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On creative mechanisms in Descartes' description of man

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The view that man is a machine was very common in the age of Enlightenment. Most famous for this view was Julien Offray de la Mettrie's book *L'homme machine*, despite its actual content about problems of dualism. The debates on the man-machine were carried out on the most fundamental levels, attacking the other camp's core concepts: materialistic arguments against theories of an immaterial soul or an immaterial mind, materialistic deism and atheism against god.

My prime concerns are not the fundamental and metaphysical consequences of the view that man is a machine or that man can be a machine, but concern a meta-theoretical interest. What does it mean to describe man as a machine? What reasons are there behind matching man and machine? My goal is to show, firstly, that René Descartes anticipates a model in order to explain the human body and, secondly, to show that the Cartesian man-machine model carries a certain creative aspect. Likewise, I would like to contribute with peculiarities of Cartesian philosophy to a characterisation of models in science.

Reading Descartes' anatomical writings

The main aim of Descartes in his anatomical writings is to show that the soul does not influence bodily processes. Therefore, he describes the abilities of the human body as purely physical processes, as mechanisms that are only caused

by matter. He begins his *Traité de l'homme* with a thought experiment. He supposes, and invites to reader to do so as well, a body that is “nothing other than a statue or machine of earth, which God has formed expressly to render it as similar as possible to us” (Descartes, 2004, p. 99). With ‘as similar to us’ he means ‘as similar to us humans’. It is clear, that “those machines are not just like human bodies: they are human bodies” (Des Chene, 2001, p. 4). The body is described step by step and finally, at the end of the text – or at the surviving end of the text, because it remains a fragment – he gives an overview of all functions and abilities of the machine with the assertion, that no unnecessary assumption has been made. Hence, he shows that no special human organ or the soul is necessary to perform the actions the human body can perform. In his book on Descartes, Rainer Specht raises the question that was raised by Descartes’ contemporary readers and interpreters as well: “What is the purpose of the soul when it is not included in the explanation of vegetative and sensual principles?” (Specht, 1966, p. 121, translation TH). Descartes answer, which is not given in the survived *Traité de l'homme* but is prominent in his other writings, is thinking. Thinking, of course, is not an ability of the machine. In order to be able to think, the machine needs a soul. With this understanding, Descartes developed a new understanding of the concept of the soul, that is separated from physical abilities.

What new explanations of the physical abilities, which were formerly explained by the vegetative and sensual faculty of the soul, does he give? It is very common to state, that he explains abilities like nutrition, growth, movement, pain, memory, also language in a certain aspect as mechanisms. But can this actually be found in the text, and, how are phenomena described or explained as mechanisms? The description of the human body in *Traité* starts with digestion. Fluids in the intestines dissolve food “just as ordinary water does those of quicklime, or *aqua fortis* those of metals” (Descartes, 2004, p. 100). The food is broken down into smaller pieces “just as [it] occurs with new hay if it is shut up in the barn before it is dry”. The digested food reaches the liver, which is compared to a “single vessel” (*un seul vaisseau*, in French), “just as”, Descartes writes, “when one shakes meal in a sieve, the purest parts flow out and it is only the small size of the holes through which it passes” (Descartes, 2004, p. 100). In the liver, the dull white fluid is “taking on the colour and form of blood, just as the white juice of black grapes is converted into light-red wine when it is allowed to ferment on the vine stock” (Descartes, 2004, p. 101).

The passages I have just cited are found on two pages of the 70 pages English translation, so there is a striking high density of comparisons to find in the text. Remarkably, Descartes does not give distinct mechanic descriptions; if he provides explanations in terms of mechanisms, then in a very general way of bringing up

natural events. He does not even refer to physics, at least not in the systematic way as he does in his *Principia Philosophiae*. He naturalises the human body in a way that he puts processes of the body in analogy to natural events.

There is another interesting feature of the text when Descartes describes the esprits animaux, animal spirits in the English translation, that I want to mention. Animal spirits come from very fine particles of the blood, which ascend to the brain. Besides the circulation of blood, the esprits animaux form another system of bodily substance that moves through veins. This second system is responsible for movement, tactile, visual and pain sensation. The modern equivalent for esprits animaux are nerve impulses.

Descartes comes up with two analogies when he describes the esprits' mechanics: The first comparison is given when he starts explaining movement. He writes about water that flows through pipes in a garden and which is "needed to move various machines, and even to make them play certain instruments or pronounce certain words, depending on the particular arrangements of the pipes through which the water is conducted" (Descartes, 2004, p. 107). The comparison reads:

And the nerves of the machine that I am describing can indeed be compared to the pipes in the mechanical parts of these fountains, its muscles and tendons to various other engines and springs which serve to work these mechanical parts, its animal spirits to the water that drives them, the heart with the source of the water, and the brain's cavities with the apertures. (Descartes, 2004, p. 107)

Following this analogy, Descartes denotes nerve pathways as "tubes" (Descartes, 2004, p. 108), "tuyaux" (AT XI, p. 123), he remarks that this comparison is very adequate – "Et veritablement l'on peut fort bien comparer les nerfs de la machine que je vous décrit, aux tuyaux des machines de ces fontaines" (AT XI, p. 130–131) – and uses water metaphors again when he describes the structure of the brain. Converging veins are "like Euripos", which is a strait that separates the island of Euboea from the Greek mainland (cf. Descartes, 2004, p. 106), and their fluid content "bathes the whole external surface of the brain" (Descartes, 2004, p. 106). In the brain, blood and blood particles "flow" (s'écouler) into the gland, the esprits "stream" (couler) out into the nerves. The exit through which the esprits leave the brain is called "pore or tiny canal" (Descartes, 2004, p. 116). When bodily movements are described in terms of a garden fountain, the heart is called spring and the brain is the centre of the water's distribution.

The second analogy is given when Descartes compares esprits animaux with air, after explaining outer and inner sensation (which are hunger and thirst) and before focussing on personality. The distribution of the esprits in the body is

compared with the distribution of air in an organ. Heart and arteries can be understood as the organ's air supply. The organist's pressing of keys leads air in certain organ pipes just as external object can cause esprits animaux to enter certain nerve pathways. The bellow, which appears in this analogy, is also used as metaphor for the lung. The analogy of esprits animaux as air reappears when Descartes describes muscle tension, which is reducible to the esprits' flow, with the process when "the air in a balloon hardens it and stretches the membranes that enclose it" (Descartes, 2004, p. 113).

The model and mechanisms of man-machine

There are a several noteworthy findings to discover in these passages. Importantly, that Descartes does not provide a unified, mechanical machine model of the human body. There are many small analogies, metaphors and comparisons from different fields of science, like chemistry, or crafts, like winegrowing. There are a few larger and more complex analogies, namely the analogy between esprits animaux and water as well as between esprits animaux and air. These larger analogies have a widespread influence on the text, concerning the evolvment of a semantic framework that words belong to (like for instance writing about 'streaming' and 'flowing' instead of 'moving').

Despite conceptual questions about the nature of the unity of body and soul, the human body is a unit. Des Chene (2001, p. 116–152) digs deeper into this problem and investigates the unity in terms of a substantial (which is the unity of the soul–human), physical, phenomenal and functional unit. My claim is that the Cartesian man-machine is a model with the function to explain the body. 'Machine' is the unifying term for many incoherent mechanisms. This raises the question, about how literal the descriptions can be read. Can, or should, we try to understand them in an abstract way so that we can build an explanatory machine unit or should we try to read them literally and accept them as incoherent? In order to answer this, we have to ask what 'machine' can mean.

According to the second volume of the *Dictionnaire de l'Académie française* from 1718, a machine is either an "instrument propre à faire mouvoir à tirer, lever, lancer quelque chose" or a poetic expression, like "l'homme est une machine admirable" (Académie française, 1718, p. 2). According to the German dictionary by Johann Christoph Adelung, the *Grammatisch-kritisches Wörterbuch der hochdeutschen Mundart*, from 1811, 'Maschine' has two meanings, first:

“Essentially, every artificially composed thing without life or own movement”¹ (Adelung, 1811, col. 91; translation TH). The second meaning is metaphorical: “A living being, that is only moved by mechanical, outside influences. Its actions are not inspired by reason”² (Adelung, 1811, col. 91; translation TH). So, there are two options: to read machine literally as an artificial tool or to read it as a metaphorical expression. The latter meaning is still unclear.

When we speak of physical processes in the framework of Cartesian philosophy, all these processes are mechanisms due to their ontological nature, because, extension is the only property that physical entities have. The laws of nature can in principle be formulated in mechanical terms (cf. Des Chene, 2001, p. 71), whether the description of a mechanism can be found or not. What is a mechanism? In terms of Peter Machamer, mechanisms are fundamental for any scientific theory. He writes: “Mechanisms are entities and activities organized such that they are productive of regular changes from start or set-up to finish or termination conditions” (Machamer, Lindley & Craver, 2000, p. 3). They are regular, have a beginning and an end, they are temporally determined, and include entities that can engage activities (cf. Machamer, 2009, p. 3–4). In other words: Mechanisms are well-defined descriptions. Following George Canguilhem (2009, p. 210), a mechanism is never a random nexus of movement, but something meaningful. A mechanism aims to fulfil an objective, so it is a teleological relation.

A machine is to be understood as a unit that incorporates certain mechanisms; such mechanisms that function inside the body and such that enable the body to interact with its surrounding nature. I have stated, that Descartes does not provide a unified machine model of the human body. In order to do so, he would have needed to describe one single and complex mechanism that explains the body unit. Nevertheless, the body is a unit and the many analogies that are used to describe it have the character of a model.

Paul Hoyningen-Huene writes that empirical generalisation is the method to make a model (cf. Hoyningen-Huene, 2013, p. 47–49). One has to “abstract away all features of phenomena that make them identifiable as individual events” (Hoyningen-Huene, 2013, p. 47). The explanations, which are provided by a model, are based on deterministic regularity. This for sure is the case for Descartes’ mechanisms and analogies. Hoyningen-Huene understands a model

¹ „Eigentlich, ein jedes künstlich zusammen gesetztes Ding ohne Leben oder eigne Bewegung“ (Adelung, 1811, col. 91)

² „Ein lebendiges Wesen, welches nur durch mechanische, oder fremde, von außen her empfangene Ursachen wirkt, nicht nach eigenen vernünftigen Einsichten handelt“ (Adelung, 1811, col. 91)

as follows: “A model typically states something that is known not to be literally true, or even blatantly false, due to the idealizations and/or abstractions employed. However, a good model is used, in the appropriate context, as if it were a correct empirical generalization, or a well-confirmed theory, or the expression of real entities having certain properties and entertaining certain relations” (Hoyningen-Huene, 2013, p. 56).

So, the man-machine is a model in the sense that it assembles mechanisms. These mechanisms are described in the model and they relate to processes of the human body, in such a way, that a mechanism explains a body process. Both entities, the mechanism in the model and the feature of the body, relate to the same abstract properties. Nevertheless, the reader actually does not learn, for instance, how food is digested. Descartes fills this explanatory lack with two analogies taken from chemistry: Water dissolves quicklime – which describes the process that calcium oxide reacts with water and turns to calcium hydroxide – and aqua fortis – for which the contemporary name is nitric acid, HNO_3 , that dissolves metal. Neither of them take place during digestion, but the explanatory value (if I may speak of such thing) is far higher than the explanatory value of faculties. Gastric acid starts to dissolve food. The chemical, intestinal process is called hydrolysis, the splitting of chemical compounds through reaction with water. So, digestion happens, just like water and acid dissolve something. Descartes was – to a certain extent – right in this case.

However, let me further investigate his chemical analogies: Chemistry was not a distinct scientific discipline until the 18th century. Chemical knowledge (in modern terms) was present in different occupational groups like pharmacy, architecture, or mining; one can trace back the origins of chemistry to ancient times, but in the 17th century when Descartes wrote his physics, chemistry did not exist as a discipline. It was also not included in the seven artes mechanicae.

Yet it is surprising that Descartes made – at least some – analogies between processes that share the same principle. This may be the result of an empirical generalisation, and the characteristic feature of a model in terms of Hoyningen-Huene. On what could Descartes base his empirical generalisations considering that the scientific knowledge about the nature of molecule splitting in terms of a chemical reaction was not present at his time? Is there any explanatory value in terms of chemistry? Descartes would have rejected any principle other than physics from his investigation on the body. He might have assumed that there has to be an explanation for certain issues, but it has not been found yet. Instead, he uses analogies. So, a non-scientific reader is provided with a picture of a certain process that he or she can experience in everyday life and that obviously does not involve a soul or outer-physical influences. A contemporary scientific reader may

try to research the nature of these processes. Read literally, Descartes' analogy does in fact stimulate science. It is rather complicated to examine processes, which happen inside the human body that is enclosed with skin. If Descartes was right, it would be possible to find something out about digestion, blood creation, breathing, and so on, by investigating processes that occur in nature. A scientific reading may result in finding the legitimacy of Descartes' descriptions, or reasons to reject an analogy, because something disturbs the relation. His description benefits from both cases: In the first one, his theory is justified and in the second one an analogy is lost, which was just a support for a theory that still holds. Blood, for instance, is not produced in the liver as Descartes writes, but in the bone marrow, and the process is no fermentation process as in his analogy, but the rather complex process of haematopoiesis. In order to find this out, one learns about the liver. So, models, at least in a historical perspective and especially in the case of Descartes, encourage a protoscientific engagement with certain questions. When science does not suffice to hold a theory together, a model may do so.

By investigating the chemistry in Cartesian physics, one can also find the call for engagement in his demand for empirical evidence. In some cases there is no explanation beside an analogy. These explanations are implicitly open for evaluation. When it comes to chemical topics in the *Principia Philosophiae*, he helps himself with Aristotelian and alchemical doctrines, as long as they are compatible with his principles. Descartes also believes that they are true, but states the necessity for empirical evidence, so they are explicitly open for evaluation. For instance, he adopts the Aristotelian view, that metals are produced by moving material in the bowels of the earth. Metal is found on the earth's surface, because "particles [...] are easily carried upward by quicksilver which has been rarefied by heat; and they form various metals [...]. I would perhaps have described these individually here, if I had previously had the opportunity to perform the various experiments which are required for a certain knowledge of these metals" (Descartes, 1982, p. 213; PP IV §63).

Regarding his methodical skepticism, this approach may come unexpectedly. In the second meditation he shows that it is impossible to get infallible truth qua sense experience with the description of the transfiguration of a piece of wax. Nonetheless, he is not the kind of thinker who does guesswork. In his physical and anatomical writings he invites to experiment and find empirical evidence. The reader of the *Discours* is asked to dissect a heart before continuing to read (cf. Descartes, 2011a, p. 83), the reader of the *Principia* is informed about the lack of empirical evidence in the quote I just gave, and the reader of the *Traité* is provided with physical analogies.

In the following part, I want to explain my ascription of creativity to Descartes. Two possible questions can link to it: How does empirical generalization work and why does Descartes give two different analogies for esprits animeux?

On creativity

In the historical dictionary of philosophy, the *Historisches Wörterbuch der Philosophie*, Wolfhart Matthäus writes, that creativity “has not yet been specified as scientific concept” (Matthäus, 1976, col. 1194). This article on creativity was published in 1976 and since then empirical research on creativity has made much progress. Nevertheless, it was not established as a philosophical concept. Creativity is a neologism of 19th century, which derives from the latin verb *creare*, which just means: to create. Niklas Luhmann writes that there are three dimensions of creativity to identify in the time between the 17th and the 19th century: Creativity concerns time, something creative is something new; it concerns things (this is probably quite vague), something creative is something significant; and it concerns a social dimension, something creative is surprising. These aspects do not have to be manifest immediately, but can be revealed later (cf. Luhmann, 1988, p. 16).

Anyway, there is an aspect of creativity, which leads back to the etymological root, namely in terms of producing something that has not been here before. In difference to the notion of new, and in addition to Luhmann’s understanding, something creative accomplishes to overcome a theoretical tradition. So, new ideas cannot be caught up by established concepts and systems. Something creative stands on its own. In order to show this aspect of creativity in Descartes’ writings, I want to leave Descartes and investigate Galileo Galilei who proposes a discourse that I want to anticipate.

Galilei seems to be more a character of literature than a historical person. His character is shaped by two series of events. The first series is his scientific work in astronomy and the second series is his conflict with contemporary academics from university and later on with the church. It is easy to see a resemblance to Giordano Bruno’s life in the life of Galilei. Both, Bruno and Galilei, held their opinions against those who were more powerful, and they were condemned by unjustified Christian dogmatism. Both thinkers became typical martyrs of philosophy. In the case of Galilei, blind faith stood against evident facts.

But discourses in history of science are multi-layered. To see Galilei as the representative of empiricism and the church as those who prefer to believe in the text of the bible rather than their own eyes is a rather naïve understanding of the whole affair. As Carl Friedrich von Weizsäcker (1999, p. 110–112)

writes, Galilei's achievement was to idealise the phenomena of nature and to describe the world in a way that it is actually not experienced. Galilei's descriptions of inexperienceable phenomena competed against scholastic explanations of natural phenomena, which lead back to Aristotle. The heliocentric model of Copernicus belongs to the set of inexperienceable phenomena. According to von Weizsäcker, it was a weakness of Aristotle – and his epigones – to operate too empirically. Aristotelian explanations of nature, as well as the Aristotelians' explanations, were metaphysical descriptions without abstractions that are necessary for modern science (cf. von Weizsäcker, 1999, p. 111).

An example for Galilei's abstraction is the law of falling bodies: According to Galilei two bodies with different mass fall with the same speed. In the free fall they accelerate with the same speed to the same speed maximum. According to Aristotelian physics, bodies with different mass fall with different speed. The speed of their movement is proportional to the nature of the material of the space they move in (falling through air and sinking down in water is meant) (cf. Aristoteles, 1987, p. 185–195; Physics IV.8). So, to state that the speed of fall is dependent on the mass of the falling body is justified by authority as well as by experience. If, a classical example, one observes a feather and a cannon ball that are falling down, the cannon ball will hit the ground faster than the feather. Galilei's law of falling bodies contradicts both, Aristotle and experience. In addition, it was necessary to accept the concept of vacuum, which – as von Weizsäcker (1999, p. 111) writes – Galilei was not able to produce. There are therefore justified reasons to reject Galilei's physics.

In the same way it is rather deviant to conclude that the earth moves around the sun. The thesis that the earth moves around the sun, can be formulated in an abstract and idealised way, but not with the empirical possibilities of the 17th century. One just does not experience it. Every day there is a path that the sun repeatedly draws along the sky and there is no movement of the earth to sense. So the conflict between Galilei and the church can be seen in a different light, as the dispute between somebody who could not prove a rather deviant, sense experience contradicting theory and was, in terms of Arthur Koestler (1959), asking for trouble and others who represented a justified and coherent system.

In this sense, Galilei is the figurehead of the anarchistic scientist for Paul Feyerabend. The anarchistic scientist proceeds counter-intuitively, which means he or she formulates hypotheses that contradict well-established theories and experiments. In *Against method* Feyerabend writes, that it is commonly assumed, that the ideal theoretical description of a phenomenon consists of “ideas so closely connected with observations that it needs a special effort to realize their existence and to determine their content.” (Feyerabend, 1993, p. 54). Feyerabend calls

these ideas natural interpretations; but this name shall not mislead. It is Feyerabend's concern to demonstrate that natural interpretations are not natural, but prejudices from ideology (cf. Feyerabend, 1993, p. 57–62). Galilei's scientific merit was not to develop a new theory – and in fact, he did not develop a new theory, but adapt the work of Copernicus – but to overcome natural descriptions and to introduce a new observation language (cf. Feyerabend, 1993, p. 63).

Descartes' man-machine as creative endeavour

The lives of Galilei and Descartes have been very different. Galilei was, at least, not indisposed to wrangle. Descartes rather committed himself to Ovid's dictum 'bene vixit qui bene latuit' – 'to live well is to live concealed'. He may not have introduced a new observation language in the strict sense of Feyerabend. But the already quoted question by Specht, what to do with the well-established concept of soul, appears, if one accepts the Cartesian model of man-machine. He overcame natural interpretations, introduced new understandings of nature and the soul, and abolished Aristotelian concepts. This is quite the mainstream interpretation. But, I suppose we all have experienced this, the image of philosophical traditions is kaleidoscopic. There are continuities and disruptions that all seem to form a plausible picture, but like the picture of a kaleidoscope changes with a turn, these connections can fall apart, yielding to another plausible picture from another point of view. Regarding the human body, one can find predecessors of Descartes, for instance Spanish philosopher and physician Gómez Pereira, who wanted to prove that animals are mere machines (cf. Canguilhem, 2009, p. 192–194).

I see the creativity of the man-machine in the abstraction of body features that yield to description in mechanisms. Despite the continuous reference to examples from empirical science, Descartes' analogies are abstractions in the same way, in which Galilei's nature is an abstraction. And after all, Descartes proposes a thought experiment to imagine the statue that has a body just like us. The use of two different analogies for esprits animaux can be explained by the examination of two different functions – movement and sensation. The core difference is an orchestration centre, the organ player, which is present in one case – because it is needed for explanation, and missing in the other case, because it is not needed. To make this empirical generalisation and to find analogies that, firstly, match and, secondly, do not lead back to scholastic understanding, is a creative act. Valuable explanation is more important than coherent descriptive unity.

Surprisingly, the use of imagination is a part of Descartes' scientific method, not as it is described in the *Discours de la Méthode*, but as it is described in his, *Regulae ad directionem ingenii*. This text remained unpublished and unfinished

but has quite the same purpose as the *Discours*: To provide a scientific methodology that the philosopher can apply in order to find true sentences. A central difference between the *Discours* and the *Regulae* is the value of phantasy and imagination (*phantasia* and *imaginatio* in Latin).

Descartes justifies and enforces the use of imagination in science and philosophy. When imagination is methodically used to find out the truth about something, then it is always used to imagine something known in relation to something that is unknown. Rule fourteen reads: “The problem should be re-expressed in terms of the real extension of bodies and should be pictured in our imagination entirely by means of bare figures” (Descartes, 2011b, p. 56; translation online). In the rule’s exposition he writes about “the common idea” of the imagined shape of a crown and a crown that can be made from different materials: “This common idea is carried over from one subject to the other solely by means of simple comparison, which enables us to state that the thing we are seeking is in this or that respect similar to, or identical with, or equal to, some given thing” (Descartes, 2011b, p. 57; translation online).

Galilei’s accomplishment in abstraction of natural experience is similar to Descartes comparisons between body features and natural processes. Galilei tried to formalise his theory, Descartes remained in a scholastic textbooks tradition – at least in his anatomical writings, (this may be a statement to argue). Nevertheless, in the writings of both thinkers we find descriptions of nature, but in a way it is not experienced. As a mathematical model in the case of Galilei and as an explanatory machine-model in the case of Descartes. The model is creative because it requires abstraction and the abstraction is done according to an understanding of nature that refrains from engaging with past traditions.

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