of Others that are related to: (1) cell lifespans or the limits of cell division, (2) the mechanisms of lifespans and aging (e.g., a specific gene related to longevity as well as telomeres and telomerase), (3) the cellular suicide mechanism, or apoptosis, that is crucial for the formation and maintenance of living organisms, and (4) a method for initializing differentiated cells into undifferentiated cells, offering a glimpse into the possibility of "unwinding" life.²⁷ These discoveries and other biological findings have driven the development of bold hypothetical theories about the mysteries related to the origins of sexual reproduction and death.²⁸

Despite these remarkable findings, biology in general does not focus on death as a theme, let alone *my* death. In other words, biology's position on the concept of death is unclear. Standard biology textbooks do not discuss death as a single concept; even the word "death" is rarely used.²⁹ Rather, biologists prefer to use the term "lifespan," indicating that biological research is essentially conducted within the scope of life phenomena.³⁰ In addition, medicine is especially concerned with life *up to the point* of death, as its purpose is to help people avoid death. Thus, death itself is outside its scope.³¹ Overall, as science assumes the distinction between *my* death and the death of Others and does not even focus on death as an inherent theme, it is not surprising that the dialogues between science and philosophy have not traditionally focused on *my* death as a theme.³²

²⁵ Hine (2019, p. 643).

²⁶ Biology often does not explicitly define "life" itself, as seen in Hine (2019).

²⁷ Barinaga (1996); Blackburn (1992); Friedman and Johnson (1988); Harley et al. (1990); Hayflick and Moorhead (1961); Johnson (1990); Sonneborn (1954); Steller (1995); Takahashi and Yamanaka (2006).

²⁸ Lane (2005, 2015); Takagi (2010).

²⁹ Alberts et al. (2014, 2015); Reece et al. (2011); Sadava et al. (2008); Stanier et al. (1979); Watson et al. (2014).

³⁰ The concept of lifespan is discussed later in this section in relation to *my* death.

³¹ End-of-life medicine certainly acknowledges death, while forensic pathologists are concerned with the cause of death. The question here is whether death, as a concept, is considered in the context of medicine as a natural science. However, neither end-of-life medicine nor forensic pathology is concerned with the nature of death. Although "how to face *my* death" and "what *my* death means" might share some common ground, these questions are of a fundamentally different nature.

³² As mentioned in the Introduction, existential philosophy shares this assumption.

4.2 My death

The universal unknown described previously can serve as a basis for this dialogue between philosophy and science, with a view of *my* death as something not only different from the death of Others, embodied by the cessation of life functions, but also different from *my* death as a pure unknown. In this subsection, I specifically refer to Sartre's arguments on *my* death.³³ For Sartre, *my* death is the death captured by the gaze of Others, who observe calmly and seek to expose everything as anatomists do. He wrote, "the very existence of death alienates us wholly in our own life to the advantage of the Other. To be dead is to be a prey for the living. This means therefore that the one who tries to grasp the meaning of his future death must discover himself as the future prey of others."³⁴ Being a dead person or a corpse, Others can look down on *me* and observe *me* thoroughly. In principle, any Other has the possibility of doing so, irrespective of whether they actually do. The only one who cannot is *me*. Neither can *I* look back at those who are doing so, nor can *I* experience *my* death through them. *My* death is never given to *me*; in *my* death, *I* am completely entrusted to Others. In other words, "to die is to be condemned [...] to exist only through the Other" and "the fact of death [...] gives the final victory to the point of view of the Other."³⁵ *My* death constitutes an unknown formed in *my* rearview that Others can see. From the perspective of continuity and discontinuity, this death corresponds to continuity that contains discontinuity or to continuity that emerges from discontinuity.³⁶

I extend this argument to biology through an in-depth consideration of *my* death, drawing on and exceeding Sartre.³⁷ As long as *my* face or back can be shown to *me* indirectly, *my* rearview cannot constitute a complete unknown. As exemplified by microscopic polyps, scientific and technological progress has provided us with a vision of ourselves that was previously unthinkable. Correspondingly, the unknowns in *my* rearview have been successively introduced into *my* known. This has allowed us to detach ourselves from our entrustment to Others and increase our degree of "self-sufficiency."³⁸ However, *my* death can never be witnessed by *me*, even though the most advanced scientific and technological devices. Therefore, entrusting *myself* to Others, which occurs in *my* rearview, takes its perfect form in *my* death. This makes *my* death the perfect embodiment of the unknown that in principle can be known to any Other but remains unknown to *me* alone (universal unknown). As long as everyone dies and must be seen unilaterally by Others, the complete entrustment

³³ See note 7 for the reasons behind my choice to refer to Sartre.

³⁴ Sartre (1956, p. 695).

³⁵ Sartre (1956, p. 696).

³⁶ Therefore, *my* death also has divisions that should be integrated. See note 22.

³⁷ As already discussed, although *Being and Nothingness* is not connected to science, its originality becomes clearer when situated in a scientific context. This study is one attempt at doing so. Additionally, Hegel's *Science of Logic* (1969), which discusses death from the perspective of genus, is another historical work that has strong potential for intersecting philosophy with modern biology.

³⁸ Related to what I discuss subsequently, this high degree of "self-sufficiency" must be closely associated with the fact that our society has lost sight of *my* death's enormous significance, which must once have been more deeply felt by those people privy to it before technological advancements.

of *myself* to Others extends to the entire world.³⁹ The eyes of the Other, which see all of *me*, cannot, in principle, be the eyes of any particular Other, but must be those of all mortal people. Thus, *my* death—a state that comes to all—terminates *my* life and connects *me* to Others. Based on *my* death, the continuity of the Other emerges in the midst of the discontinuity of *my* life.⁴⁰

4.3 For dialogue between biology and philosophy

At first glance, the statement “*my* death terminates *my* life” is completely self-evident: Not just human beings, but all living things inevitably die. However, based on the evolutionary history of reproduction, it is possible to question the self-evident nature of this fact. For example, bacteria continually divide and multiply through asexual reproduction. They die from lack of food, being eaten, or being physically destroyed. Hypothetically, if their ideal conditions were met (i.e., sufficient food, absence of predators, and a safe environment), they could continue to divide forever.⁴¹ This is decisively different from organisms born through sexual reproduction, who always die, regardless of ideal conditions. For approximately 1.8 billion years after the emergence of life (i.e., approximately 3.8 billion years ago), prokaryotes were the only living organisms on Earth. Thus, death was not an inevitable event for organisms.⁴² Even today, death is not inevitable for organisms that reproduce asexually. Life has created a strategy within the evolutionary process, such that death always intervenes to sustain life. In this way, organisms first possessed a lifespan that is inextricably linked to sexual reproduction. Lifespan and death are not of the same dimension, as bacteria, which do not possess a lifespan, also die.

In contrast to asexual reproduction, in which death may or may not occur, the emergence of sexual reproduction sublimated the coincidence of death into an inevitability that no individual could avoid, in principle. Organisms in which individuals are necessarily genetically different from each other through sexual reproduction and in which all inevitably die have acquired the concept of generations, which is not present in organisms that reproduce asexually. Correspondingly, the impossibility of experiencing this inevitable event and of converting it into a known has been passed down intergenerationally. An understanding of the universal unknown lies behind the biological concept of alternation of generations, which is related to the most fundamental division of organisms: prokaryotes and eukaryotes. Without

³⁹ This extension is already mentioned in Sect. 3.

⁴⁰ The Other’s one-sided view of *me* is crucial to *my* life. This does not neglect at all the fact that our lives are fulfilled by the reciprocal human relationship of seeing and being seen, experiences that research on humans has effectively revealed based on existential philosophy or phenomenology. *My* death decisively breaks this reciprocity. As explained, the world cannot emerge without this cessation of reciprocity. As the concept of the Other stems from *my* rearview, the reciprocal relationship between *me* and the Other is also based on this cessation.

⁴¹ Clark (1996).

⁴² Morin’s *Man and Death* (1970), first published in 1951, is a rare example of a classic humanities book that mentions biological immortality. This book refers to Woodruff’s research, which claims to have experimentally proven that paramecia have no lifespan. However, Sonneborn (1954) rejected the results of this research.

being aware of doing so, biological science's examination of evolution from asexual to sexual reproduction has revealed a completely new dimension of life—*my* death.

The fact that the concept of *my* death emerged along with sexual reproduction can also be understood from the perspectives of continuity and discontinuity. As *my* death always interrupts an individual's life, it naturally connects to a discontinuity, but not to one that is not unified with continuity or does not bring about continuity. When the survival strategy is to divide and multiply, if at all possible, it follows that the death of each individual should be avoided, if at all possible. Given the harsh realities of the environment, many cells that divide and multiply will die, leaving only a few to survive; however, death in asexual reproduction is a matter of "chance" for individuals, because they do not die equally. By contrast, sexual reproduction destines individuals to inevitable death as the key to reproduction; its survival strategy is to ensure that each individual's life is interrupted, allowing the life that runs through it to survive.⁴³ Therefore, this death can be seen as one that is discontinuous yet connected to continuity at its foundation, or one that secures the continuity that emerges from discontinuity.

Thus, *my* death is both existential and biological. One can argue that reproductive theory approaches and describes *my* death concretely as a concept that completes *my* rearview. In this regard, this theory has the potential to bring biology closer to an understanding of *my* death, not just death. However, as mentioned, biology does not focus on death as an inherent theme. Even in reproductive theory, death is just a potential theme and *my* death is only addressed as the obverse of reproduction. Therefore, to a large extent, the task of expanding this potential falls to the philosophers.

5 Conclusion

This study focused on the movement between the unknown/continuity and the known/discontinuity, elucidating the essential commonality between the foundation of science's progress and the foundation of *my* consciousness and body, the kind of unknown that scientific activities confront, and the contact point between biology and philosophy. The investigation of the scientific importance of *my* death reveals the scholarly significance of the unknown, which penetrates different fields. Although the discussion has been limited to interpreting the outcomes of reproductive theory and clarifying the relationship between biology and *my* death, not just biology but science as a whole can be regarded as having *my* death at its foundation. No one can confirm that the universe will not end with *my* death. Scientists, who are mortal, can present the truth only based on the premise that science seeks to reveal will continue to exist after *my* death. Importantly, this fact does not imply that the outcomes of science are equivocal. As this study has clarified, the continuity of the universe, which encompasses discontinuities, can be affirmed, especially because *my* death disrupts *my* life and completes *my* rearview. As no *I* can confirm the survival

⁴³ Biologically speaking, the origin of sexual reproduction is mysterious (Sadava et al., 2008). Hence, in the context of this study, the origin of *my* death is also biologically mysterious.

of the universe after *my* death, science and its outcomes are meaningful to us. Future scientific progress could place a greater distance between *me* and *my* death, but it should not be able to cause *me* to experience *my* death. *My* death should continue to remain beyond the reach of science, constituting the foundation of the universe that science seeks to reveal.

For future studies, philosophically interpreting biological research on reproduction from the perspective of *my* death, especially in line with the evolution of reproductive mechanisms, should be an important direction. In this sense, hypothetical theories on the mysterious origins of sexual reproduction and death are important themes. Additionally, whether we consider lifespans to be “present” or “absent” also constitutes an interesting philosophical question from the perspective of continuity and discontinuity. Regarding limitations of the study, I was unable to concretize how the continuity that emerges within the discontinuity corresponds to the unknown of *my* rearview, as my study’s focus is restricted to clarifying the relationship between continuity and discontinuity. Continuity within discontinuity is like magma, gushing forth with enormous energy. Future research can attempt to elucidate this aspect to clarify the inherent relationship between biology and philosophy further. In addition, clarifying how an epistemological project like this study could relate to *my* death as a question with emotional earnestness, such as feelings for *my* family that has been left behind, is an important subject for expanding the scope of this study and further clarifying its significance.

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References

- Alberts, Bruce, Dennis Bray, Karen Hopkin, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter. 2014. *Essential cell biology*. 4th ed. New York: Garland Science.
- Alberts, Bruce, Alexander Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts, and Peter Walter. 2015. *Molecular biology of the cell*. 6th ed. New York: Garland Science.
- Aurelius, Marcus. 2003. *Meditations*. Translated by Gregory Hays. New York: Modern Library.
- Barinaga, Marcia. 1996. Forging a path to cell death. *Science* 273 (5276): 735–737. <https://doi.org/10.1126/science.273.5276.735>.
- Blackburn, Elizabeth H. 1992. Telomerases. *Annual Review of Biochemistry* 61 (1): 113–129. <https://doi.org/10.1146/annurev.bi.61.070192.000553>.
- Cicero. 1923. *On old age, on friendship, on divination*. Translated by William Armistead Falconer. Cambridge: Harvard University Press.
- Clark, William R. 1996. *Sex and the origins of death*. Oxford: Oxford University Press.

- De Broglie, Louis. 1939. *Matter and light*. Translated by William H. Johnston. New York: W.W. Norton.
- Descartes, René. 1998. *Discourse on method and meditations on first philosophy*. 4th ed. Translated by Donald A. Cress. Cambridge: Hackett Publishing Company.
- Epicurus. 2012. *The art of happiness*. Translated by George K. Strodach. New York: Penguin Classics.
- Freeman, Kathleen. trans. 1948. *Ancilla to pre-Socratic philosophers: a complete translation of the fragments in Diels*. Cambridge: Harvard University Press.
- Friedman, David B., and Thomas E. Johnson. 1988. A mutation in the *age-1* gene in *Caenorhabditis elegans* lengthens life and reduces hermaphrodite fertility. *Genetics* 118 (1): 75–86. <https://doi.org/10.1093/genetics/118.1.75>.
- Gallagher, Shaun, and Dan Zahavi. 2008. *The phenomenological mind*. New York: Routledge.
- Gallagher, Shaun, and Daniel Schmicking. eds. 2010. *Handbook of phenomenology and cognitive science*. Dordrecht: Springer.
- Godfrey-Smith, Peter. 2014. *Philosophy of biology*. Princeton: Princeton University Press.
- Harley, Calvin B., A. Bruce Futcher, and Carol W. Greider. 1990. Telomeres shorten during ageing of human fibroblasts. *Nature* 345 (6274): 458–460. <https://doi.org/10.1038/345458a0>.
- Hayflick, Leonard, and Paul S. Moorhead. 1961. The serial cultivation of human diploid cell strains. *Experimental Cell Research* 25: 585–621. [https://doi.org/10.1016/0014-4827\(61\)90192-6](https://doi.org/10.1016/0014-4827(61)90192-6).
- Hegel, Georg Wilhelm Friedrich. 1969. *Science of logic*. Translated by Arnold V. Miller. New York: Humanity Books.
- Heidegger, Martin. 1962. *Being and time*. Translated by John Macquarrie and Edward Robinson. New York: Harper & Row.
- Heidegger, Martin. 1996. *Gesamtausgabe. II. Abteilung, Vorlesungen 1919–1944, Bd.27. Einleitung in die Philosophie*. Frankfurt am Main: Vittorio Klostermann.
- Hine, Robert S. ed. 2019. *A dictionary of biology*. 8th ed. Oxford: Oxford University Press.
- Hull, David Lee, and Michael Ruse. eds. 2007. *Philosophy of biology*. Cambridge: Cambridge University Press.
- Husserl, Edmund. 1970. *The crisis of European sciences and transcendental phenomenology*. Translated by David Carr. Evanston: Northwestern University Press.
- Husserl, Edmund. 1973. *Cartesian meditations*. Translated by Dorion Cairns. Hague: Springer.
- Husserl, Edmund. 2012. *Ideas*. Translated by W. R. Boyce Gibson. New York: Routledge.
- Jankélévitch, Vladimir. 1966. *La mort*. Paris: Flammarion.
- Jaspers, Karl. 1969. *Philosophy. Vol. 2*. Translated by E. B. Ashton. Chicago: University of Chicago Press.
- Johnson, Thomas E. 1990. Increased life-span of *age-1* mutants in *Caenorhabditis elegans* and lower Gompertz rate of aging. *Science* 249 (4971): 908–912. <https://doi.org/10.1126/science.2392681>.
- Kierkegaard, Søren. 1980a. *The concept of anxiety*. Translated by Reider Thomte. Princeton: Princeton University Press.
- Kierkegaard, Søren. 1980b. *The sickness unto death*. Translated by Howard V. Hong and Edna H. Hong. Princeton: Princeton University Press.
- Lane, Nick. 2005. *Power, sex, suicide*. Oxford: Oxford University Press.
- Lane, Nick. 2015. *The vital question*. London: Profile Books.
- Mahner, Martin, and Mario Bunge. 1997. *Foundations of biophilosophy*. Berlin: Springer.
- Merleau-Ponty, Maurice. 1963. *The structure of behavior*. Translated by Alden L. Fisher. New York: Beacon Press.
- Merleau-Ponty, Maurice. 2012. *Phenomenology of perception*. Translated by Donald A. Landes. London: Routledge.
- Montaigne, Michel. 1993. *Essays*. Translated by John M. Cohen. London: Penguin Books.
- Morin, Edgar. 1970. *L'homme et la mort*. Paris: Seuil.
- Noë, Alva. 1991. *Action in perception*. Cambridge: The MIT Press.
- Okasha, Samir. 2019. *Philosophy of biology*. Oxford: Oxford University Press.
- Pascal, Blaise. 1910. *Thoughts, letters and minor works*. Translated by William Finlayson Trotter, Mary L. Booth, and O. W. Wight. New York: P. F. Collier and Son Company.
- Plato. 2003. *The last days of Socrates: Euthyphro, Apology, Crito, Phaedo*. Translated by Hugh Tredennick and Harold Tarrant. New York: Penguin Classics.
- Reece, Jane B., Lisa A. Urry, Michael L. Cain, Steven A. Wasserman, Peter V. Minorsky, and Robert B. Jackson. 2011. *Campbell biology*. 9th ed. London: Pearson.
- Rosenberg, Alex, and Daniel W. McShea. 2008. *Philosophy of biology*. New York: Routledge.
- Sadava, David E., Craig Heller, Gordon H. Orians, William K. Purves, and David M. Hillis. 2008. *Life: the science of biology*. 8th ed. New York: W. H. Freeman.

- Sartre, Jean-Paul. 1956. *Being and nothingness*. Translated by Hazel E. Barnes. New York: Washington Square Press.
- Sartre, Jean-Paul. 1986. *L'imaginaire*. Paris: Gallimard.
- Sartre, Jean-Paul. 2014. *Sketch for a theory of the emotions*. Translated by Philip Mairet. New York: Routledge.
- Seneca. 2004. *On the shortness of life*. Translated by C. D. N. Costa. London: Penguin Books.
- Sober, Elliott. 2000. *Philosophy of biology*. 2nd ed. New York: Routledge.
- Sonneborn, Tracey M. 1954. The relation of autogamy to senescence and rejuvenescence in *Paramecium aurelia*. *Journal of Protozoology* 1: 38–53. <https://doi.org/10.1111/J.1550-7408.1954.TB00792.X>.
- Stanier, Roger Y., Edward A. Adelberg, John L. Ingraham, and Mark L. Wheelis. 1979. *Introduction to the microbial world*. Hoboken: Prentice Hall.
- Steller, Hermann. 1995. Mechanisms and genes of cellular suicide. *Science* 267 (5203): 1445–1449. <https://doi.org/10.1126/science.7878463>.
- Sterelny, Kim, and Paul E. Griffiths. 1999. *Sex and death*. Chicago: The University of Chicago Press.
- Takagi, Yoshiomi. 2010. On the origin of sexual reproduction: a hypothesis. *Japanese Journal of Protozoology* 43 (2): 89–93.
- Takahashi, Kazutoshi, and Shinya Yamanaka. 2006. Induction of pluripotent stem cells from mouse embryonic and adult fibroblast cultures by defined factors. *Cell* 126 (4): 663–676. <https://doi.org/10.1016/j.cell.2006.07.024>.
- Varela, Francisco J., Evan Thompson, and Eleanor Rosch. 1991. *The embodied mind*. Cambridge: The MIT Press.
- Waterfield, Robin. trans. 2000. *The first philosophers: the presocratics and sophists*. Oxford: Oxford University Press.
- Watson, James D., Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael Levine, and Richard Losick. 2014. *Molecular biology of the gene*. 7th ed. New York: Pearson.

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