On Descartes’s Conjecture That Yeast May Lay the Folds Of the Heart:

The Role Of Ancient Intuitions In Descartes’s Rejoinder

1. Introduction

In reply to a damning observation, that the excised heart of an eel continues to pulse, Descartes suggests that there is “in the folds of the heart some humor resembling a ferment (or yeast)?”¹ What drives him to make this claim? Descartes reports that his interlocutor, the physician Plempius, suggested that the view is “quite far-fetched, and that [Descartes] was using it as a last resort, as if [he] were hard pressed, and the point provided the only way of escape.”² Is Plempius right? Is the yeast conjecture little more than a desperate attempt to salvage a rationalist theory in the face of an empirical counterexample? That is, is Descartes some sort of village rationalist³ who “did not control his theory by observation or experiment?”⁴ Or, is Descartes a kind of empiricist⁵ who “seems positively to glory in the face of evidence of the senses, in what can be seen and touched?”⁶ Indeed, in reply to Plempius, Descartes holds that, while his view does not require the yeast conjecture, observations and theory both support it. He writes that:

it is necessary to admit that some blood that is rarified remained in [the heart] from one diastole to the next, and that rarefaction is increased by the fresh blood that flows in and mixes with it; and that the nature and properties of fermentation are clearly relevant to this fact.⁷
The protracted debate over the heart’s motion is a rich source of material documenting the Cartesian scientific practice of drawing upon both observation and theory. G. Groham has correctly noted that neither the village rationalist readings, nor the purely empirical readings adequately accommodate both dimensions. His third interpretation bring these elements together. Shifting focus from method to metaphysics, Gorham maintains that Descartes method is shaped by his metaphysics. While this approach provides the most robust explanation (accommodating both dimensions), it directly contravenes Descartes’s repeated claims that his entire philosophy is the product of a method. Method is supposed to yield his particular metaphysics.

In what follows, I will explain the yeast conjecture and draw upon an ancient intuition to argue that method drives Descartes’s metaphysics. I will not characterize Descartes’s method. My task is to show that this intuition is explicitly at work in his discussions about the method.

2. The Central Issue: What Causes the Hardening of the Heart?

The Harvey-Descartes debate over the motion of the heart turns on divergent explanations of its hardening. Whereas Descartes maintains that the heart hardens while expanding, the English physician William Harvey maintains that it hardens while contracting. In de Motu Crodis Harvey held that the heart’s motion results from a contractile element located in the heart. A “pulsific faculty” originates the initial movement in the heart’s right auricle. This contractile movement is the first in a chain of four separate and distinct movements. The four movements occur in a four-chambered
heart. Blood flows continuously into the right auricle by way of the *vena cava*. Upon reaching capacity, the auricle contracts, driving the blood into the right ventricle. The ventricle then contracts, driving the blood into the left auricle by way of the “artery-like vein” or pulmonary artery. The left auricle then contracts, driving the blood into the left ventricle. These four distinct but perfectly synchronous movements appear as two movements with two phases. In the systolic phase, the blood is expelled. The heart whitens, becoming shorter and harder. It strikes the wall of the chest. In diastole the heart fills with blood. It reddens, becoming longer and softer.

Descartes did not postulate an inexplicable pulsific faculty. His view requires only one type of motion, change in extension. In his *Descriptions of the Human Body* he holds that nutrified venous blood enters the *vena cava* from the liver. One drop at a time, it fills the heart’s right chamber. At the same time, blood enters the heart’s left chamber from the ‘pulmonary vein’. There are only two chambers. Encountering a heat in the heart, a certain ‘fire without light’, the blood is instantaneously rarified. During this process, venous valves are forced shut and arterial valves are forced open. The blood in the right cavity is driven into the pulmonary artery. The blood in the left chamber is driven into the arteries, simultaneously expanding them. The heart becomes longer and softer, once it has expelled the blood. This two-chambered heart hardens along with the blood’s expansion.

To summarize both hold that blood is being expelled when the heart hardens. Harvey correctly maintains that its hardening is due to contraction. His view relies upon an inexplicable pulsific faculty. Descartes held the erroneous view that its hardening is due
to the blood’s expansion from a process of instantaneous rarification. His view only employs the one source of motion: change in extension.

3. The Pulsing Of an Excised Heart: Two Robust Reconstruction

The first robust reconstruction pits Harvey’s vitalist conception against Descartes’s mechanist physics. Harvey’s relied upon an inexplicable occult quality to explain the source of the heart’s motion. Since Descartes’s metaphysical physics will not admit of occult qualities, Descartes is forced to reject Harvey’s view as an “unknown or strange faculty.”

In this vein Descartes’s yeast conjecture could be understood in terms of his metaphysical physics. But instead of offering such an account, M. Grene is simply astonished by Descartes’s suggestion that a yeast like ferment may lie in the fold’s of the heart.

She classifies the conjecture as one of five separate replies, each of which is supposed to independently salvage Descartes’s view against the damning counterexample. In Grene’s words, the excised heart continues to beat because:

(1) There is always blood; (2) for the purposes of distillation, the less, the better; (3) the heart is used to dilating, and so goes on doing it (which seems to contradict the first point); (4) perhaps there is “in the folds of the heart some humor resembling a ferment (or yeast), by mixing with which another humor, arriving, makes it [the heart] swell.”
Finally (5), still answering Plemp’s first objection, Descartes points out that his view
can be understood as an improvement on, the common opinion of those who believe that the heart beat
depends on some faculty of the soul.\textsuperscript{12}

Seemingly unmotivated, these five independent replies are said to be jointly inconsistent.
The third contradicts the first. Descartes seems to be deeply confused; Plempius’s
characterization appears apt. The set of five seemingly inconsistent replies appear not to
be driven by any method, but by desperation.

Whereas the first robust reconstruction dealt with the metaphysical physics, the second
maintains that \textit{both} mechanism and mind-body dualism are required to explain
Descartes’s rejection of Harvey’s view.\textsuperscript{13} Harvey’s view seems “to require an
unconscious mental operation, something entirely contrary to the principles of Descarte’s
dualistic ontology.”\textsuperscript{14} According to Gorham, Descartes only appeals to a non-physical
cause where conscious volition is immediately present. All other cases require a
mechanistic explanation. “[T]his methodological rule follows directly from the dualistic
metaphysics which confines the capacity for independent action to the realm of spirit.”\textsuperscript{15}
Gorham is very emphatic about the dependency here. He also writes, “[t]o me it seems
clear that Descartes’s limited anti-vitalism and his resultant dispute with Harvey derives
from his famous ontological dualism of mind and body.”\textsuperscript{16}

Recall Grene’s list. Dualism is an issue in the \textit{so-called} fifth reply. However, dualism \textit{per}
\textit{se} does not explain the yeast conjecture. An appeal to Descartes’s mechanistic framework
is required. Unfortunately, Gorham has nothing to say on the matter. In a footnote, Gorham defers to Grene’s analysis of the text. As we have seen, Grene’s analysis is wanting.

In addition to this wanting analysis, Gorham’s view, that metaphysics drives Descartes’s method, is immediately at odds with Descartes’s own view. In what follows, I will correct the wanting analysis and show that both Descartes’s dualism and Law B result from his development of ancient intuition, showing that method drives Descartes’s philosophy.

4. The Pulsing Of an Excised Heart: Rebalancing the Quantity Of Motion

The yeast conjecture is not an independent reply within a set of five inconsistent replies. The fifth reply stands alone; it alone concerns the soul. The first four are unified by a single theme – transfer of motion. This is the basis for his metaphysical physics.

How does Descartes explain the continued pulsing of an excised heart? He rebalances the equation between the required motion and the available motion. Since the heart moves, the available motion cannot be less than the required motion. For this reason Descartes does two things: he decreases the amount required to move the heart and he increases the amount available per drop of blood.

If the heart pulses because of expanding blood, blood should be present. Grene’s so-called first reply, in which it is observed that blood is present, indicates that a source of motion is present in the beating heart. This must be confirmed by observation. The so-
called second reply continues in this vein. By observing that, for the purposes of distillation, less blood is better, Descartes is increasing the amount of motion that is available per drop of blood. Grene’s so-called third reply misrepresents Descartes point. She claims that Descartes held that the heart is “used to dilating and so goes on doing it.” However Descartes actually claims that, “as the heart expands and contracts a countless number of times from the first movement of its formation, the slightest force is enough to impel it to carry out its own repeated movement.” In his rebalancing of the equation, Descartes is reducing the required amount of motion to move the heart. Finally, the so-called fourth reply –the yeast conjecture– suggests an additional source of motion, should it be required. The presence of a yeast like substance in the folds of the heart increases the amount of motion per drop of blood.

The yeast conjecture is part of a unified reply. The entire reply is obligated by Descartes’s laws of motion. It is obligated by Law B, which balances the amount of motion received with the amount of motion available. According to Law B: When one body pushes another it cannot give the other any motion unless it loses as much of its own motion at the same time; nor can it take away any of the other’s motion unless its own increases by as much. Law B informs Descartes’s overall reply and the yeast conjecture in particular.

A discussion of motion is required when the issue pertains to extension and changes extension: the physical realm. A discussion of mind is required when an opponent suggests an explanation involving non-physical elements, such as the soul. To this end,
dualism informs, at least, the so-called fifth reply. If Gorham’s analysis of Harvey is correct, it may also inform Descartes’s rejection of Harvey’s pulsific faculty. As we will see, Descartes’s dualism and the laws of motion result from his unique development of an ancient intuition.

5. An Ancient Intuition’s Redevelopment

The intuition, call it inseparability, is suggestive of a simple, yet powerful means of separating the deeper reality from surface appearances. To distinguish between the attributes which must belong from those that have no requirement to belong, simply remove the elements. Those that unnecessarily belong can be removed with no consequence to the underlying subject. Those that must be present cannot be removed without destroying the underlying subject.

The intuition informs criterion for non-reciprocal dependency relations, such as priority and necessary belonging. In *Topics VI*, 4, for example, Aristotle relies upon the test to establish priority. The genus is prior to the species because the species cannot continue to exist without it. The genus is inseparable from the species, but the species is separable from the genus. Thus, the species is non-reciprocally dependant on the genus. This is how Aristotle establishes priority.

Priority relation naturally developed into an interconnected network of dependencies: the so-called order of nature. Tuominen characterizes the kind of relational epistemologies characteristic of Platonic-Aristotelian frameworks: “reality is taken to have an intelligible
structure with discrete elements called forms. The forms have necessary connections with each other and the structure involves relations of priority. Therefore, reality itself has an intrinsic order. Knowledge in the proper sense is taken to be knowledge about the structure of reality.”

Inseparability informs a test the ancients used to both to identify each unity and their relations within an interconnected network.

Not only does Descartes’s conception of reality contain an intrinsic order, but also the method by which he arrives at an understanding of this ordered reality explicitly draws upon inseparability. In The Search for Truth Descartes claims that,

All truths are interconnected (se invicem consequuntur) and are mutually held together by a bond (& mutuo inter se vinculo continentur). The whole secret is [a] to begin with the first and simplest truths, and then [b] to proceed gradually and as it were step by step to the most remote and most complex truths (a primis et simplicissimis incipiamus, & deinde sensim & quasi per gradus usque as remotissimas & maxime compositas progrediamur).  

Inseparability informs the means by which Descartes arrives at his basic substances and the means by which he identifies their inter-dependencies – they are held by necessary bonds. Inseparability is all about testing for such bonds. In his study of basic substances, Descartes relies upon the intuition. Consider his assertion in the second Meditation: “[a]t last I have discovered it – thought; this alone is inseparable from me.”
Inseparability is equally at work in the discovery of extension as a substance. In the second *Meditations* he writes that,

I put the wax by the fire, and look: the residual taste is eliminated, the smell goes away, the colour changes, the shape is lost, the size increases; it becomes liquid and hot; you can hardly touch it, and if you strike it, it no longer makes a sound.

But does the same wax remain? It must be admitted that it does.\(^{23}\)

All of these aspects are separable from the piece of wax. The wax remains without them. The second *Meditation* ends with the lesson that “bodies are not strictly perceived by the senses or the imagination but by the intellect alone.”\(^{24}\) While this lesson tells us how to make proper use of observations, it is not until the sixth *Meditation* that we have enough background to learn that the essence of body is extension. It alone is inseparable from an existing body, an extended thing.

The intuition informs part of the method by which Descartes arrives at dualism. It ultimately informs Law B. In *Le Monde* Descartes explicitly grounds the laws of motion in God’s simplicity and immutability.\(^{25}\) Law B requires that the quantity of motion be preserved through all changes. Descartes tells us that this law “follows manifestly from the fact that God is immutable and that, acting always in the same way, he always
produces the same effect.” The inseparability informs Descartes about God’s attributes, such as immutability. In the third Meditation he writes that,

the unity, the simplicity or the inseparability of all the attributes of God is one of the most important of the perfections which I understand him to have. And surely, the idea of the unity of all his perfections could not have been placed in me by any cause which did not also provide me with the ideas of the other perfections; for no cause could have made me understand the interconnection and inseparability of the perfections without at the same time making me recognize what they were.  

6. Conclusion

The yeast conjecture is not, as Plempius suggested, a “far-fetched, last resort.” It is in keeping with his metaphysical physics. His conjecture is informed by Law B. Gorham errs in holding that Descartes’s metaphysics informs his method. The dualism and Law B are both the product of Descartes’s unique redevelopment of an ancient intuition, one which informs tests for non-reciprocal dependencies.

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4 Whitteridge, William Harvey, 155.


6 Grene, “The Heart.”


12 Grene “The Heart,” 327.
13 Gorham, “Mind-Body.”
21 Miles, M. Insight and Inference: Descartes’s Founding Principle and Modern Philosophy (Toronto, ON: University of Toronto Press, 1999), 253.
27 Descartes, “Vol. II,” 34.