

# DESCARTES AND THE METEOROLOGY OF THE *WORLD*

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**Abstract.** Descartes claimed that he thought he could deduce the assumptions of his *Meteorology* by the contents of the *Discourse*. He actually began the *Meteorology* with assumptions. The content of the *Discourse*, moreover, does not indicate how he deduced the assumptions of the *Meteorology*. We seem to be left in a precarious position. We can examine the text as it was published, independent of Descartes' claims, which suggests that he incorporated a presumptive or hypothetical method. On the other hand, we can take Descartes' claims as our guide and search for the epistemic foundations of the *Meteorology* independent of the *Discourse*. In this paper, I will pursue the latter route. My aim is to explain why, and how, Descartes thought that he had deduced the assumptions of the *Meteorology*. My interest, in this case, is solely Descartes' physical foundation for the *Meteorology*, in the physics and physiology that resulted in Descartes' explanation. With this aim, I provide an interpretation of Descartes' *World* where many of its conclusions serve as evidence for the assumptions of the *Meteorology*. I provisionally conclude that Descartes thought that his *World* was the epistemic foundation for his *Meteorology*.

**Keywords:** Descartes, Meteorology, World, deduction, physics, physiology

## Introduction

Descartes began his *Meteorology* with “assumptions,” which he knew was unexpected, even for his closest correspondents,<sup>1</sup> for his method required him to begin with the “simplest and most easily known objects” and, then, “ascend little by little [...] to knowledge of the most complex.”<sup>2</sup> For this reason, he prepared his readers in Part Six of the *Discourse*: “Should anyone be shocked at first by some of the statements I make at the beginning of the *Optics* and the *Meteorology* because I call them ‘suppositions’ and do not seem to care about proving them, let him have patience to read the whole book attentively.”<sup>3</sup> On the one hand, Descartes did, indeed, begin with assumptions, which has led many scholars to conclude that he endorsed a hypothetico-deductive method in his natural philosophy.<sup>4</sup> On the other hand, he claimed that the conclusions of the *Meteorology* were deduced from his first principles, his principles of physics and metaphysics. For instance, he wrote, again, in Part Six of the *Discourse*, “And I have called them ‘suppositions’ simply to make it known that *I think I can deduce them from the primary truths* I have expounded above.”<sup>5</sup>

He made a similar claim to Vatiér,

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I cannot prove *a priori* the assumptions I made at the beginning of the *Meteorology without expounding the whole of my physics*; but the observational data which I have deduced necessarily from them, and which cannot be deduced in the same way from other principles, seem to me to prove them sufficiently *a posteriori*. I had indeed foreseen that *this manner of writing would shock my readers* at first, and I think I could easily have prevented this by refraining from calling the things I discussed initially ‘assumptions’ and by enunciating them only after I had given some reasons to prove them. However, I will tell you candidly that I chose this manner of expounding my thoughts for two reasons. First, *believing that I could deduce them in due order from the first principles of my metaphysics*, I wanted to ignore other kinds of proofs; secondly, I wanted to see whether the simple exposition of truth would be sufficient to carry conviction [...].<sup>6</sup>

In this case, he “believed” that he could deduce his *Meteorology*. However, he claimed that he did deduce this material in his Letter to Dinet,<sup>7</sup>

In the brief set of *Meditations* which I published are to be found all the principles of the philosophy on which I am working. And in the *Optics* and the *Meteorology* I deduced *many specific results from these principles* which illustrate the method of reasoning which I employ. Hence, although I have not yet revealed the whole of my philosophy, I think that the *samples I have already produced* make it easy to understand what it will be like. I think I was quite justified in preferring to *publish certain specimen essays* to begin with, rather than setting out *the entire system* before there was a demand for it.<sup>8</sup>

His derivation, he claimed, began with his early metaphysics<sup>9</sup> and the “specimen essays,” the *Discourse* and *Meteorology*, provided a first approximation of his derivation.

The problem, then, is as follows. Descartes claimed to have deduced the assumptions of his *Meteorology*, but, to this point, his claim is all that we have. He actually began this treatise, however, with assumptions and even proposed it as an independent textbook for the Jesuit Colleges.<sup>10</sup> The content of the *Discourse*, moreover, does not indicate how Descartes deduced the assumptions of the *Meteorology*. We seem to be left in a precarious position. We can examine the text as it was published, independent of Descartes’ claims, which suggests that he incorporated a presumptive or hypothetical method. On the other hand, we can take Descartes’ claims as our guide and search for the epistemic foundations of the *Meteorology* independent of the *Discourse*. In this paper, I will pursue the latter route. My aim is to explain, in broad strokes, why, and how, Descartes thought that he had deduced the assumptions of the *Meteorology*. My interest, in this case, is solely Descartes’ physical foundation for the *Meteorology*, in the physics and physiology, broadly construed, that resulted in Descartes’ explanation. With this aim, I provide an interpretation of Descartes’ *World* where many of its conclusions serve as evidence for the assumptions of the *Meteorology*. I, however, will not provide an explanation of all of the assumptions in the *Meteorology*.<sup>11</sup> Rather, I assess his claim that he could explain the Scholastic elements and qualities by his particle physics. Based on this interpretation, I provisionally conclude that Descartes thought that his *World* was the epistemic foundation for his *Meteorology*.

### The Foundation of the *Meteorology*

Before we take up the main task of this paper, let's first establish that such an explanation is possible. There is evidence that makes it seem as if, first, Descartes did not attempt to teach his method and, second, that he did not apply it in the *Meteorology*.<sup>12</sup> Descartes explained in his opening remarks of the *Discourse*, “My present aim, then, is *not to teach the method* which everyone must follow in order to direct his reason correctly, but only to *reveal how I have tried to direct my own*.”<sup>13</sup> He made a similar claim in his explanation of the title to Mersenne: “I have not put *Treatise on the Method* but *Discourse on the Method*, which means *Preface or Notice on the Method*, in order to show that I do not intend to teach the method but only to discuss it.”<sup>14</sup> The method, then, was not fully disclosed in the *Discourse*, which seems to make a description of Descartes' epistemic foundations implausible. Similarly, Descartes seemed to have claimed that he did not apply the method in the *Meteorology*. He explained to Mersenne, “*I am not actually following the method*, but trying rather to give some demonstrations of it in the three consecutive treatises appended to the *Discourse*, where I describe it.”<sup>15</sup> As well, he wrote to Vatier, “*I could not demonstrate the use of this method* in the three treatises which I gave, because *it prescribes an order of research which is quite different from the one I thought proper for exposition*.”<sup>16</sup> Descartes' descriptions seem to be problematic for my main task. If Descartes did not teach the method in the *Discourse*, and did not fully apply it in the *Meteorology*, then how is it possible for us to explain how he thought that he deduced his meteorological assumptions?

My response is that although it is true that Descartes did not completely follow the method in the *Meteorology* and, for this reason, did not demonstrate it, this does not mean that Descartes failed to disclose key portions of what he thought were meteorological deductions. He did admit, first, that his meteorological explanations were deduced from his assumptions in the *Meteorology*, thus, for him, forming a deductive chain. He wrote, “Compare the deductions I have made from my assumption – about vision, salt, winds, clouds, snow, thunder, the rainbow, and so on – with what the others have derived from their assumptions on the same topics.”<sup>17</sup> This suggests that he disclosed, in some sense, his deductive application of the method to his *Meteorology*. For this reason, we can have a general idea of how he deduced his meteorological explanations from his assumptions. However, it is his deduction of these assumptions that we are presently interested in. The key question is whether he conducted such a deduction and, if so, did he disclose his arguments? There is evidence that he did. He claimed that he thought he could deduce his meteorological assumptions in the *Discourse*.<sup>18</sup> Moreover, Descartes' description internal to the *Discourse* indicates that, by his lights, the physical foundation of the *Meteorology* was the physics and physiology of Part Five, which was a selective summary of his *World*. For instance, he wrote at the beginning of Part Five, “I would gladly go on and reveal the whole chain of other truths [the content of the *World*] that I deduced from these first ones [his metaphysics]”<sup>19</sup> and then explained, “I endeavored to *explain the most important of these truths in a treatise*, which certain considerations prevent me from publishing, and I know of no better way to make them known than by summarizing its contents.”<sup>20</sup> It is agreed by commentators that this suppressed “treatise” was the *World*.<sup>21</sup> So, if we want to explain the foundation of Descartes' meteorological assumptions, we should turn to his arguments in this treatise.

Descartes began writing the *World* in 1629 and completed a version of it in late 1633. It seems that he had something close to a finished draft. He wrote to Mersenne, “I had intended to send you my *World* as a New Year gift, and two weeks ago I was quite determined to send you at least a part of it, *if the whole work could not be copied in time*.”<sup>22</sup> He explained, however, that he decided not to publish it.<sup>23</sup> Rather, he decided to “suppress” the treatise, in

part, because he had learned of the condemnation of Galileo for his heliocentric thesis in his *Dialogues on Two Chief World Systems* and Descartes' *World*, similarly, included the Copernican thesis.<sup>24</sup> It was not until after Descartes' death that parts of the treatise were published independently.<sup>25</sup> What seems to be well-established by Descartes' description in Part Five of the *Discourse* is that by 1637 the *World* was the collective title for the *Treatise on Light* and *Treatise on Man*. In the former, Descartes attempted to provide a proof of his theory of matter, derived laws of physics from the perfections of God, and proposed that if God created a chaotic plenum and applied these laws, it would come to resemble the present universe. His treatise covered such topics as the formation of the sun, stars, planets, moon, comets, the rotation of the planets, gravity, and the principal properties of light, among others. The *Treatise on Man*, on the other hand, sought to explain human physiology. Descartes assumed that God created a living human and then used his corpuscularian thesis to explain the heart, lungs, digestion, muscle movement, blood, and the nervous system. His principal interest, however, was to provide a competitive explanation of the heart to rival William Harvey's *De motu cordis* and, further, to provide an explanation of sensory perception, emphasizing the functionality of the brain.

It was this treatise, the *World*, which Descartes thought was the foundation for his *Meteorology*. To begin, we should, perhaps, be careful with our search for Descartes' actual deduction. He wrote in the *Treatise on Light*: "I do not promise to set out exact demonstrations of everything I say. It will be enough for me to open up the way for you to find them yourselves"<sup>26</sup> He openly claimed that he did not give what he thought was a full deduction, but that he provided only the key premises that would be necessary for his reader to make one. Moreover, it seems that Descartes was not as strict as he should have been with his use of the terms "deduction" and "demonstration" in his writings.<sup>27</sup> For this reason, I will explain Descartes' arguments in very broad strokes, in order to provide a first approximation of the epistemic connection that Descartes proposed between the *Meteorology* and the *World*.

### The General Principles of Nature

Descartes wrote in the *Meteorology* that the human mind has admiration for objects in the heavens – e.g. lightning, parhelia, the rainbow, etc. – and that his aim was to "explain the nature of the clouds, in such a way that we will no longer have occasion to wonder at anything that can be seen of them."<sup>28</sup> He began this task by describing the causes of meteorological phenomena. He wrote, "I shall speak, in this first discourse, of *the nature of terrestrial bodies in general*."<sup>29</sup> His goal was to reduce matter to an indefinite collection of minute particles that are introduced into the sky by the force of light particles emitted from the sun. It was his description of the shape and sizes of corpuscles that, in part, would be the foundation of his meteorological explanations. His starting point in the *Meteorology*, however, was not to prove what shapes these particles must have. Rather, he assumed them along with other parts of his theory of matter. He wrote, "It is true that since the knowledge of these matters *depends on general principles of nature* which have not yet, to my knowledge, been accurately explained, *I shall have to use certain hypotheses at the outset*."<sup>30</sup> His "hypotheses," he claimed, were "general principles of nature," and this content was one of the topics covered in his *World*. For instance, he wrote in the *Discourse*, "My aim was to include in it [the *World*] everything I thought I knew about *the nature of material things* before I began to write it."<sup>31</sup> In what follows, I provide my interpretation of Descartes' arguments for his principles of nature in the *World*. My interest in this case is solely on Descartes' claim that he could explain the

Scholastic elements and qualities by his particle theory. This explanation, I will claim, suggests that in some sense the *World* was the foundation for Descartes' *Meteorology*.

### The Reduction of the Scholastic Elements

In the first assumption of the *Meteorology*, Descartes started by reducing the Scholastic elements to particles. He wrote, "I assume, first, that water, earth, air, and all other such bodies that surround us are composed of many small particles of various shapes and sizes."<sup>32</sup> He made a similar claim at the end of the First Discourse. He wrote,

Then, know also that in order to keep my peace with the philosophers, I have no desire to deny that which they imagine to be in bodies in addition to what I have given, such as their *substantial forms*, their *real qualities* and the like; but it seems to me that my explanations ought to be approved all the more because *I shall make them depend on fewer things*.<sup>33</sup>

His claim was that the Scholastic elements and qualities were not basic, but could be explained by the shapes and sizes of corpuscles, that is, they could be explained with fewer principles.

His explanation of the elements was not given in the *Meteorology*, at least, not entirely, but in his *World*. Let's begin by explaining how Descartes thought that particles in motion were necessarily entailed by his observations of physical phenomena. The goal of chapters 2–5 of the *Treatise on Light*, his theory of matter, was, in part, to reduce the Scholastic elements to particles in motion. His main subject, however, was light and, for this reason, he first explained the element of fire, a source of light. Unlike the *Meditations*, he did not propose hyperbolic doubts about his sensory cognitions of external objects.<sup>34</sup> Rather, he assumed the veracity of his sensory perceptions – that is, those guided by reason – and then posited only the theoretical concepts that were necessary for explaining this physical phenomenon. He wrote, "Someone [...] may [...] imagine the 'form' of fire, the 'quality' of heat, and the 'action' burning to be very different things in the wood. For my own part, *I am afraid of going astray if I suppose there to be in wood anything more than what I see must necessarily be there*." For him, fire only necessitated particles in motion.<sup>35</sup> The Scholastic concepts, on the other hand, could be postulated, albeit probabilistically, as he wrote,

For you can posit 'fire' and 'heat' in the wood and make it burn as much as you please: but *if you do not suppose in addition that some of its parts move* or are detached from their neighbours then *I cannot imagine that it would undergo any alteration or change*.<sup>36</sup>

For Descartes, the concept of fire implies motion and this concept entails parts, for there must be something that moves. In other words, he thought that the concept of fire is necessarily connected to the concept of parts in motion and this concept was primitive for him.

Descartes' task, then, was to explain the Scholastic elements by his hypothesis of particles in motion and this, in part, would provide evidence for his assumption in the *Meteorology*. The Scholastics thought that elements were known through the perception of elemental qualities.<sup>37</sup> For instance, fire was hot and dry; earth was dry and cold; water was cold and wet; and air was hot and wet.<sup>38</sup> With this said, Descartes explained,

If you find it strange [...] I do not use the qualities called “heat”, “cold”, “moistness”, and “dryness”, as the Philosophers do, I shall say that these *qualities* appear to me to be *themselves in need of explanation*.<sup>39</sup>

Descartes' explanation, in this case, had two parts. The strategy was to first explain the shape and size of the particles that compose the elements in the *Treatise on Light* and then provide a physiological explanation of how these particles caused the cognition of elemental properties in the *Treatise on Man*. I will take up the first task in this section and then turn to a general explanation of his perception of elemental qualities in the next.

In the *Meteorology*, Descartes began with a general assumption that the elements could be reduced to the shape and size of particles.<sup>40</sup> In the next series of assumptions, he then assumed the shapes that these particles must have in order to explain meteorological phenomena,

[...] I assume that the small particles of which *water* is composed are long, smooth, and slippery like little eels, which are such that however they join and interlace, they are never thereby so knotted or hooked together that they cannot easily be separated; and on the other hand, I assume that all particles of *earth*, as well as of *air* and most other bodies, have *very irregular and rough shapes*, so that they need be only slightly intertwined in order to become hooked and bound to each other.<sup>41</sup>

What is noticeable in his description is that, in the First Discourse, he did not mention the element of fire, at least, not by name. He, rather, referred to it as “light.” He wrote before this passage, “I assume that these spaces are not empty, but are *filled with that very fine material* by means of which (*as I have explained above*) the action of light is communicated.”<sup>42</sup> Descartes' reference, in this case, was to his analogy of a wine vat in the *Optics*, where, like the *Meteorology*, he used assumptions, or rather analogies, to illustrate his general principles of nature. He imagined a wine vat full of half-pressed grapes and explained that when one pulls the cork at the bottom there is an immediate movement, or force, in a straight line towards the hole. The individual particles, however, actually move in circular motions to escape through the hole. For Descartes, the example illustrated that the half-pressed grapes were similar to the air particles in the sky and the wine similar to the minute light particles that are scattered between the element of air. His claim was that when light is emitted from the sun there is an immediate “force” in a straight line released toward the eye. However, the actual movement of light particles is circular, where the minute particles of light, or fire, travel in vortices to the agent's retina. Implicit in Descartes' assumption concerning light in the *Meteorology* is the claim that the element of fire is “very fine” and smaller than the other elements.

His assumption was thus that water had eel-like shapes, earth and air had irregular and rough shapes, and fire particles were very fine and minute. The question is whether there is any proof for these claims in the *Treatise on Light*. It seems that Descartes thought so. He began this treatise by explaining the element of fire by observing a flame burning wood. He explained, “the body of the *flame* which acts against the wood *consists of minute parts*, which move independently of one another with a *very quick and violent motion*; and as they move in this way, they push against and move those parts of the body that they touch.”<sup>43</sup> The proof strategy, again, aimed only to postulate those explanatory concepts that are necessary to explain the properties of the phenomenon. For this reason, he held that the particles that

make up the element of fire must be “minute,” “very quick,” and have a “violent motion.” The motion of the fire entailed that there were parts that moved. Moreover, Descartes observed a chaotic, violent motion, where multiple parts of the flame move incessantly with unpredictable variation. He thought that this necessitated that the parts of fire be very small. This proposal would, first, explain the quick motion that can easily be transferred to these particles and, second, it explained the unpredictable variation among the parts of the flame. The violent motion, moreover, led him to “*not attribute [its] parts having any determinate shape or size*” because the “impetuosity of their motion is sufficient to cause it to be divided, in every way and in every sense, by collision with other bodies, and that its parts change shape at every moment to accommodate themselves to the shape of the places they enter.”<sup>44</sup>

He next turned to the elements of air and earth. He began his description, in part, by explaining a scale to compare particles, one that seems to be broader than the Scholastic’s distinction between the elements. He conceived “two extremes” – perfect solidity and perfect fluidity. Hard bodies, he explained, are the most difficult to separate, while fluid ones are the easiest.<sup>45</sup> With this scale, he compared the parts of a burning flame. He explained that the violent, quick-moving, fire particles collide with the wood, detaching the element of earth and hurling it into the air as smoke. The question that needed to be sorted out was what can be concluded about the shape and sizes of these particles. In terms of his scale, he explained that fire is more fluid than wood, that is, earth. Moreover, smoke is more fluid than air, for smoke is easily separated and cuts through the air. In this case, Descartes did not need to explain the relation of the element of air to that of smoke, for his scale enabled him to describe the difference solely based on the properties of the particles. His observation led him to conclude that the element of air is a “very subtle fluid” in comparison with earth, but, in comparison with fire, more solid.<sup>46</sup> This led him to propose a size and shape for these particles. He wrote, “[...] we need to attribute some size and shape to each of its parts [in relation to particles of fire] and imagine *them as more or less round and joined together* like sand or dust.”<sup>47</sup> The shape needed to account for the fact that air particles could be easily separated, at least, in relation to the elements of earth and water. However, they were more resistant than the element of fire.

Descartes also used his strategy of positing “what necessarily should be there” to explain the element of earth. In his explanation of burning wood, the fire particles move at an extremely fast speed, but it takes some time for them to separate all of the wood particles into smoke and ash. For him, this suggested that the element of earth is the most resistant to force. For this reason, he concluded that the element must “be proportionately larger than and [move] more slowly” than the other elements.<sup>48</sup> If it is harder to separate, then it is harder to communicate motion to its parts. This, Descartes thought, implied that they have a larger size and slower speed than the other elements. This likewise entailed that the particles have an irregular shape. He explained, “And the form of the third element [earth] consists in its parts being so large or *so closely joined together* that they always have the force to resist the motions of other bodies.”<sup>49</sup> The shapes, then, of earth particles were irregular or hook-shaped in order for them to be “joined together.”

Descartes did not provide an explanation of the shape and size of the element of water in the *Treatise on Light*. In fact, he explained that there were only three elements – earth, air, and fire – which were explained in terms of their fluidity. He did, however, speak of bodies of water in this treatise, most notably in chapter 9 with his explanation of the origin of the planets and in his explanation of the ebb and flow of the sea in chapter 12. We, moreover, can have a general idea of the properties of this element during the time of his

composition of the *World*. Water, of course, was not part of Descartes' explanation of fire. However, Descartes did explain that bodies of water rest on top of earth and that air rests above it in the sky.<sup>50</sup> It follows from this that the element of air is more fluid than water because it rests at a higher altitude. As well, water is more fluid than earth. This, moreover, entails that particles of water are more solid than air, but more fluid than the element of earth. Descartes, however, did not provide such an explanation in the *World*.

Rather, he claimed that he gave the beginning of a proof in the *Meteorology* itself. He wrote to Plempius for Fromondus, "He [Fromondus] is convinced that my assumption that the parts of water are oblong like eels is rash and baseless. He should remember what is said on page 76 of the *Discourse on Method*."<sup>51</sup> Descartes' reference was to his explanation of his use of assumptions at the end of Part Six, where, in part, he wrote, "I think I can deduce them [the assumptions of the *Meteorology*] from the primary truths I have expounded above."<sup>52</sup> Moreover, Descartes' way forward in this letter was to explain how "countless syllogisms could be constructed to prove what I say," where he, in fact, provided some of them.<sup>53</sup> Although Descartes did not provide what could be construed as a proof for his assumption concerning the shape of water particles in the *World*, it could be the case that he was aware of this and, for this reason, provided a longer discussion of the shape of water particles in the *Meteorology*.<sup>54</sup>

All this seems to indicate that Descartes thought that he had an informal argument, broadly construed, for his assumption that the Scholastic elements could be explained by his particle physics in the *Meteorology*. His exact assumption was "I assume, first, that water, earth, air, and all other such bodies that surround us are composed of many small particles of various shapes and sizes."<sup>55</sup> He thought in the *Treatise on Light* that his observation of physical phenomena necessitated that particles should have a general shape. These shapes, he claimed, could explain elemental qualities, which, as will be seen, depend on Descartes' physiology.

### The Physiological Explanation of Scholastic Qualities

Descartes had some basis for his claim that the particles that make up the elements must have a general shape and size, but in order to fully reduce the Scholastic elements to his corpuscularian thesis, he must explain the elemental qualities of heat, cold, wet, and dry. His claim in the *Meteorology* was that he could make the Scholastic's "substantial forms" and "real qualities" depend on "fewer things."<sup>56</sup> The completion of the explanation, Descartes thought, entailed a physiological explanation of elemental qualities. In fact, the connection between physiology and the perception of qualities was one of Descartes' assumptions in the *Meteorology*. He wrote,

For I am *assuming* here that, as regards *heat and cold*, we need to consider nothing except that *the small particles of the bodies we touch*, being agitated more or less strongly than usual – either by small particles of this very fine material or by whatever other cause there may be – also agitate more or less *the small threads of those of our nerves which are the organs of touch*. And when they agitate them more strongly than usual, this causes the *sensation of heat* in us, whereas when they agitate them less strongly, this causes the *sensation of cold*.<sup>57</sup>

He assumed this in the *Meteorology*. The question is whether he provided a proof of this material in the *World*.

In the opening chapters of the *Treatise on Light*, Descartes explained fire as a source of light and, in this discussion, he briefly turned to the quality of heat.<sup>58</sup> He wrote, “Someone else may if he wishes imagine the ‘form’ of fire, the ‘quality’ of heat, and the ‘action’ of burning to be very different things in the wood.”<sup>59</sup> In regard to heat, he wrote,

As regards heat, it seems to me that *our sensation of it can be taken as a kind of pain* when it is violent, and sometimes as a kind of tickling when it is moderate. Since we have already said that there is nothing outside our thought which is similar to the ideas which we conceive of tickling and pain, we can well believe that there is nothing that is similar to that which we conceive of as heat; rather, *anything that can move the minute parts of our hands or of any other place in our body can arouse this sensation in us.*<sup>60</sup>

Descartes’ claim was that there is no corresponding idea between the phenomenological experience of pain and the external agitation of our nerves.<sup>61</sup> For this reason, he claimed that a physiological explanation must be given for the perception of heat and, as will be seen, for the other qualities.

He explicitly provided this physiological explanation in the *Treatise on Man*. In this treatise, he assumed that God created a human being<sup>62</sup> and then explained the functions of the human body using his corpuscularian thesis. The body, for Descartes, was a system, or, as he put it, a “machine.”<sup>63</sup> Its parts are interconnected such that a proof, for instance, of sensory cognition necessitates a general explanation of the vital functions of the human body: the heart, lungs, digestion, the nervous system, muscle movement, among others. Although he provided such an explanation, this general discussion is not pertinent to my aims. Rather, I will begin with Descartes’ explanation of sensory perception. He explained, “Notice first that very many tiny fibres [...] begin to separate from one another at the internal surface of the brain where they originate, and from there they are distributed throughout the rest of the body, where they serve as the organs of the sense of touch.”<sup>64</sup> His claim was that nerves were distributed throughout the body to the pineal gland in the brain where he thought the soul is located. For him, sensation comes about when an external object presses on the agent’s nerves, which causes a push and pull on the taut blood particles. Like minute cords, the blood in the nerves pulls on little valves located on the pineal gland, which, Descartes thought, caused sensation. In this discussion, he provided his explanation of Scholastic qualities. He began with an explanation of pain:

Suppose for example that the tiny fibres that make up the marrow of the nerves are pulled with such a force that they are broken and separated from that part of the body to which they were attached [...]. The movement that they will then cause in the brain [...] will cause the soul to have the sensation of pain.<sup>65</sup>

His explanation centered on how much pressure is communicated to the pineal gland. If it is immense and the nerves are detached, then the agent senses pain. If, however, the force is lessened, the agent will experience pleasure. He wrote, “And if they are pulled by a force almost as great as this, but nevertheless are not broken [...], they will cause a movement in the brain which [...] will cause the soul to feel a certain bodily pleasure which we call ‘tingling.’”<sup>66</sup> If, again, the force was still lessened and the small fibres are equally tugged, the agent experiences a “smooth” feeling. On the other hand, if there is an unequal pressure, the agent perceives that the body is “uneven or rough.”

Descartes' strategy, then, was to explain the Scholastic qualities in terms of how much force the external object places on the pineal gland. He wrote,

*And if they [the nerves] are set in motion only slightly, and separately from one another, as they are constantly by the heat that the heart transmits to the other bodily parts, the soul will have no more sensation of this than of any other normal bodily function. But if this movement is increased or lessened by some unusual cause, its increase will cause the soul to have a sensation of heat, and its decrease a sensation of cold.*<sup>67</sup>

For Descartes, heat was a slight increase on the pressure of the nerves, while cold amounted to a slight decrease. The explanation that Descartes later pursued in the *Treatise on Man*, but only briefly, was the paths and state of the nerves and brain in the cognition of heat and pain. He attempted to map out the paths that the nerves would take from the hand to the brain and then tried to explain how the nerves swell with blood in various parts of the brain based on the amount of pressure put on the nerves.<sup>68</sup> It seems that this type of explanation would provide a better approximation of how much force results in pain, pleasure, and, for our interest, heat. However, Descartes did not finish his explanation.

This gives us Descartes' explanation of the quality of heat and cold. He, however, aimed to explain the other qualities, mainly wet and dry. Immediately after his explanation of heat, he wrote, "Finally, depending on the various other ways in which they are stimulated, the fibres will *cause it to perceive all the other qualities* that come under touch in general, such as humidity, *dryness*, weight, and so on."<sup>69</sup> In this case, he did not provide an explanation, but, as he wrote in the *Treatise on Light*, "It will be enough for me to open up the way for you to find them [the deductions] yourselves."<sup>70</sup> It is clear from the present study that Descartes had some general explanation of the qualities "dryness" or "wetness," but did not disclose them.

### **Conclusion: Did Descartes Deduce the Assumptions of the *Meteorology*?<sup>71</sup>**

As I have shown, Descartes began the *Meteorology* with assumptions, but claimed that he could deduce them. In this paper, I have attempted to follow his claim that he gave the physical foundation for his meteorological assumptions in his *World*. I have provided an interpretation of the latter treatise in order to give some credence to this claim. In particular, I have argued that Descartes provided informal arguments for his assumption that he could explain the Scholastic elements and qualities by his particle physics. The question that I now take up is whether he had any basis for concluding that he deduced the assumptions of his *Meteorology*. By today's standards, it is clear that Descartes did not provide a deduction. He, however, did admit that he did not give "exact demonstrations," but even with this claim, it seems that no modern reader would think that Descartes, in fact, achieved certain cognition on these matters. Moreover, it is unclear whether Descartes thought that he, in fact, achieved a deduction in this case. I will argue that he did not.

My main evidence is as follows. Descartes presumed in the *Treatise on Man* that God created a human being and then explained the functions of the body based on his particle physics. If God happened not to create a functioning man, but, in fact, created a chaotic plenum and laws of motion that entailed that the world within time would resemble the present one, then, it seems, that Descartes does not have an exhaustive explanation. He would have to explain the evolution of the human body from this plenum, using his theory of matter and vortices. However, it may seem, at first glance, that Descartes did not seriously consider this possibility. He wrote in the *Discourse*, "Yet I did not wish to infer from all this

that our world was created in the way I proposed, for it is much more likely that from the beginning God made it just as it had to be.”<sup>72</sup> Notice, however, that he did not claim that the world was created “five or six thousand years ago,”<sup>73</sup> but “just as it had to be.” For he explained, even during the composition of the *Treatise on Man*, that he wanted to provide an explanation of the formation of the human body. He wrote, “For the last month I have been trying to decide whether I should include in *The World* an account of *how animals are generated*” and concluded “I have finally decided not to, because it would take me too long.”<sup>74</sup> Similarly, he wrote in 1639, “In my *World* I supposed the *body of an animal already formed*, and merely exhibited its functions; if I were to start it again I should undertake to include also the *cause of its formation and birth*.”<sup>75</sup> In fact, Descartes later attempted such a description in his *Description of the Human Body* in 1647–1648.<sup>76</sup> This feature, among others,<sup>77</sup> reveals that Descartes most likely did not think that he achieved a deduction in the *Treatise on Man* and, for this reason, did not provide a deduction of his assumption concerning the Scholastic elements in the *Meteorology*.

Why then did he claim that he deduced this content? It seems that, in most cases, he fell short of claiming that he deduced his assumptions. He explained that he “believed” that he could provide a deduction. The claim was forward-oriented. He thought that, based on the perceived success of his scientific system, he would have a genetic explanation of the human body within time. For this reason, he most likely thought that he had something close to a deduction. In his Letter to Dinet, however, he seemed to have spoken in hyperbole.

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## References

<sup>1</sup> For instance, this, in part, seemed to be the focus of Mersenne’s first objections after reading the *Discourse*. He requested Descartes to publish his “*Physics*,” the foundation of the *Essays*, in order to assess Descartes’ deductive method. See the Letter to Mersenne of February 27, 1637 (AT I, 348–349; CSMK, 52–53). I use the following abbreviations: AT = *Œuvres de Descartes*, eds. C. Adam and P. Tannery, 2nd edition (Paris: Vrin, 1964–1974), 11 vols.; CSM = *The Philosophical Writings of Descartes*, trans. J. Cottingham, R. Stoothoff, and D. Murdoch (Cambridge: Cambridge University Press, 1984–1985), 2 vols.; CSMK = *The Philosophical Writings of Descartes*, vol. III, trans. J. Cottingham, R. Stoothoff, D. Murdoch, and Anthony Kenny (Cambridge: Cambridge University Press, 1991); *World* = *The World and Other Writings* trans. S. Gaukroger (Cambridge University Press: Cambridge, 1998); *Light* = Gaukroger, S. (1998), 3–75; *Man* = Gaukroger, S. (1998), 99–169; *Optics* = *Discourse on Method, Optics, Geometry, and Meteorology*, trans. P. Olscamp (Indianapolis: Hackett, 2001), 65–173; *Meteorology* = Olscamp, P. (2001), 263–361; *Principles* = *Principles of Philosophy*, trans. V. R. Miller and R. P. Miller (Dordrecht: D. Reidel, 1983).

<sup>2</sup> AT VI, 18; CSM I, 120. See also AT VII, 577; CSM II, 398.

<sup>3</sup> He thought that the precision of his explanations drawn from his assumptions would satisfy his readers. See the Letter to Morin of July 13, 1638 (AT II, 200; CSMK III, 107).

<sup>4</sup> For instance, see Clarke, D., *Descartes’ Philosophy of Science* (Manchester: Manchester University Press, 1982), 180–194; Curley, E., *Descartes Against the Skeptics* (Cambridge, MA: Harvard University Press, 1978), 21–45; Hatfield, G., “Science, Certainty, and Descartes” in *PSA: Proceedings of the Biennial Meeting of the Philosophy of Science Association 1988*, vol. 2, eds. A. Fine and J. Leplin (East Lansing, Mich.: Philosophy of Science Association, 1989), 249–262; Martin, C., *Renaissance Meteorology: Poponazzzi to Descartes* (Baltimore: Johns Hopkins University Press, 2011), 126–132; and Olscamp, P., “Introduction”, in Olscamp, P. (2001), ix–xxxiv.

<sup>5</sup> AT VI, 76; CSM I, 150, emphasis added.

<sup>6</sup> Letter to Vatier of February 22, 1638 (AT I, 563; CSMK, 87; emphasis added).

<sup>7</sup> This letter was published at the very end of the 1642 2nd edition of the *Meditations* (Amsterdam: L. Elzevier).

<sup>8</sup> AT VII, 302; CSM II, 397; emphasis added.

<sup>9</sup> His metaphysics most likely amounted to material that is similar to the metaphysics of Part Four of the *Discourse*, which may have been similar to his now lost *Treatise on Metaphysics*. In fact, he claimed that he wrote the *Meditations* to clarify this material. See the Letter to Huygens of July 31, 1640 (AT III, 751; CSMK, 150) and the *Conversation with Burman* (AT V, 153; CSMK, 338).

<sup>10</sup> Letter to Huygens of December 4, 1637 (AT I, 455; CSMK, 75); also AT VII, 573; CSM II, 386.

<sup>11</sup> Despite this, I do think that Descartes provided some form of argument for most of the assumptions in the *Meteorology* in the *World*.

<sup>12</sup> Many have noted that Descartes did not apply the full method in his *Essays*, but only in the anaclastic line example in the *Rules* and his explanation of the rainbow in the Eighth Discourse of the *Meteorology*. For an example, see Garber, D., “Descartes and Method in 1637”, in *Descartes Embodied: Reading Cartesian Philosophy through Cartesian Science* (Cambridge: Cambridge University Press, 2001), 33–51.

<sup>13</sup> AT VI, 4; CSM I, 112; emphasis added.

<sup>14</sup> Letter to Mersenne of February 27, 1637 (AT I, 349; CSMK, 53).

<sup>15</sup> Letter to an unknown correspondent from the end of May 1637 (AT I, 370; CSMK, 58; emphasis added).

<sup>16</sup> Letter to Vatier of February 22, 1638 (AT I, 559; CSMK, 85; emphasis added).

<sup>17</sup> Letter to Morin of July 13, 1638 (AT II, 200; CSMK, 107).

<sup>18</sup> AT VI, 76; CSM I, 150.

<sup>19</sup> AT VI, 40; CSM I, 131.

<sup>20</sup> AT VI, 41; CSM I, 132; emphasis added.

<sup>21</sup> For instance, see Descartes, R., *Discours de la méthode*, ed. É. Gilson (Paris: Vrin, 1925), 374.

<sup>22</sup> Letter to Mersenne from the end of November 1633 (AT I, 270; CSMK, 40; emphasis added).

<sup>23</sup> Similar explanations, however, were included in Parts Two and Three of the *Principles*.

<sup>24</sup> Letter to Mersenne from the end of November 1633 to Mersenne, (AT I, 270–272; CSMK, 40–41).

<sup>25</sup> In 1662, Florent Schuyl published an edition of the *Treatise on Man* entitled *Renatus Des Cartes de Homine* (Leyden: Leffen & Moyard). Clerselier also published an edition of this treatise in 1664 that used original manuscripts: *L'Homme de René Descartes & un Traité de la Formation de Foetus du mesme Auteur* (Paris: Theodore Girard). This same year the first edition of the *Treatise on Light* was published: *Le Monde de M<sup>r</sup> Descartes, ou Le Traité de la Lumiere* (Paris: Jacques Le Gras). However, it was not until 1677 that Clerselier published a joint edition that used original manuscripts.

<sup>26</sup> AT XI, 48; *Light*, 32.

<sup>27</sup> See Clarke, D., “Descartes’ Use of ‘Demonstration’ and ‘Deduction’”, *Modern Schoolman* 54, 4 (1977), 333–344.

<sup>28</sup> AT VI, 231; *Meteorology*, 263.

<sup>29</sup> AT VI, 232; *Meteorology*, 263; emphasis added.

<sup>30</sup> AT VI, 233; *Meteorology*, 264; emphasis added.

<sup>31</sup> AT VI, 41; CSM I, 132; emphasis added.

<sup>32</sup> AT VI, 233; *Meteorology*, 264.

<sup>33</sup> AT VI, 239; *Meteorology*, 268; emphasis added.

<sup>34</sup> He did propose mitigated, or practical doubts, concerning the senses in chapter 1 of the *Treatise on Light*.

<sup>35</sup> In that case, any motion implied moving particles for Descartes.

<sup>36</sup> AT XI, 7; *Light*, 6; emphasis added.

<sup>37</sup> Aristotle, *On Generation and Corruption*, trans. R. McKeon (New York: Random House, 1941), Book II.

<sup>38</sup> Aristotle, *On Generation and Corruption*, trans. R. McKeon (New York: Random House, 1941), Book II, 3.

<sup>39</sup> AT XI, 26; *Light*, 18; emphasis added.

<sup>40</sup> AT VI, 233; *Meteorology*, 264.

<sup>41</sup> AT VI, 233; *Meteorology*, 264; emphasis added.

<sup>42</sup> AT VI, 233; *Meteorology*, 264; emphasis added.

<sup>43</sup> AT XI, 8; *Light*, 7; emphasis added.

<sup>44</sup> AT XI, 24; *Light*, 17; emphasis added.

<sup>45</sup> He thought that all bodies were divisible. See AT XI, 12, 13; *Light*, 10.

<sup>46</sup> AT XI, 24; *Light*, 17.

<sup>47</sup> AT XI, 24; emphasis added.

<sup>48</sup> AT XI, 25; *Light*, 18.

<sup>49</sup> AT XI, 27; *Light*, 18; emphasis added. His description “so closely jointed together” is somewhat similar to his description of “hook shaped” in the *Meteorology*.

<sup>50</sup> AT XI, 80–82; *Light*, 52–53.

<sup>51</sup> Letter to Plempius for Fromondus of October 3, 1637 (AT I, 422; CSMK, 65).

<sup>52</sup> AT VI, 76; CSM I, 150.

<sup>53</sup> Letter to Plempius for Fromondus of October 3, 1637 (AT I, 422–424; CSMK, 65–66).

<sup>54</sup> For more details on this subject, see AT VI, 236–239; *Meteorology*, 267–268.

<sup>55</sup> AT VI, 233; *Meteorology*, 264.

<sup>56</sup> AT VI, 239; *Meteorology*, 268.

<sup>57</sup> AT VI, 235–236; *Meteorology*, 266; emphasis added.

<sup>58</sup> AT XI, 9–10; *Light*, 8.

<sup>59</sup> AT XI, 7; *Light*, 6; emphasis added.

<sup>60</sup> AT XI, 9–10; *Light*, 8; emphasis added.

<sup>61</sup> Also see, AT XI, 5–6; *Light*, 5–6.

<sup>62</sup> The proposal in the *Treatise on Man* was that God created a machine without a soul.

<sup>63</sup> AT XI, 120; *Man*, 99.

<sup>64</sup> AT XI, 142; *Man*, 118.

<sup>65</sup> AT XI, 143–144; *Man*, 119.

<sup>66</sup> AT XI, 144; *Man*, 119.

<sup>67</sup> AT XI, 144; *Man*, 119; emphasis added.

<sup>68</sup> AT XI, 191, 199; *Man*, 161–162, 167.

<sup>69</sup> AT XI, 144–145; *Man*, 119–120; emphasis added.

<sup>70</sup> AT XI, 48; *Light*, 32.

<sup>71</sup> There does seem to be a prominent counterexample to the thesis of this paper. Descartes’ claimed that his explanation of the rainbow in the Eighth Discourse of the *Meteorology* was an example of his method (Letter to Vatier of February 22, 1638, AT I, 559; CSMK, 85; AT VI, 325; *Meteorology*, 332). In this case, it seems that Descartes took up a specific question and reduced it to an intuition, all within this discourse. For example, see Garber, D. (2001). On the present thesis, however, the deduction in the Eighth Discourse depends on the subsequent discourses and on the physical foundations in the *World*. In response, I note that Descartes explained, “I could not choose a more appropriate subject [the rainbow] for demonstrating how, *with the method that I am using*, we can arrive at knowledge [...]” (AT VI, 325; *Meteorology*, 332; emphasis added). He referred to an ongoing application of the method. Moreover, his account of the rainbow depended on his explanation of vapors, winds, clouds, and precipitation, the subjects of the preceding discourses.

<sup>72</sup> AT VI, 45; CSM I, 133.

<sup>73</sup> AT XI, 32; *Light*, 21.

<sup>74</sup> Letter to Mersenne of June 1632 (AT I, 254; CSMK, 39; emphasis added).

<sup>75</sup> Letter to Mersenne of February 20, 1639 (AT II, 525; emphasis added).

<sup>76</sup> For further details, see AT XI, 252–286. As well, it seems that Descartes was not invested in a literal translation of Genesis. He told Burman, “As far as Genesis is concerned [...] the story of the creation to be found there is perhaps metaphorical, and so ought to be left to the theologians” (AT V, 169; CSMK, 349).

<sup>77</sup> Descartes also did not explain how specifically the shapes of the elements entailed the cognition of qualities.