

# Descartes's Pineal Gland Reconsidered<sup>1</sup>

LISA SHAPIRO

Contemporary commentators ridicule Descartes's views about the pineal gland, yet discussion of this matter has been virtually nonexistent.<sup>2</sup> This lacuna in the literature suggests that readers of Descartes simply want to shrug their shoulders and dismiss Descartes's preoccupations with the pineal gland as an eccentricity we

1. I very much appreciate this opportunity to honor Paul Hoffman and his philosophical work. His writings on Descartes, and in particular his paper, "The Unity of Descartes' Man," and his work on the import of the accounts of the passions for Descartes's metaphysics and philosophy of mind, as well as the accounts of mind of Malebranche and Spinoza (see "Three Dualist Theories of the Passions") were hugely influential on my own work, both in their content and in their style. As I began work on my dissertation, which focused on Descartes's *Passions of the Soul*, Hoffman's work was always there to wrestle with, where there was very little other secondary literature on these topics. While in the end, I took issue with his reading of Descartes, I shared his resistance to the dominant reading of Descartes as a mere interactionist. Paul Hoffman's work was always very careful, taking texts extraordinarily seriously, and it was creative, looking at those texts in new ways. His work has proven to be trailblazing, in that it staked out claims that others were perhaps too timid to defend and so opened up new and invariably rich discussions.

2. While there is some discussion of Descartes's views of the gland, it deals largely with the *medical* aspects of the pineal gland—but these are mostly concerned with updating Cartesian anatomy rather than explaining the function he assigns the structure. See, for example, Canguilhem (1995a,b), Dankmeijer (1951), Dreyfus-LeFoyer (1937) and Jefferson (1949). Lindeboom (1979) deals almost exclusively with Descartes's writings on the heart. Lokhorst (2011) surveys Descartes's claims about the gland and situates them in an historical context. There *is* one paper that discusses the philosophical import of Descartes's views: Stephen Voss's "Simplicity and the Seat of the Soul" (Voss 1993a). I discuss this piece in some detail later in this paper.

just cannot account for.<sup>3</sup> That this might be so is especially remarkable as Descartes's position that the pineal gland is the seat of the soul does seem to be extraordinary. While Descartes is not the first person to remark upon the pineal gland—Galen, in *On Anatomical Procedures*, identifies the gland *conarion*, so named because it appears as a small pine cone, and Vesalius follows suit in his *Fabrica*, using exactly the same language—he does seem to be the first person to assign it a specific function.<sup>4</sup>

Attending to Descartes's writings will show that he does not hold his views about the pineal gland wholly without reason for, as we shall see, he does on occasion justify his position about the peculiar function of the gland. In this essay, I have two aims. First, I want to explicate and evaluate these justifications. Second, I want to focus on one set of justifications—the anatomical arguments. Considering just how these arguments can serve to assign functionality to the gland in a way consistent with Cartesian metaphysical principles can not only lend a degree of plausibility to his claim that the pineal gland is the seat of the soul (though not a sufficient degree to make it easy to swallow), it can also shed light on Descartes's mechanism and in particular what it might mean for a part of a machine to have a function.

## 1. DESCARTES'S CLAIM ABOUT THE PINEAL GLAND AND ITS JUSTIFICATION

Descartes's claim that the pineal gland is the principal seat of the soul is one of his most enduring claims. He maintains this from his earliest biological writings and continues to do so up through *Passions of the Soul*. In *Treatise of Man*, he first associates the soul specifically with the pineal gland.<sup>5</sup> In *Discourse on Method*, he

3. Spinoza does a bit better. He takes the problem of the pineal gland as emblematic of the problems in making sense of Cartesian mind–body interaction. In the Preface to Part V of *Ethics*, Spinoza takes Descartes to task for assuming “a hypothesis more occult than any occult quality” he, Descartes, had so censured the Scholastics for relying upon (Spinoza 1994, 244ff). This “occult hypothesis” is simply that of the union of mind and body understood as their efficient causal interaction. Spinoza cannot see how a thought can be “so closely united” to a quantity of motion as it seems to him to be in Descartes's scheme of things. For it would seem that if both the soul and the animal spirits have the power to move the gland, we would need to compare their forces. However, since mind and body are meant to be really distinct, there can be, as Spinoza puts it, no common measure between the two and so no basis for comparing the force with which the soul and the animal spirits can direct the pineal gland. To compound the problem even more, it seems that Descartes gets his biology wrong (Spinoza was aware of this, and Lokhorst [2011] provides more detail) and so his reasons for thinking the pineal gland of all organs is the seat of the soul seem completely misguided.

4. See Vesalius (1952). It seems that Descartes has appropriated the work of these anatomists, and Annie Bitbol-Hespériès has argued that Descartes is especially influenced by Caspar Bauhin. She maintains, however, that Descartes's contentions about the function of the gland, both in directing animal spirits and with respect to the soul, are his own (see Bitbol-Hespériès 1990, 195–202). Timo Kaitaro (1999) argues that with his claims about the pineal gland, Descartes is the first person to localize brain function.

5. See AT XI,176–77 along with AT XI, 131–32 and AT XI, 143. In these passages, Descartes establishes the pineal gland to be the principal seat of the soul.

alludes to his discussion in *Treatise of Man*, though he does not there explicitly invoke the soul. He claims only that he “explained which part of the brain must be taken to be the ‘common sense,’ where these ideas are received [both in *Man* and here, it is clear that he is referring corporeal ideas]; the memory, which preserves them; and the corporeal imagination, which can change them in various ways, form them into new ideas . . .”<sup>6</sup> (AT VI, 55; CSM I, 139). It is clear that he is here talking about the pineal gland; he only omits to say that the soul can access these corporeal ideas on the surface of the gland. In the Fifth Discourse of *Optics*, the soul’s liaison with this “part of the brain” is reiterated.<sup>7</sup>

In *Meditations*, Descartes is still sounding this same theme, claiming that the soul is immediately affected only by a “small part” of the brain:

. . . the mind is not immediately affected by all parts of the body, but only by the brain, or perhaps just by one small part of the brain, namely the part which is said to contain the “common sense.” Every time this part of the brain is in a given state, it presents the same signals [*idem*] to the mind, even though the other parts of the body may be in a different condition at the time. (AT VII, 86; CSM II, 59–60.)

And this theme is carried through to the *Passions of the Soul*. There, this small part of the brain is once again identified as the seat of the soul: “in examining things with care, I seem to have evidently discovered that the part of the body in which the soul immediately exercises its functions is not in any way the heart; nor is it either the whole brain, but only the most internal of its parts, which is a certain very small gland . . .” (PS, a. 31; AT XI, 352). The fact that Descartes makes the claim so persistently would seem to indicate that it is not a view he is committed to by accident. Moreover, since his claim about the function of the gland appears to be an original one, one would think that he must hold his view for a reason, and one which at least appears to be good.

Yet while Descartes *makes* the claim that the soul can “immediately exercise its functions” at the pineal gland quite clearly and consistently, it is far from clear what his justification is for making it. In these most prominent texts where he makes this assertion, he does not seem to offer any explanation. However, Descartes does justify his claim that the pineal gland is the seat of the soul in two places. He first sets out a relatively detailed view of the gland in a series of letters to Meyssonier and Mersenne (and to Meyssonier and Villiers<sup>8</sup> through Mersenne) starting in 1640 and continuing into 1641. This view is then elaborated but left largely unaltered in the *Passions of the Soul*.<sup>9</sup> The justifications he offers

6. The passage continues: “and, by distributing the animal spirits to the muscles, make the parts of this body move in as many different ways as the parts of our bodies can move without being guided by the will, and in a manner which is just as appropriate to the objects of the senses and the internal passions.”

7. See AT VI, 109 and AT, 129.

8. Meyssonier and Villiers were both physicians, among other things.

9. See in particular PS, aa. 31–50.

fall into two general categories: *anatomical* and *analogical*. I will present each of these justifications briefly first as it will prove useful to have had an initial overview. I will then turn to evaluate Descartes's arguments.<sup>10</sup>

### 1.1 The Anatomical Arguments

By far, the bulk of the reasons Descartes gives for the gland's serving the function it does within the human being are anatomical. Because the gland is anatomically situated in the way it is, these arguments go, it uniquely is amenable to the soul's thinking the way it does while it is joined with the body.<sup>11</sup> There are two basic species of such anatomical arguments. On the one hand, Descartes argues that the anatomical position of the gland uniquely meets the constraints of our sensory perception. This argument runs something like this: We can never have more than one thought at a time; however, although we have double sense organs (i.e., two eyes, two ears, etc.), we have a singular object of sensory perception, thus there must be a place where the sensory images from the sense organs combine, that is, the "common sense." This place will be the seat of the soul. Because the pineal gland is the only part of the brain that is not double, it is the only place where these sensory images can combine and so it is the seat of common sense, thus the pineal gland must also be the seat of the soul.<sup>12</sup> On the other hand, Descartes argues that the gland's protected position within the brain—its central location, small size, incomparable mobility—is uniquely suited to receiving ideas and so conducive to a "good and subtle mind." While this appears to be a wholly different point, it turns out that for this reason too, the gland must be the seat of common sense. And so, again, as it is the seat of common sense, the gland must be the seat of the soul. Thus, both sorts of anatomical argument aim to show that the pineal gland is the seat of common sense, and from there, go on to conclude that the gland is the seat of the soul. These anatomical arguments are first advanced in the letters of 1640–41, though they are also suggested in the *Treatise of Man*. They are then reiterated in the *Passions*.

Descartes originally offers the first sort of anatomical argument in a letter to Meyssonier of 29 January, 1640.<sup>13</sup> After he announces that it is the function

10. These arguments were taken quite seriously by Descartes's followers. Louis La Forge (1666), in Ch. XV of his *Traité de L'Esprit de L'Homme*, uncritically reiterates these arguments in arriving at the conclusion that the gland called conarion is the principal seat of the soul.

11. While Descartes does get parts of the anatomy wrong (see Lokhorst [2011]), we will see that there is still something philosophically interesting to be gleaned from these arguments.

12. Descartes thus seems to be operating under the basic premise that the soul itself has no power to combine the sensory impressions we receive from our different sense organs. All the synthesis of the multiple impressions from, say, the eyes, he presumes occurs within the body prior to any thought on the part of the soul. It is thus an interesting question what more thought adds in the case of sensation. I cannot address this question here.

13. We can actually find in the *Treatise of Man* the seeds of this sort of argument in Descartes, though it is not so nearly well-developed. He does not here yet explicitly demand the

of the *conarion* to be the “principal seat of the soul and the place in which all our thoughts are formed” (AT III, 19; CSMK 143), he proceeds to reason in the following way: Because we “never have more than one thought at a time”—that is, that even though we have two eyes (or two ears, etc.), we only see (or hear, etc.) one thing—it must be the case that the two impressions from our double sense organs unite in some part of the body; that part must clearly *not* be double if it is to present our mind with a single impression from which the mind might conceive a single idea, and “I cannot find any part of the brain, except this [the pineal gland], which is not double” (ibid.).<sup>14</sup> While this line of argument is alluded to in a letter to Mersenne of 1 April 1640,<sup>15</sup> which includes a reply to a second letter from Meyssonier, he offers it again in its entirety in a later letter to Mersenne of 24 December 1640.<sup>16</sup> The only alternative to the gland’s being the seat of the soul, Descartes suggests there, is to say that the soul is not joined to any solid body part but rather to the animal spirits as they lie in various concavities, but that, he claims, is patently absurd. And anyway, it is much easier to understand how the images coming from our double sense organs combine into one at the pineal gland than it is to see how they would do so in the concavities. This argument—that since the gland is not double and so is the seat of “common sense,” it is the *only* place where the soul could properly exercise its functions—is summarized succinctly in the *Passions of the Soul*, a.32. He reasons, because all our sense organs are double, and because “we have only one sole and simple thought about a given object at any one time, it is necessary that there be some place where the two impressions,” from one object through a double sense organ, “can come together in a single impression before reaching the soul, so that they do not present to it two objects instead of one.” We can conceive of such a unification through the animal spirits, and it is only in the pineal gland that these spirits can be united (PS, a. 32; AT XI, 353).<sup>17</sup>

nondoubleness of the gland, nor does he yet claim that the gland is the only part of the brain that can serve this anatomical function (AT XI, 182–83.)

14. To further defend his claim that the pineal gland is “where all our thoughts are formed” Descartes invokes the situation of the gland within the brain as a whole: the gland is “in the most suitable possible place” for double sense impressions to unite, being in the middle of the brain’s concavities, and it is “surrounded and supported by the little branches of the carotid arteries which bring the spirits into the brain” (AT III, 20; CSMK, 143).

15. He writes that it is only this gland “to which the soul can be so joined; for there is nothing else in the whole head which is not double” (AT III, 48; CSMK, 145–46).

16. See AT III, 264.

17. In the articles that follow (PS, aa. 34–50), Descartes details the workings of the pineal gland. It is moved both by the animal spirits coursing through the cavities in which it is suspended and by the soul. It is in the soul’s nature to receive impressions in accordance with the movement of the gland, and in the body’s mechanism for changes in the animal spirits due to movements of the gland to have far-reaching effects in the body (PS, a. 34). It unites two impressions of the same object in one image (PS, a. 35). Certain movements of the gland due to the spirits are “ordained by nature” to make the soul feel certain passions (PS, a. 36), although in different people, the “very same movement of the gland” can excite different passions (PS, a. 39). The activity of the soul consists in moving the gland to “produce the effect corresponding to this volition” (PS, a. 41). In particular, the soul facilitates memory—just by its wanting to remember something, the gland moves to appropriately redirect animal spirits to recall impres-

The second sort of anatomical argument also gets its first expression in the 29 January letter to Meyssonnier,<sup>18</sup> but it does not gain full expression until a letter to Mersenne of 30 July 1640 (containing a response to Villiers).<sup>19</sup> In between, in a letter to Mersenne of 1 April 1640, through a consideration of the place of memory within the brain, Descartes begins to clarify the significance of the mobility of the gland. Memory is properly situated in the brain and not the pineal gland because memory seems to require a kind of fixity that would be inimical to the other function of the pineal gland as the locus of idea formation. The particular mobility of the gland is most conducive to our being able to think about the wide variety of things we do.<sup>20</sup> Descartes then, in the 30 July letter to Mersenne, pairs this mobility of the gland with its stability in order to defend himself against Villiers' objection that the gland cannot be the seat of the soul because it is as subject to alteration as the rest of the brain. For Descartes, this objection is a nonstarter for it would entail that the soul is nowhere joined to the body. Descartes writes:

for it is certain that the soul must be joined to some part of the body, and there is no other part which is not as much or more subject to alteration than this gland. Although it is very small and soft, it is situated in such a well-protected place that it is almost immune from illness. (AT III, 123; CSMK, 149.)

The soul, it seems, needs to be joined to a stable entity, and within Descartes's concise response to Villiers, we can discern his reasons for thinking this must be so. Because of its peculiar situation, the gland is ideally suited to reflect the alterations in the body captured in the impressions it receives: Since the gland by itself does not change, only the impressions it receives can be responsible for any changes within it. Moreover, the gland's own stability allows for the stability of our

sions of the object remembered (PS, a. 42)—and in the same way, this coordination of gland and will facilitates attentiveness, imagination, and bodily motion (PS, a. 43). The relationship between the two can change, however, through the acquisition of new habits (PS, a. 44, 45, 50). These details all presuppose that the pineal gland has been firmly established as the seat of the soul and so serve for Descartes as confirmation of the power of that explanation of the union of mind and body.

18. Descartes writes there, in response to Meyssonnier's apparent contention that the memory is housed in the pineal gland, that "in the case of very good and subtle minds, I think the gland must be free from outside influence and easy to move" (*op. cit.*). Thus, he maintains, the memory is to be found in the substance of the brain rather than in the pineal gland.

19. Intimations of the second anatomical argument are also present in the *Treatise of Man*, but again, the argument is incomplete. In this case, the gland's suitability to a mind is nowhere made explicit. See AT XI, 179.

20. See AT III, 48; CSMK, 145–6. This argument also appears in *Passions of the Soul*, where Descartes notes that the gland is remarkable for its situation in the middle of the brain and its suspension above a central conduit of the animal spirits. By virtue of this situation, "the least movements in the gland may alter very greatly the course of the spirits, and reciprocally the least changes in the course of the spirits may do much to change the movements of the gland" (AT XI, 352), and so the gland, Descartes implies, meets the conditions necessary for the soul's exercising its functions.

perceptions: We can be confident that like impressions will cause like changes in the gland.<sup>21,22</sup>

Finally, in the last of this series of letters to Mersenne, of 21 April 1641, Descartes distills his reasons for claiming that the pineal gland meets the basic anatomical constraints of the seat of common sense, and hence of the soul, into a succinct justification that involves both these forms of anatomical argument. He argues that since no nerve goes to the pineal gland and since the pineal gland is very mobile, it is indeed well-suited to be the seat of common sense. Since the pineal gland is not attached to one nerve in particular, it is not associated with one sense in particular. Thus, it is capable of being connected to all the senses in the same way as must be the seat of the common sense (AT III, 361; CSMK, 180). Moreover, all the senses can only be connected by means of the animal spirits, “and that is how they are connected with the *conarium*” (AT III, 362; CSMK, 180). And furthermore, “only the *conarium* fits this description” of the seat of common sense: It is not only “very mobile, to receive all the impressions which come from the senses” but also “movable only by the spirits which transmit these impressions” (ibid.).

## 1.2 The Analogical Argument

Outside of these anatomical considerations, Descartes in one instance also offers what appears to be an *analogical* argument for his claim that the pineal gland is the seat of the soul. In the 30 July 1640 letter to Mersenne, he writes:

since our soul is not at all double, but single and indivisible [*indivisible*], it seems to me that the part of the body to which it is most immediately joined should also be one and not divided [*non divisée*] into two similar parts. I cannot find such a part in the whole brain except the gland. (AT III, 124; CSMK, 149.)

21. Descartes is glad to admit, conceding a point Villiers makes and turning it to suit his own views, that certain “troubles of mind” with unknown cause may be attributable to some organic alteration in the gland. After all, such troubles are not normal human functioning:

It happens much more often that people become troubled in their minds without any known cause—which could be attributed to some malady of this gland—than it happens that sight is lost through a malady of the crystalline humour. Moreover, all the alterations which take place in the mind, when a man sleeps after drinking, for instance, can be attributed to some alterations taking place in the gland. (AT III, 123; CSMK, 149.)

22. Descartes also argues from considerations of mobility that it is the pineal gland and not the pituitary gland that is the seat of the soul (Letter to Mersenne, 24 December 1640). While the two are similarly situated within the brain—both lie “between the carotid arteries and on the straight line by which the spirits come from the heart to the brain” (AT III, 263)—this is not sufficient for them to have the same function. For one, the pituitary gland is “not, like the other [the pineal gland], in the brain, but beneath it and entirely separated from its mass” (ibid.), and presumably the seat of common sense, and so of the soul, must be in the brain. Moreover, the pituitary gland is “entirely immobile, and we find [*éprouvons*], in imagining, that the seat of common sense, that is to say, the part of the brain where the soul exercises all its principal operations must be mobile” (ibid.). That is, while the pineal gland itself is stable, it can readily change its orientation in accordance with the changing flow of animal spirits. The pituitary gland does not have this flexibility, and, Descartes remarks, it has its own function where it is.

He then proceeds to rule out other candidates for the principal seat of the soul on these grounds: the cerebellum, he says, is one only superficially and in name only, and even its *processus veriformis* can be divided into two parts; similarly, the marrow of the spinal cord is divisible in four. Descartes thus claims that the pineal gland is “one and not divided”—indeed, that it is the only such part in the brain—and that by virtue of this feature, it is particularly suited to joining with the soul. Because the gland is not divided, and so is one thing, and because the soul is one and indivisible, the two are conformable to one another; it is the analogy in their structures that brings them together.

## 2. EVALUATING THE JUSTIFICATIONS: THE ANALOGICAL ARGUMENT

I now want to consider these arguments in more detail. I begin by considering the analogical argument, for in some ways it appears to afford the most promise for understanding this relation. For one, it seems to account for the soul’s union with the body at the pineal gland and so perhaps the union of soul and body, in terms of a similarity between the two. We will find, however, that the supposed analogy raises more questions than it answers, and so it is perhaps no wonder that Descartes offers it only on one occasion. After locating the problems with this argument, I will then turn to consider the set of arguments Descartes offers most consistently—the anatomical arguments—in support of his assignment of function to the pineal gland.

As we have just seen, Descartes claims, in a letter to Mersenne, that the soul and the pineal gland are joined together just because they are structurally analogous to one another: As the soul is indivisible, so is the pineal gland undivided. The analogical argument Descartes presents seems to rest on the unstated assumption that the soul, because it is unitary and indivisible, can only join itself immediately with objects that are equally unitary. For only with this assumption in place can Descartes rule out in principle, in the way he does, any part of the body other than the pineal gland as candidate for the seat of the soul. Stephen Voss (1993b) contends that Descartes not only tacitly assumes this feature of the soul but also elevates it to a principle to which he subscribes in full voice. According to Voss, Descartes in the 21 April 1641 letter to Mersenne is adhering to a Simplicity Principle (SP) he had articulated several years earlier in a letter to Plempius of 15 February 1638. Voss’s SP holds that “if the soul is simple, or indivisible, it can interact with only one object at once.”<sup>23</sup> Insofar as we grant that Descartes holds

23. (Voss 1993b, 129). In the letter to Plempius, Descartes had proposed a mechanistic explanation of the beating of the heart, claiming that blood, as it comes into the heart, is rarefied—that is, heated so that it expands—and is then forced out of the cavity (see also *Discourse on Method*, Part V). Plempius wants to maintain that the heart’s movement is effected by a faculty of the soul rather than the mechanism of the human body. In his letter, Plempius provides an example that he takes to be explainable on his theory while remaining unexplainable on the Cartesian mechanistic model: He claims that upon removing an animal’s heart and cutting it into pieces, one can observe the pieces continuing to beat. Descartes counters that, in fact, he can explain this phenomenon: On his account, each piece will undoubtedly still contain some heated blood whose rarefaction will cause each piece to expand. He concludes his rebuttal to Plempius as follows:

this tacit assumption, the analogical argument does hold some promise in that it seems to afford us a principled means of accounting for why Descartes so consistently maintains that the pineal gland is the seat of the soul.

There are, however, two problems with this interpretation. First, it is not clear that Descartes actually espouses SP. Despite Voss' assertion of SP, Descartes nowhere claims that the indivisible soul "can interact directly with only one object at once" at all. Further, in the letter to Plempius from which Voss extracts this principle, Descartes claims that in order to account for the phenomenon at issue (the beating of the heart as a whole along with the beating of its dissected parts), one cannot consistently maintain that the soul is indivisible, that the soul beats the heart as a whole, *and* that the soul beats each part of the heart. Descartes clearly maintains that the soul is indivisible, and he simply rejects deciding between the latter two claims by rejecting the soul's involvement with the mechanism of the heart at all.<sup>24</sup> So, the SP, which Voss attributes to Descartes, concerns the soul's interaction with an

Besides, this objection seems to me to be much more damaging to the view which is commonly held by others, that the movement of the heart is due to some faculty of the soul. For how, I ask, can the movement which occurs in the cut-up bits of the heart depend on the human soul, when it is taken as an article of faith that the rational soul is indivisible, and has no other sensitive or vegetative soul attached to it? (AT I, 523; CSMK, 80–81.)

It is from this passage that Voss arrives at Simplicity Principle (SP).

Voss then goes on to argue that indeed Descartes did subscribe to such a simplicity principle. He maintains that SP is the "necessary fulcrum" of Descartes's argument in the Sixth Meditation, which supports his observation that "any given movement occurring in the part of the brain that immediately affects the mind [the pineal gland] produces just one corresponding sensation" (AT VII, 87; CSM II, 60). For Descartes's conclusion hinges on an earlier observation that the mind is only immediately affected by "one small part of the brain, namely the part which is said to contain the 'common' sense" (AT VII, 86; CSM II, 59), and Voss believes that this observation is theoretically defensible only by appeal to SP. Whereas in his letter to Plempius, Voss points out, Descartes is concerned with the soul's ability to affect the body, here he is concerned with the reciprocal process—the body affecting the soul—and thus, he has applied SP to both directions of the relation between body and soul.

Voss is thus claiming that the anatomical arguments Descartes offers depend on the analogical argument. I contend that these two forms of argument are independent of each other.

24. Both Descartes and Plempius are concerned to explain how the heart beats. Descartes offers a mechanistic explanation, whereby blood flowing into the heart initiates a certain series of events that "follow just as necessarily from the mere disposition of the parts of the heart, which we can see with our naked eye, and the heart, which we can feel with our fingers, and from the nature of the blood, which we can know from observation, as does the movement of the clock follow from the force, the position and the shape of its counter-weights and wheels" (*Discourse*; AT VI, 50). Plempius takes issue with precisely this mechanistic picture; from his point of view, the beating of heart pieces *outside* of the mechanism of the heart shows clearly that the heart's beating is not a wholly mechanical matter but rather involves a faculty of the soul as the animating force. Now there are three ways in which the soul could animate the heart: either (1) a singular human soul could animate the whole human heart or (2) each part of the heart—each piece as it has been dissected—could be animated by either (2a) its own soul or (2b) a part of the human soul. Descartes's rhetorical question at the end of his reply (see fn. 23) is meant to point out that those who want to claim the human soul animates the whole heart have no way of accounting for the beating of the dissected pieces unless they reject one of their most fundamental tenets—that the human soul is indivisible. According to option (1), in order to animate each of the distinct pieces, the soul would need to divide itself. It is this same fundamental presupposition that excludes options 2a and 2b as well. Option 2b is in straightforward contradiction with this basic tenet. And,

object, but the mechanistic explanation of the heart's beating, which Descartes offers in the *Discourse* and reiterates in correspondence, completely removes the soul from any such interaction. Voss's extraction of SP is misleading.

However, even if Voss were right about Descartes's holding SP, there is a deeper objection to the analogical argument: The argument rests on the indivisibility of the soul proving analogous to the undividedness of the pineal gland. Indivisibility and undividedness are, however, two very different qualities as far as Descartes is concerned. For one, indivisibility is essential to the nature of the soul. Body, on the other hand, is essentially divisible. Indeed, it is this very difference in the natures of mind and body that forms the basis of the second argument Descartes offers in the Sixth Meditation for the real distinction of mind and body.<sup>25</sup> Insofar as the pineal gland is material, then, it too is divisible *by nature*. That the pineal gland is undivided can only be *accidental*; it is not necessarily one and a single thing.

It is worthwhile to note that while the claim of undividedness here appears on its face to be on a par with the claims that Descartes makes in the anatomical arguments that the gland is not double,<sup>26</sup> in the anatomical arguments, Descartes always describes the gland as *not double*, always contrasting it with the multiplicity of our sense organs: He never goes so far as to claim that the gland is "one and undivided."<sup>27</sup> To say that the gland is not double is not to deny that it, as a piece of matter, has parts into which it can be divided. It is to say that unlike our organs of sight and hearing, its various parts are consolidated and hence are able to move as one thing. Now, this may amount to a simplicity of a sort, but it does *not* seem that this sort of simplicity is *essential* to the pineal gland in the relevant respect and so capable of driving the analogy.

Furthermore, even if we can maintain the principle of the analogy, it seems that the pineal gland is not the only body that can satisfy the terms of the relation, and so the analogical argument is insufficient to establish the pineal gland as the seat of the soul. To see this, we need only look at remarks that Descartes makes about individuation and the unity of the human body. In a letter of 9 February 1645 to Mesland, Descartes, discussing the numerical identity of the human body, says:

In that sense, it [the human body] can even be called indivisible; because if an arm or a leg of a man is amputated, we think that it is only in the first sense of "body" [i.e., as a determinate part of matter] that his body is divided—we do not think that a man who has lost an arm or a leg is less a man than any other. (AT IV, 167; CSMK, 243.)

if each heart piece were to have its own soul, these souls would then need to coalesce to form the "human soul." But here again the human soul would be divisible into the souls of, at the very least, the heart's parts. For a discussion of Descartes's account of the beating of heart see Gorham (1994).

25. See AT VII, 85–6; CSM II, 59.

26. Voss assimilates these two descriptions of the pineal gland in his discussion of this argument.

27. Indeed, even in the 30 July 1640 letter to Mersenne, Descartes asserts that the seat of the soul must be "not divided into two similar parts," which assimilates the point to that of the anatomical arguments. One might think that Descartes was simply a little less precise in his language here than he is elsewhere.

Here, it seems that the *whole* of the human body constitutes an object to which the soul is joined, not merely the pineal gland. And Descartes reiterates this claim in article 30 of the *Passions of the Soul*.<sup>28</sup> So it seems we have at least two candidates for the soul to join with according to the terms of the analogical argument.<sup>29</sup> Moreover, Descartes goes so far as to claim that the human body is, in a sense, *indivisible*—he never says the same about the pineal gland—so it would seem that the human body is more well-suited to make the analogical argument go through than the pineal gland. So why then does Descartes not argue that the whole body is the seat of the soul rather than the pineal gland? It is perhaps open to Descartes to skirt this issue by claiming that the soul is united to the body, a larger object of which the gland is a truly simple part, in virtue of being united to the pineal gland.<sup>30</sup> However, this rejoinder fails. We would *still* need to understand what constitutes the simplicity of the gland. Only with this understanding could Descartes address objections such as Villiers': Why is not the cerebellum the proper seat of the soul?<sup>31</sup> As we have seen, Descartes responds (through Mersenne) that the "cerebellum is one only superficially and nominally," as it is clearly divisible into two halves (AT III, 125), but this was not so clear to Villiers (nor is it clear to us). Thus, the analogical argument fails because it evades the issue of individuation: How are the parts of the body—and even their parts—defined for Descartes? From what point of view is the cerebellum "clearly divisible" into two halves and the pineal gland not?<sup>32</sup>

Thus, the analogical argument fails on two counts. On the one hand, it seems to draw an analogy at the point of fundamental *difference* between soul and body. The divisibility of body is, in part, what constitutes its real distinction from the indivisible soul. And moreover, if we do manage to overcome this problem somehow, then it seems that Descartes does not sufficiently limit the potential

28. "For the body is a unity which is in a sense indivisible because of the arrangement of its organs, these being so related to one another that the removal of anyone of them renders the whole body defective. And the soul is of such a nature that . . . it is related solely to the whole assemblage of the body's organs." (AT XI, 351.) While he emphasizes different attitudes toward losing a limb in these two passages, Descartes's point is here the same: The human body constitutes a single object, and the soul is united to the human body.

29. In fact, we might seem to have a third since Descartes does not seem to contest the singularity of the pituitary gland (see the letter to Mersenne of 24 December 1640; AT III, 263; see fn. 56 earlier).

30. It is in the next article of the *Passions*, article 31, that he remarks upon the "little gland" on which the soul "exercises its functions more particularly."

31. Villiers claims that "it is also believable that it is in the cerebellum, which is single like the pineal gland, that the aforementioned operations [proper to the principal instrument of the soul] must be carried out." Villiers to Mersenne for Descartes, end of April 1640 (Mersenne, 9, 293–97). Translated by Voss in his "Simplicity and the Seat of the Soul."

32. There are further problems. If we take the pineal gland to be *essentially* one, according to Descartes, we will find him running into all sorts of problems. For one, as Voss (1993b) points out, the Cartesian account of motion would need to be suspended in the case of the pineal gland. For rather than explain its motion in terms of the movements and other changes of its parts, as he would any other piece of matter, Descartes would need to explain the motion of the parts of the pineal gland in terms of the whole of which it is a part: It is the whole of the gland that the soul moves, not its parts. Voss also points out tensions of this picture of a unitary pineal gland with Descartes's theodicy.

analogues to the soul. Indeed, he suggests that the whole human body bears more of a similarity to the soul than does the gland. And in the same regard, he fails to offer a principle whereby we can distinguish the truly simple body part from those that are simple only superficially. Though the analogical argument fails, how it does so brings out an aspect of Descartes's claim about the pineal gland, which is important: the individuation of the gland.

### 3. THE ANATOMICAL ARGUMENTS: A RECONSIDERATION

#### 3.1 Individuation of Bodies and the Individuation of the Gland

I want now to consider just how Descartes might have singled out the gland, for understanding just how Descartes individuates the gland as part of the human body can help us better understand the anatomical arguments for the gland's being the seat of the soul he offers and the implications of those arguments for Descartes's mechanism. Before considering Descartes's account of individuation of the gland, however, I want to draw attention to a constraint on any account he might offer. While the point might be an obvious one, it is worth reminding ourselves of it. Descartes insists that body is really distinct, or independent, from the soul, and that commitment entails that the differentiation of bodies is to be explained by the nature of extension and the laws of nature alone. Thus, to explain the undividedness of the pineal gland by appealing to the fact that the gland is the locus of the soul's immediate interaction with the body is not only question begging, it is also at odds with Cartesian metaphysics and physics. So, in keeping with this constraint, we need to arrive at a wholly corporeal account of the individuation of the pineal gland.

Let me begin a consideration of the individuation of the gland with Descartes's account of the individuation of material things in general. After briefly presenting that account as gleaned from the *Principles*, I apply it to the pineal gland. I argue that Descartes individuates the pineal gland by the place it holds in the body-machine. Moreover, I suggest that for Descartes, this place is a very special one, for the pineal gland serves as the site at which the workings of the body are coordinated. As such, the gland serves a regulative capacity within the human body. Understanding the gland in this way does require that we rethink Descartes's mechanism for it entails that we see the physical world not simply as an efficient causal chain but as one in which it makes sense to conceive of ends internal to that chain. If we can do this, we are afforded a way of lending some plausibility to Descartes's claim that the gland is the seat of the soul.

For Descartes, what individuates one body from another is the concerted movement of a particular part of matter. And of course, matter for Descartes is nothing but extension of length, breadth, and depth. Within matter, as such, there is no way to distinguish one object from another.

The matter existing in the entire universe is thus one and the same, and it is always recognized as matter simply in virtue of its being extended. All the properties which we clearly perceive in it are reducible to its divisibility and consequent mobility in respect of its parts . . . ; any variation in matter or

diversity in its many forms depends on motion. (*Pr.* II, 23; AT VIII A, 52–53; CSM, I 232)

Thus, individual bodies, or objects, are differentiated by the motion of matter. Motion, strictly speaking, for Descartes, is simply the “transfer of one piece of matter, or one body, from the vicinity of the other bodies that are in immediate contact with it, and which are regarded as being at rest, to the vicinity of other bodies” (*Pr.* II, 25; AT VIII A, 53–54; CSM I, 233).

Now, all motion, for Descartes, is *local* motion—for him, unlike for Newton, there is no such state as absolute rest or motion against which a body's motion is defined—and within the local framework under consideration, the motion of a body is defined by the changing relation of the body under consideration to other bodies in its neighborhood. From this definition of motion, it becomes clear that an individual piece of matter, or a body, is nothing other than that volume that is collectively displaced in relation to other volumes at a moment in time. A body is “whatever is transferred at a given time even though this may in fact consist of many parts which have different motions relative to each other” (*Pr.* II, 25; AT VIII A, 53–54; CSM I, 233). The problems with this account of individuation have been long recognized. Cordemoy, for instance, argues that we must appeal to something outside motion, that is, a privileged frame of reference, to individuate bodies because we do not have a clear idea of a body completely at rest with respect to other bodies. Leibniz takes another tack, arguing that motion is insufficient to distinguish one region of homogeneous undifferentiated space from another: It is not clear just how motion can add distinctions to a space that is not already differentiated.<sup>33</sup> Nevertheless, I want to bracket these concerns here, and consider just how Descartes would individuate the pineal gland.

The pineal gland, as a part of matter, is, for Descartes, divisible into parts, and indeed, the animal spirits arriving from the different areas of our body impinge on different areas of the gland.<sup>34</sup> The gland, however, moves as a unit. The gland *as a whole* orients itself in such a way that the animal spirits are redirected to certain parts of the body, resulting, for instance, in our elevating our arm or training our eyes on some object; the motion of the animal spirits (set in motion by, say, an object affecting our eyes) through the gland causes it *as a whole* to orient itself in a certain way. The gland, as it is affected by other parts of the body, always remains intact and thus possesses a certain integrity of its own. And so the gland is singled out just in virtue of the way in which it stands to the other moving parts of the human body. That is, the pineal gland emerges as an anatomical entity—an individuated object—insofar as it stands in a certain relation to the cavities of the brain in which it rests, the tubules that terminate at those cavities, and the animal spirits that flow into and from it. These anatomical elements, however, are themselves defined insofar as they stand in a certain relation to other physioanatomical

33. See Garber (1992, 157–72) for a good discussion of Descartes's views about motion; and see Garber (1992), pp. 175–81, and Rodis-Lewis (1950), chap. 2, for comprehensive summaries of the objections leveled against Descartes.

34. See *Treatise of Man*, Figs. 29, 32–36.

elements—the muscles, the sense organs, the skeleton, and so on—and they all, in turn, can be identified as one thing, namely a human body, insofar as they all move together in relation to other bodies.<sup>35</sup>

There are two things to note about this account of the individuation of the pineal gland. First, it confirms the failure of the analogical argument. Insofar as the unity of the pineal gland is an accidental unity, contingent on the relation of the motion of the volume of matter identified as the pineal gland to the motion of the volume of matter surrounding it, its undividedness is more disanalogous with the indivisibility of the soul than analogous.

Second, this account of the individuation of the pineal gland (and of bodies in general) is completely consistent with Descartes's characterization of the human body as a machine (and with his characterization of the physical world as mechanistic). For within a machine, too, each part is defined by how it stands to the other parts of the machine, and the standing of one part of the machine to another is determined precisely by the way in which one part *moves* in relation to another. So the pineal gland, insofar as it is a part of the machine of the human body, is individuated with respect to the workings of the human body.<sup>36</sup> So we now are drawn to ask just in what relation Descartes thinks the gland does stand to the rest of the human body. Answering this question can help us to understand just why Descartes thinks the pineal gland is the seat of the soul.

### 3.2 The Pineal Gland as a Part of the Body-Machine

Let us consider once again the anatomical arguments Descartes advances in defense of his claim that the pineal gland is the seat of the soul. Recall that in those arguments Descartes maintains two things about the pineal gland: the gland is able to serve as the locus for combining the impressions we receive from our double sense organs and the gland is appropriately mobile so that it can receive a diversity of impressions and is also appropriately stable, or well-protected, so that it responds consistently to those things affecting it. That is, Descartes is claiming that

35. Indeed, it is this conception of motion that informs Descartes's account of life. Life for him is a mechanical matter, arising from the heat in the heart and the conduciveness of that heat to the functioning of the human machine. The quality of life, in this biological sense, then depends not only on the integrity of the heart but also on that of the working parts of the body. Descartes's characterization of death as the result of the decay of the principal parts of the body echoes this idea (see PS, a. 6). The integrity or decay of any principal part of the human body for Descartes can only be understood in terms of the motion of matter for it is the motion that constitutes these parts. Moreover, this motion, for Descartes, is not due to any animative faculty of the soul but rather is explainable by its conformity to the laws of nature derivable from God's immutability. The motions constitutive of a living being, as motion of matter, result from the various motions God imparts to matter in creating it, and which he preserves (*Pr.* II, 36; AT VIII A, 61–2; CSM I, 240). Thus, the living human body is a special kind of matter only by virtue of the combination of motions that define it as a body. For a discussion of this matter, see Rodis-Lewis (1950, 65–6).

36. On this interpretation, we can easily accommodate comments like that to Villiers (via Mersenne) in which Descartes suggests that distorted perceptions—“trouble in their minds”—are the result of some constitutive change in the gland (AT III, 123; CSMK, 149). When something other than the orientation of the gland changes, not only is the communication between body and soul impaired but so are the physiological workings within which the gland plays an integral part.

the pineal gland is that part of the body-machine where the motions of the various parts of that machine can combine with the least amount of distortion, and because of this very particular place within the body-machine, Descartes thinks the gland is the seat of the soul.

I now want to suggest that in conjunction with the special place it holds within the body, the gland also plays a special role. In particular, I want to suggest that Descartes implies that the gland serves a *regulative* function within the body-machine. In serving this function, the gland is the site at which the body-machine works to maintain itself. It is *this* feature of the gland's situation to which the anatomical arguments advert. My argument for this position comes in three stages. First, I will show how we can make sense of a notion of a good proper to a machine, for such a notion is presupposed in assigning a part of a machine a regulative function. It is widely held that with his rejection of final causes in physics, Descartes rejects any notion of a good proper to body,<sup>37</sup> though he can appeal to a notion of good extrinsic to a particular body—the purposes to which that body might be put. However, Descartes's rejection of final causes in physics entails only a rejection of substantial forms, and the sort of good associated with them. I will argue that he can still appeal to an intrinsic good of mechanical structural integrity to characterize the good proper to body and that he need not fall back on an extrinsic notion of bodily good. I will then go on to consider just how a part of a machine can serve to regulate the machine itself. From there, I show that Descartes implicitly holds, on anatomical grounds, that the pineal gland serves such a function and that its doing so provides some grounds for the soul's being joined to it.

### 3.2.1 Bodily Good?

Conceiving of the pineal gland as serving a regulative function within the human body implies conceiving of the body as having some good toward which the body might be regulated, and this might seem objectionable. Descartes makes a point of rejecting an Aristotelian teleological conception of the human body in favor of a mechanical one. It is thus unclear what sense one can make of a good of the body within this purely mechanist framework.

Descartes most obviously rejects Aristotelian biology in his account of human life. Whereas the scholastics, with Aristotle, maintain that the soul is what animates the human body, for Descartes, the "principle of life" is nothing other than "a continual heat in our heart, which is a species of fire that the venous blood maintains in it" (PS, a.8; AT XI, 333). So, for Descartes, life and death in no way depend upon the soul's being in the human body or in the body of any other living thing. Rather, whether we are alive or dead depends only on whether our body is in good working order; the human body is simply a machine for Descartes.<sup>38</sup>

37. See in particular Des Chene (2001), especially chap. 6.

38. See PS a. 6; AT XI for a succinct statement of this point: "death never occurs through the fault of the soul, but only because one of the principle parts of the body disintegrates. And let us judge that the body of a living man differs from that of a dead man as much as a watch or other automaton (that is, other self-moving machine), when it is wound and contains the bodily principle of the movements for which it is constructed, along with everything required for its action, [differs

Moreover, Descartes seems further to be denying that the body has its own proper end insofar as it is a machine. In the Sixth Meditation, in the discussion of the way in which our bodies lead us into error, he distinguishes two senses of nature. The meditator is trying to understand how God can still be good, and so not a deceiver, even though our bodies do on occasion lead us astray. How are we to account for the fact that “those who are ill, for example, may desire food or drink that will shortly turn out to be bad for them” (AT VII, 84; CSM II, 58)? To answer this question, the meditator first remarks on the mechanics of the human body, comparing it with a clock. Just as a poorly made clock still “observes all the laws of its nature,” so a disordered human body still follows all the laws of its nature. While a poorly made clock may be said to deviate from its nature as a time-telling machine, the sense of “nature” in play here is *extrinsic* to the machine itself. The purpose to which we put the clock does not govern the workings of its mechanism for Descartes, although it might well figure in the design of the mechanism. In a similar way, we might think the purposes to which the soul uses the human body do not govern the workings of the body, though the design of the body may turn out to be amenable to the soul’s purposes. Instead, the nature of both the clock and the body, what “is really to be found in the things themselves” (AT VII, 85; CSM II, 59), is just their being governed by the laws of motion. And this nature is not so much proper to the clock as a clock, or to the human body as a human body, but rather to each of their natures as extended things. One might even say that in this sense, the natures of the clock and the human body are the same. In behaving in this law-governed way, neither the clock nor the human body strive toward some end; they just move in accordance with the fixed path determined by the nature of extension. Thus, insofar as the nature of the human body consists just in the workings of its mechanisms, there seems to be nothing one might properly call the good of the body. Any well or poor functioning of a particular body, it seems, must be conceived relative to some end extrinsic to the body itself, that is, the end toward which the laws of motion are being applied.<sup>39</sup>

It should also be clear from Descartes’s rejection of Aristotelian substantial forms that Descartes cannot appeal to a form as a source of good intrinsic to a body. On the Aristotelian view, it is a thing’s substantial form that makes it of the nature it is, and it is this nature that determines how that thing will move and

from] the same watch or other machine when it is broken and the principle of movement ceases to act.” See also his descriptions of the workings of the human body in the *Treatise of Man*, Part Five of *Discourse, Passions, and Description of the Human Body*, where he explicitly draws analogies between body parts and the working parts of machines such as hydraulic automatons, church organs, and clocks. In *Treatise of Man*, for example, he writes, “one may compare the nerves of the machine I am describing with the pipes in the works of these fountains [hydraulic automatons], its muscles and tendons with the various devices and springs which serve to set them in motion, its animal spirits with the water which drives them, the heart with the source of the water, and the cavities of the brain with the storage tanks” (AT XI, 131; CSM I, 100).

39. Hoffman (2007) argues that the clock analogy is consistent with a kind of *hylomorphism*, but one that does not explain the life of a material by the presence of a soul. Hoffman and I disagree in that he maintains that the soul does still serve to individuate the human body, while I maintain, as will become clear in what follows, that the human body, and indeed any body, can be individuated in mechanical terms.

behave more generally. Descartes's rejection of substantial forms as intelligible explanations of the movements of bodies<sup>40</sup> precludes his appealing to a substantial form to account for any intrinsic good that might underpin assigning a regulative function to a part of a body. These considerations, along with Descartes's commitment to dualist metaphysics, rule out his appealing to the soul as the source of a regulative principle proper to the body. For if the soul were to provide the explanation of the well-being of the body, it would seem either that Descartes would be claiming that the workings of the body were in part determined by the soul, and so violating his dualist principles, or that any sense of well-being we would assign the body according to this principle would be an extrinsic one, that is, the body would be functioning well relative to the purposes of the soul. Thus, there seems to be no way to make any sense of a good intrinsic to a body.<sup>41</sup>

Before we settle on this conclusion, we should consider whether we have properly understood what a machine is according to Descartes. There are several passages that suggest there is something more to Descartes's account of machines. For instance, in PS, a.107, Descartes maintains that there was some nutriment in the body that made it work better.

For it seems to me that our soul's first passions, when it began to be joined with our body, must have been due to the blood, or other juice entering the heart, sometimes being a more suitable nourishment than the usual for maintaining the heat in it which is the principle of life. (AT XI, 407)

Here, he seems to be suggesting that there is a good of the body independent of its union with the soul and internal to its mechanism. And this is not the only place Descartes speaks of the body in this way. He also adverts to a perfection proper to the body itself. Later in *Passions*, Descartes claims that the "natural use [of the passions] is to incite the soul to consent and contribute to actions which can serve to *preserve the body or render it more perfect in some way*" (PS, a. 137; AT XI, 430; emphasis added). And to Elizabeth, while explaining the correlation of "the pleasure of the soul which constitutes its happiness" with our bodily state, he writes that we feel cheerful in "bodily exercises like hunting and tennis which are pleasurable in spite of being arduous" because "in the process it [the soul] is made aware of the strength, or skill, or some other *perfection* of the body to which it is joined."<sup>42</sup> It seems then that Descartes does admit a certain good of the body, at least insofar as he is willing to speak of its perfection. How are we to understand this perfection or good of the body in a way consistent with Descartes's mechanism?

40. This is part of the point of the Sixth Meditation discussion. For an express statement of this rejection, see *Pr.* IV, 198: "there is no way of understanding how these same attributes (size, shape and motion) can produce something else whose nature is quite different from their own—like the substantial forms and real qualities which many <philosophers> suppose to inhere in things; and we cannot understand how these qualities or forms could have the power subsequently to produce local motions in bodies" (AT VIII, 323; CSM I, 285).

41. Des Chene (2001) subscribes to the view outlined in these arguments.

42. To Elizabeth, 6 October 1645; AT IV, 309; CSMK, 270; emphasis added.

Descartes claims that the perfection of the body is evidenced in those demonstrations of strength, whereby the body manages to sustain itself despite undertaking an arduous activity. Why should such an activity demonstrate bodily perfection? In the account of pleasure and pain he offers in the *Treatise of Man*, Descartes suggests that it is the soul's sense of the body's *completeness*—of its forming an integrated whole, which because of the “good constitution” of each of its parts, withstands breakage and the separation of one of the parts from the whole—which leads to a feeling of pleasure. Similarly, we feel pain when the completeness of the body's construction is undermined by an external force.<sup>43</sup> If we apply these observations to Descartes's later explanations of pleasure and pain, it then seems that Descartes takes the perfection of the body to lie just in the mechanical structural *integrity* of the construction of the body-machine.<sup>44</sup> Why might he think this is so?

To answer this question, we need to look again at the accounts Descartes gives of the human body. Recall that Descartes consistently claims that the human body is defined just by the disposition of its organs, that is, by the construction of the body-machine. So for instance, Descartes, in the Synopsis of the *Meditations*, writes that

the human body, insofar as it differs from other bodies, is simply made up of a certain configuration of limbs, and other accidents of this sort . . . a human body loses its identity merely as the result in the change in shape of some its parts. (AT VII, 14; CSM II, 10.)<sup>45</sup>

Here, he is only reiterating ideas that he had articulated much earlier. In the *Treatise of Man*, he claims that the workings of human bodies “depend only on the disposition of the organs”: it is the organization of the parts of the body that make it the machine it is.<sup>46</sup> Descartes espouses this view again and again.<sup>47</sup>

43. See AT XI, 143–4. See also *Pr.* IV, 191.

44. For my argument here, this account of perfection applies to living things, that is, bodies with moving parts. I am not sure, however, that mechanists have a principled way of distinguishing between organized living bodies and crystals, say. I discuss this point in a bit more detail in Shapiro (2003).

45. See also, within *Meditations*, the Second Replies: “But in the case of the human body, the difference between it and other bodies consists merely in the arrangement of the limbs and other accidents of this sort; and the final death of the body depends solely on a division or or change of shape” (AT VII, 153; CSM II, 109).

46. See AT XI, 120.

47. Later in *Treatise of Man*, he accounts for bodily sensation in terms of the arrangement of the nerve fibers in the parts of the machine serving as sense organs (AT XI, 141), and more generally, he accounts for all of our bodily functions simply by the “arrangement of the machine's organs” (AT XI, 202). Descartes also maintains this position—that the functioning of the body depends entirely on the disposition of its organs—in the unfinished *Description of the Human Body*. There, he states his position much more strongly, going so far as to claim that “when the body has all its organs disposed for some movement, it has no need of the soul in order to produce that movement” (AT XI, 225). The rest of the work is then devoted to defending this claim by describing “all of the machine of our body” (AT XI, 226), laying out its general structure and its workings in the beating of the heart, nutrition and in gestation. And the idea does not undergo any

Descartes's account of the basic human bodily functions in these terms follows naturally from his view that the human body is a machine.<sup>48</sup> A machine is just a system of parts that transfers forces, motion, or energy in a predetermined manner. We tend to think of machines in terms of the way they transform energy, that is, by the work they perform.<sup>49</sup> So, for instance, a car engine might convert chemical energy contained in the gasoline–air mixture into, ultimately, the rotational mechanical energy needed to turn the wheels and power the car (and thus, the engine is defined in part by its horsepower). In part because we have this picture of machines, there is a widespread view that a mechanistic picture of the world, and hence the mechanism of someone like Descartes, models the world simply as a chain of efficient causes: A certain physical state of affairs effects another physical state of affairs, which effects another and so on. Insofar as we conceive of Cartesian matter in this way, it seems like there can be no proper perfection of the body: If the body is just ticking away from one state to another along a well-determined course, then it does not seem that there is any space for any notion of the body's good.

For a seventeenth century thinker such as Descartes, a clock is the paradigm of a machine—and as we have seen, he explicitly compares the human body to it. But a clock does not transfer its motion to anything outside of itself. In a machine like a clock, the parts of the machine transfer energy to each other so that that energy remains within the machine itself.<sup>50</sup> While a clock also moves just according to the laws governing the motion of its parts, and so moves as a chain of efficient causes, in its case, those movements are geared only toward keeping the machine itself moving. In characterizing a clock by the work it does, then we are saying very little about it. It is rather its own mechanical structural integrity—that it is fitted

significant change when Descartes summarizes the central points of these unpublished works in Part Five of the *Discourse* and outlines his account of the beating of the heart (see AT VI, 46; CSM I, 34). Indeed, the idea still pervades Descartes's thoughts about the human body in the *Passions*, where, in his “brief explanation of the parts of the body and some of its functions” in *PS*, a. 7, he consistently appeals to “the way in which the machine of our body is composed” in order to account for the beating of the heart and the circulation of the blood; in later articles, he goes on to explain the production of animal spirits, movement of the muscles, the action of objects on the sense organs, and the way in which these actions affect the animal spirits in a similar fashion (see *PS*, aa. 9–16).

48. In a footnote to his translation of the *Treatise of Man*, Thomas Hall remarks that for Descartes's disciple Louis La Forge, a machine is just a “body composed of several organic parts which being united conspire to produce certain movements of which they would be incapable if separate” (Descartes 1972, 4, fn. 6.) Thus, La Forge seemed to recognize the facts about machines on which I am about to draw.

49. There is little new in this conceptions of machines. Beginning with Pseudo-Aristotle's tract on mechanics, the science of mechanics has always been concerned with the problem of how to move heavy objects in certain practical contexts. With developments in mathematics, sixteenth century Italian treatises on mechanics, such as those of Tartaglia and Guido Ubaldo, involve more sophisticated solutions to those problems, but the concerns are the same. Hence, mechanics is often referred to as the “science of weights.” See Drake and Drabkin (1969).

50. Of course, a clock is not a perpetual motion machine, but in designing a clock, one wants it to keep ticking and to keep time for as long as possible. Indeed, Descartes in Rule 13, alludes to a concern with devising just such a potential motion machine (AT X, 436–37; CSM I, 55). Thus, the perfect machine is just one that is self-contained in this way.

together in the way it is, such that it maintains its structure—which allows us to specify it as the machine it is. We need to know just how the parts of the clock are configured with respect to each other and how that configuration of parts keeps the clock intact and ticking and not the work it does.

This point about clocks generalizes to other complex machines. A machine is able to perform its function—to do work—just because of the interrelation of its parts. Just as a clock works by pairing the motions of gear wheels with a timing device through an escapement so that with every period of the timer the gear wheel is allowed to rotate in an amount calibrated to move the part of the clock that indicates the time,<sup>51</sup> in the case of the car, the engine is able to produce the amount of horsepower it does just because the parts of the engine all fit together the way they do: The horsepower of the engine will depend on the shape and size of the cylinders and the piston the way the piston is fixed to the crankshaft, the length of the crankshaft, and so on. Thus, a machine is equally definable in terms of the way in which the motion of its parts are configured for it is the fact that each part of the machine is tied to other parts in the way it is so that some parts constrain the motion of others, which allows for the machine to achieve its extrinsic function.

For Descartes, the human body should be no different, and under this characterization of machines, we can see the significance of Descartes's description of the human body. In claiming that the human body is defined by the arrangement of its organs, Descartes is claiming that all we need to know to understand the way the body works is to understand how it is configured—how the machine of the human body is composed—for it is the configuration itself that determines just what motion is available. This disposition of organs defines the human body as the machine it is.

Under this conception of the human body as a machine, we can readily understand the perfection of the body as its completeness, where completeness is understood as mechanical structural integrity. For on the account I have been developing, the perfection of a machine lies just in its having all its parts in order. It is, after all, this order that allows the machine to work well, to serve the purposes to which it is put. Accordingly, the perfection of the body lies simply in the continued alignment of its parts so as to maintain its working order—its life, or its internal structural integrity. This conception of bodily perfection accords quite well with what Descartes writes to Elizabeth concerning the source of the pleasure derived from exercise and about pleasure and pain in the *Treatise of Man*. Furthermore, it is equally supported by what he states his aim to be in the *Description of the Human Body*. There, he ties a knowledge of this disposition of our organs to our maintaining our health, and the idea seems to be that if we can just discover “the nature of our body”—the way our body is put together—we will be able to better maintain its integrity and so be able to live healthier and longer lives.<sup>52</sup> Equally, this understanding of the perfection of the human body squares with what we have

51. For an account of the development of mechanical clocks and watches, see Usher (1929), chap. 10.

52. See AT XI, 223–24.

already seen Descartes write in *Passions*. Recall that there, Descartes accounts for death by the disintegration of one of the principal parts of the body. When one of the parts of the body begins to fail, then the whole mechanism of the body-machine ceases to be able to function: The machine loses its integrity and so “the bodily principle of the movements for which it is constructed . . . ceases to act” (PS, a. 6; AT XI, 331). Thus, according to Descartes, the human body dies—it ceases to be what it is or to function according to its proper principle—just when it decomposes and the parts of the machine cease to stand in their constitutive relation to one another.

Understanding the perfection of a machine, and so that of the human body, as its mechanical structural integrity does allow us to make sense of a good proper to a machine, which is neither extrinsic to it nor intrinsic in the same way that souls and substantial forms imbue bodies with a good all their own. First, this account does not explain the perfection of a machine, its good, by appeal to the purposes the machine may serve. A machine has its mechanical integrity independently of those purposes, and that it can serve any purpose at all presupposes that it does have its own integrity. In this way, this account does not entail that we explain the perfection of the human body by appeal to the purposes the soul to which it is joined might put it. Rather, we can claim that any use to which the soul might put the body depends on the body being the sort of being that it is.<sup>53</sup> Nor does this account explain the good of the body in terms of substantial forms, for it certainly does not appeal to a soul or form of the machine that gives it its nature. A machine is the machine it is, the human body is just the body it is, just in virtue of the composition of its parts, and its parts are so composed simply in accordance with the laws of nature, and it will remain that machine just so long as its parts continue to move in coordination with one another. Of course, this arrangement of parts is not necessary—the machine can decompose in a way entirely in accord with the laws of nature. But in that case, the machine will no longer be the same thing. Insofar as a machine’s mechanical structural integrity makes it the stable thing it is, that integrity constitutes its perfection or good.<sup>54</sup>

It is worth noting that Descartes needs just such a notion of mechanical perfection to make sense of what he says about animals. For animals, for him, do

53. The alternative explanation of Descartes’s “death” on which P. Gabriel Daniel’s (1690) *Voyage au Monde du Descartes* seems premised on just such a view. In this fantastic novel, we are presented with a Descartes who has discovered the nature of the union of soul and body and with this knowledge (and a little snuff) is able to separate the soul from the body at will and then rejoin it (with the help of some restorative Hungary water). In the midst of one of the soul’s expeditions away from the body, Descartes’s physician visits him, and finds a body uttering the sort of nonsense a machine without a soul would utter in reply to questions. He thus attempts to cure Descartes’s illness, but in doing so disorders the body machine that the soul is not able to reunite with it. The suggestion is that Descartes, far from being dead, is wandering the world a disembodied soul.

54. There might well still be problems with this notion of a good proper to body, but I would maintain that these problems are of a piece with the problems Descartes faces regarding the individuation of bodies, in general. I have already bracketed these questions, and continue to do so. For criticisms of Descartes’s account of individuation of bodies see fn. 33 earlier.

seem to work to maintain themselves.<sup>55</sup> But insofar as Descartes does not think that nonhuman animal bodies are joined with souls, he cannot claim that the survival of the animal is due its bodily well-being serving the ends of a soul joined with it. Nor is it at all clear what other sort of extrinsic good or purpose the continued life of the animal could serve, which does not already presuppose the life of that animal. And of course, Descartes cannot explain this continued life of the animal by appeal to any substantial form or soul that gives the animal its nature. As animals are simply machines, Descartes needs a norm of mechanical stability to explain their persistence.<sup>56</sup>

### 3.2.2 *A Part of the Body-Machine with a Regulative Function: The Pineal Gland*

Now that we have made some sense of a notion of bodily good available to Descartes, we can turn to consider how a part of a machine can serve a regulative function. Take the case of a car again. In a properly functioning automobile engine, the pistons are moved through the cylinders by the force of combustion. In order for this combustion to happen, air has to be let in through the valves just when the pistons are moving in through the cylinders. Thus, the opening of the valves must be coordinated with the motion of the pistons. In part, this coordinated motion is achieved by the rod, which drives the pistons, and the cam, the levers of which open the valves. But there is also a part of the car engine that is there precisely to facilitate this coordination of parts: the timing belt. The timing belt pairs the motions of the piston rod and the valve cam so that they move in a way that facilitates combustion. And as some unfortunate car owners know, if the timing belt breaks, the engine can be damaged to such an extent that it needs to be completely replaced: If the valves do not open and the air does not come into the cylinder, then the pistons will crash into the valves, bending them sometimes so much that they will not be able to open again. The timing belt thus both is a mechanical part of the engine—it is part of the chain of efficient causes that make up the machine—and serves a regulative function within the machine—in coordinating the motion of certain parts of the machine, it helps to preserve the integrity of the machine.

If we consider the place Descartes claims the pineal gland holds within human anatomy, we can see that the gland might indeed play a similar regulative role within the machine of the human body. As we have seen, the gland serves as the locus for the combining of the impressions we receive from our double sense organs. The two impressions made on each of our two eyes, our two ears, and presumably the multiple sense impressions made on our more diffuse sense organs all make their way, through the communication of motion, to the pineal gland where their motions are combined, it seems geometrically.<sup>57</sup> Moreover, in the

55. See *Discourse* Pt. V; Letter to the Marquess of Newcastle, 23 November 1646; AT IV, 574ff; CSMK, 303f; PS, aa. 50, 138. Carriero (2009) makes a similar point and sees this concern with a bodily good in play in Descartes's discussion of sensation in the Sixth Meditation (see pp. 397–98).

56. See Hatfield (1992) and (2007) for a view with some affinities to the one outlined in this section.

57. That is, in Descartes's picture of things, the impressions from each eye, for instance, are directed such that when they ultimately impinge on the pineal gland, they overlap point by point. Their images are perfectly superposed; there is no differential between their tracings. That this

second set of anatomical arguments, Descartes emphasizes the gland's capacity to preserve the impressions it receives. Not only is the gland "well-equipped" to receive impressions transferred through the animal spirits because of its situation, "surrounded and supported" by the conduits for them, but also it is subject to alteration to the proper degree. It is very mobile so that it can receive impressions easily. Yet equally, it is well-protected so that it is virtually immune from illness and movable only by the animal spirits. As such, the gland not only is able to reflect the wide variety of alterations in the body, but also because it is well-protected from outside influence, it does not itself distort the motions it receives.

Descartes emphasizes these aspects of the gland with an eye to their significance with regard to the formation of ideas by the soul, but this focus can be misleading. For it is tempting to think these features are important because they allow the gland to present the soul with a clear, concise image that it can then read off the surface of the gland. That is, it is tempting to think that the gland has the place it does within the Cartesian human being *solely* because it satisfies the conditions necessary for thought. These features of the gland and its situation do figure in the formation of ideas, and in so doing clearly meet the conditions Descartes thinks must obtain in order for the soul to have the thoughts it does about the material world. But the features of the gland are not given to it as arbitrarily as it sometimes seems they are. That is, it is not as if Descartes begs the question by assigning to the gland just those features, which will satisfy the soul's demands and thereby make human anatomy subordinate to the soul. The features of the gland, which just so happen to meet the demands of thought, are significant within the workings of the body itself.

That the gland is positioned to receive impressions from the various sense organs, without distorting and while preserving the motions it receives, figures in the workings of the body just because the gland not only receives the animal spirits and the signals contained within their motion. It also is the site from which those animal spirits are *directed* to the various parts of the body. The spirits do not stop moving once they reach the gland; rather, they are channeled to those parts of the

combination is geometrical is not so much evidenced in Descartes's words as in his illustrations, in particular those to the *Treatise of Man*. In diagram 41, we see the openings from tubules 2–6, one set from each sense organ. The tubules terminate at the cavity in which the pineal gland is nestled. When the tubules are set in motion—the end result of the stimulation of the sense organs—the animal spirits are directed along clearly defined linear paths from particular points on the gland to the tubules, and thereby an image is formed, and image that, in some way, represents the stimulus. Human anatomy is simply such that the spirits which go to tubule 2 of the left eye come from exactly the same locus on the gland as those which go to tubule 2 of the right eye. In this way, the impressions from our double sense organs are not only combined into one image, but also into an image that preserves all the elements of the impressions received from each eye.

Such a feature indeed becomes important when we consider it in light of the whole human body. Because the spirits *only* effect the gland's orientation, the impressions they communicate from the various parts of the body are additive. A certain smell results in a particular shifting of the gland, while a certain sight shifts it in another way. These shifts are combinable such that the smell and sight together result in a certain superposed orientation, which can ultimately be decomposed. If the spirits were to somehow change the constitution of the gland, such a superposition would be impossible. A smell would change the gland such that the sight would have a significantly different effect depending on whether it reached the gland before or after the smell.

body that through the body's own reflexive responses, are poised to react responsively to the impressions. So, for instance, when a fire is near our foot, it affects the nerves in our foot in such a way that certain pores in the brain are opened. This opening of the pores does two things: It causes the animal spirits to flow through the pineal gland, thus occasioning a feeling in the soul of a burning sensation in our foot, and it causes those spirits to flow through those pores into the muscles, which act to pull the foot away from the fire.<sup>58</sup> This is a relatively simple example since the action effected by the redirection of the spirits occurs in the same place as the original stimulus, but we might imagine a more complicated system. When our body is in need of fluids, say, this absence of water opens a set of pores that channel the animal spirits through the pineal gland such that we feel thirsty and set about finding something to drink.

It is significant that Descartes thinks that these sorts of physiological responses are entirely involuntary: They are explicable by the workings of the body alone and are not caused by our having the thought we do when our body is in that state. For insofar as the gland is the site where the animal spirits are directed to various parts of the body in accordance with the way the body is affected, the gland serves to coordinate the movements of the body. Our response to stimuli involves the coordination of *all* the parts of the body. When our foot is being burned, for instance, we are not only prompted to withdraw our foot from the fire but also we turn our head and look at where we feel the pain coming from (AT XI, 142). Similarly, when we need water, our body moves as a whole to seek that water out, lift it to our lips, and drink it. It is through the pineal gland that this coordination is achieved. The way the body is affected opens certain pores surrounding the gland. Then the spirits passing through the gland are directed toward those pores so that they are driven to those parts of the body where they are needed to effectuate the appropriate response to the stimuli. Indeed, if the movement of the various parts of the body were not well-coordinated—both so that stimuli elicit an appropriate response and so that diverse parts of the body work together to effect that response—the body would not be able to maintain itself properly. Thus, insofar as the gland serves to coordinate the movements of the various parts of the body in this way, it also serves as a regulative function within the body-machine.<sup>59</sup>

One might object that the heart, rather than the gland, is that part on which the good of the body turns. The heat in the heart is, after all, the principle of life. The heart, in serving as the engine of the body-machine, rarefying the blood and so keeping the machine moving, certainly plays a pivotal role in the body's continued life. But the heart does not seem to regulate either itself or the body: The heart's rate changes, but the heart itself has no role in effecting its rate, and equally, it naturally responds to a change of input, but does not control that input. A richer blood, say, will result in a stronger heartbeat, but the richness of the blood will be a matter of circumstance—the kind of food we have available, for instance—along with the body's effectively processing what it ingests; and these sorts of processes

58. This example is Descartes's. See *Treatise of Man* (AT XI, 141–42).

59. My argument here would gain force if Descartes had talked about the role of the pineal gland in animals, but he says very little about animal physioanatomy in general.

are regulated by the direction of the animal spirits to the proper organs. As we have seen, this direction of the animal spirits is mediated by the pineal gland and not the heart.

I have argued, the good of the body consists just in the continued well-functioning of the body-machine or the preservation of its mechanical integrity. The body's functioning well, however, depends on the coordination of its parts. The mechanics of the body itself works to keep the parts coordinated so that when one part of the body is affected in a certain way, the other parts of the body respond in such a way to keep the body in working order: It is the mechanical structure of the body that determines which pores in the brain will open, and the open pores determine to where in the body the animal spirits will flow. Yet, according to Descartes, all this coordination happens at one point, and that point is the pineal gland. Thus, insofar as the good of the body turns on the coordination of the parts of the body, and this coordination turns on the motion of the pineal gland, the gland can be said to be that part of the body on which the well-functioning of the whole turns.

#### 4. THE GLAND AS THE SEAT OF THE SOUL

Once we understand the pineal gland in this way, as serving a regulatory role in the workings of the human body, we can better understand just why Descartes thinks that the gland is the seat of the soul. For one, insofar as the gland does serve to coordinate the various motions within the body, it will afford access to the whole of the body and its workings. And with this awareness of its body, the soul gains awareness of the world insofar as the world affects the well-being of the body. Equally, it is from this point that the soul can contribute to the body's achieving its proper good, for the entire of action of the soul on the body consists just in moving the pineal gland. This reorientation of the gland, in turn, does nothing but effect a redirection of the animal spirits so that they flow into pores other than those to which they are naturally inclined.

That Descartes conceives of the relation of the soul to the pineal gland in this way is clear. In offering his account of sensation in the Sixth Meditation, Descartes takes as paradigm not cases of perceiving objects but rather sensations of hunger, thirst, and other perceptions of the way things benefit or harm the body (AT VII, 81f; CSM II, 56f).<sup>60</sup> In addition, in *Treatise of Man*, he compares the soul with the turncock of a fountain.<sup>61</sup> As Descartes sees things, the soul resides in the body just as a turncock sits in the control booth of a hydraulic machine. The turncock, in virtue of its position within the mechanism, is apprised of the way the whole machine is working. All the information about the water pressure in various parts of the machine, the status of the different valves, the positions of the various parts comes back to the main where the turncock sits. In a similar way, the soul, in virtue of its particular relation to the pineal gland, has access to the workings of the whole

60. For a nice discussion of this dimension of Descartes's account of sensation, see Simmons (1999).

61. See AT XI, 131–32.

body. All the motions within the body ultimately repair to the pineal gland, and so within the gland is contained the status of the body-machine. And just as the turncock is able to manipulate valves so as to control the flow of water through the fountain (and so the movements of the parts of the fountain that that flow of water effects), so too is the soul, by thinking the thoughts that by their association with a physical state shift the orientation of the pineal gland, able to control the flow of animal spirits, and with that the motion of the body those animal spirits effect.

An additional benefit of this account of the peculiar place of the pineal gland within Descartes's account of the human being is that it affords a straightforward way of understanding Descartes's claims that the soul is joined to the human body at a single point—the pineal gland—and that it is joined to the whole body and “one cannot properly say that it is in any one of its parts to the exclusion of the others” (PS, a.30; AT XI, 351). As the gland is that part of the body that coordinates the movements of the various parts, it can be understood as a site of mechanical regulation, and hence, a key to the continued integrity of the whole body. As such, the gland can serve as that place where the soul “exercises its functions in a more particular way” (PS, a.31; AT XI, 352) even while it is effectively joined with whole. For the thoughts the soul derive from the body to which it is joined are products of the way the body as a mechanical whole is affected. The soul senses the way things benefit and harm the body as a whole with its proper integrity.

While readers of Descartes have taken his claim that the pineal gland is the seat of the soul to be close to patently absurd, Descartes does offer two kinds of arguments for his view: some anatomical, others analogical. The few who have taken these arguments seriously have focused on the analogical arguments. I have argued, however, that any analogy between the undivided pineal gland and the indivisible soul is not only a bad one, but also that an argument that rests on that analogy risks violating the dualist tenet of Cartesian metaphysics. The anatomical arguments are more promising for understanding Descartes's view. I have argued that with these arguments, Descartes undertakes to identify the gland as serving a regulative function within the human body-machine. While doing so involves attributing the body its own good, I have shown that there is conceptual space in Descartes's mechanism for a bodily good that is neither extrinsic to a body nor intrinsic to it in the way that provided by Aristotelian substantial forms is. With this understanding of the pineal gland's anatomical place in mind, we can understand the gland as that point through which the soul could reasonably gain access to the workings of the body as a whole, and to best grasp the way things benefit and harm that body.

While this reading does lend plausibility to Descartes's claim about the pineal gland, his view is still not without problems. Most saliently, Descartes's basic anatomical claims about the pineal gland were not widely accepted in his own time and are false.<sup>62</sup> It is not clear that any inference to the regulative function of the gland could be warranted with a proper understanding of its anatomical position, and if not, Descartes's claims about the gland being the seat of the soul would fail on empirical grounds. Equally, the account of place of the pineal gland within the

62. See Lokhorst (2011).

body-machine turns on Descartes's account of the individuation of bodies, but it is not clear that given his conception of extension, Descartes has a coherent account of individuation. In addition, this account of the pineal gland goes little way towards explaining the nature of the interaction between soul and body. But neither of these problems is peculiar to Descartes's claims about the pineal gland. They reflect problems endemic to Descartes's philosophical system. Thus, Descartes's claim that pineal gland is the seat of the soul is not so much absurd in itself. Any problems in it are tied to those of his metaphysics.<sup>63</sup>

## REFERENCES

- Bitbol-Hespériès, Annie. 1988. *La Principe de la Vie chez Descartes*. Paris: Vrin.
- Canguilhem, Georges. 1955a. "Organisme et Models Mechaniques." *Revue Philosophique* 80: 281–99.
- . 1955b. *La formation du Concept de Reflexe aux XVIIe et XVIIIe Siecles*. Paris: PUF.
- Carriero, John. 2009. *Between Two Worlds: A Reading of Descartes's Meditations*. Princeton, NJ: Princeton University Press.
- Daniel, Gabriel. 1690. *Voyage au Monde du Descartes*. Paris: Simon Bénard.
- Dankmeijer, J. 1951. "Les Travaux Biologique de Rene Descartes." *Archives Internationale d'Histoire des Sciences* 6: 675–80.
- Des Chene, Dennis. 2001. *Spirits and Clocks: Machine and Organism in Descartes*. Ithaca, NY: Cornell University Press.
- Descartes, René. 1964–76. *Oeuvres de Descartes*, 12 vols., revised edition, ed. C. Adam and P. Tannery. Paris: J Vrin [AT].
- . 1972. *Treatise of Man*, trans. and commentary T. S. Hall. Cambridge, MA: Harvard University Press.
- . 1984–85. *The Philosophical Writings of Descartes, Vol. I–II*, trans. J. Cottingham, R. Stoothoff, and D. Murdoch. Cambridge: Cambridge University Press [CSM].
- . 1988. *Les Passions de l'Ame*, ed. J. M. Monnoyer. Paris: Gallimard.
- . 1989. *The Passions of the Soul*, trans. Stephen Voss. Indianapolis, IN: Hackett [PS].
- . 1991a. *The Philosophical Writings of Descartes, Vol. III*, trans. J. Cottingham, R. Stoothoff, D. Murdoch, and A. Kenny. Cambridge: Cambridge University Press [CSMK].
- . 1991b. *Principles of Philosophy*, trans. V. R. Miller and R. P. Miller. Dordrecht, The Netherlands: Kluwer.
- Drake, Stillman, and Drabkin, I. E., eds. 1969. *Mechanics in Sixteenth Century Italy*. Madison: University of Wisconsin Press.
- Dreyfus-LeFoyer, H. 1937. "Les Conceptions Medicales de Descartes." *Revue de la Metaphysique et de Morale* 44: 237–86.
- Garber, Daniel. 1992. *Descartes' Metaphysical Physics*. Chicago: University of Chicago Press.
- Gorham, Geoffrey. 1994. "Mind–Body Dualism and the Harvey–Descartes Controversy." *Journal of the History of Ideas* 55(2): 211–34.
- Guerout, Martial. 1985. *Descartes' Philosophy Interpreted According to the Order of Reasons, Vol. II, The Soul and the Body*, trans. Roger Ariew. Minneapolis: University of Minnesota Press.
- Hatfield, Gary. 1992. "Descartes's Physiology and Its Relation to his Psychology." In *Cambridge Companion to Descartes*, ed. J. Cottingham, 335–70. Cambridge: Cambridge University Press.
- . 2007. "The Passions of the Soul and Descartes' Machine Psychology." *Studies in History and Philosophy of Science* 38(1): 1–35.
- Hoffman, Paul. 2007. "Descartes' Watch Analogy." *British Journal for the History of Philosophy* 15(3): 561–67.

63. This paper has benefited from comments from audiences at Simon Fraser University, University of Toronto, and Washington University in St. Louis, and most recently by John Carriero.

- Jefferson, Geoffrey. 1949. "Rene Descartes on the Localisation of the Soul." *Irish Journal of Medical Science* 6: 691–706.
- Kaitaro, Timo. 1999. "Descartes' Dualism and the Localization of Mental Functions." In *Norms and Modes of Thinking in Descartes*, ed. T. Aho and M. Yrjonsuuri. *Acta Philosophica Fennica* 64: 171–82.
- La Forge, Louis. 1666. *Traité de l'Esprit de l'Homme*. Amsterdam: Abraham Wolfgang.
- Lindeboom, G. A. 1979. *Descartes and Medicine*. Amsterdam: Rodopi.
- Lokhorst, Gert-Jan. 2011. "Descartes and the Pineal Gland." In *Stanford Encyclopedia of Philosophy*, ed. Edward Zalta. Retrieved August 2011, from <http://plato.stanford.edu/archives/sum2011/entries/pineal-gland>
- Mersenne, Marin. 1965. *Correspondance du P. Marin Mersenne*, ed. Cornelius de Waard. Paris: CNRS.
- Rodis-Lewis, Geneviève. 1950. *L'Individualité Selon Descartes*. Paris: Vrin.
- . 1978. "Limitations of the Mechanical Model in the Cartesian Conception of the Organism." In *Descartes: Critical and Interpretive Essays*, ed. Michael Hooker, 152–170. Baltimore, MD: Johns Hopkins University Press.
- Shapiro, Lisa 2003. "The Health of the Body-Machine? Seventeenth Century Mechanism and the Concept of Health." *Perspectives on Science* 11(4): 421–42.
- Simmons, Alison 1999. "Are Cartesian Sensations Representational?" *Noûs* 33(3): 347–69.
- Spinoza, Baruch 1994. *Ethics*. In *A Spinoza Reader*, trans. and ed. Edwin Curley. Princeton, NJ: Princeton University Press.
- Usher, Abbott Payson 1929. *A History of Mechanical Inventions*. New York: McGraw-Hill.
- Vesalius. 1952. *Vesalius on the Human Brain (translation of De Fabrica)*, trans. Charles Singer. Oxford: Oxford University Press.
- Voss, Stephen, ed. 1993a. *Essays on the Philosophy and Science of Rene Descartes*. Oxford: Oxford University Press.
- . 1993b. "Simplicity and the Seat of the Soul." In *Essays on the Philosophy and Science of Rene Descartes*, ed. Stephen Voss, 128–41. Oxford: Oxford University Press.