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# The possibility of knowing the essence of bodies through scientific experiments in Spinoza's controversy with Boyle

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## ABSTRACT


In this paper, I argue for a novel reading of Spinoza's position in his exchange with Boyle about Boyle's experiment with nitre. Boyle claimed to have shown through experiments that nitre ceased to be nitre after heating. Spinoza disagreed and proposed the alternative hypothesis that nitre has changed its state and not its nature. Spinoza's position was construed in the literature as rational scepticism denying that experiments can yield knowledge of essences because all sensory experience is underdetermined and open to multiple interpretations. I argue for an alternative reading of Spinoza's position which focuses on Bacon's notion of crucial instance. According to this reading, Spinoza did not deny the possibility of knowing by experimentation whether nitre has changed its nature, he asked for a crucial instance, i.e. an experiment that would refute the hypothesis that nitre has changed merely its state. Spinoza's argumentative strategy shows that, contrary to the mainstream reading, the representational content of sensory ideas can be determined even if it does not represent the essence of the object: we can know with absolute, rather than merely moral, certainty whether nitre ceased to be nitre without knowing what nitre is.

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**KEYWORDS** Spinoza; Boyle; Bacon; natural history; crucial instance/crucial experiment

## 1. Introduction

In this paper, I present a novel reading of Spinoza's position in his exchange with Boyle about Boyle's experiment with nitre. Boyle argued that he knows through experiments whether nitre has turned into another kind of matter or just changed its state. Spinoza argued that Boyle is not entitled to that claim, he cannot show that the particular piece of matter ceased to be nitre. Available readings interpret Spinoza's position as a form of rationalist scepticism

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implying that sensory experience is always underdetermined and open to multiple interpretations. If sensory experience is always underdetermined, it cannot be decided on the basis of experiments whether nitre has turned into another kind of matter. These readings are consistent with the mainstream interpretation of Spinoza's epistemology, according to which the finite human mind cannot form an adequate idea of an external finite body based on sensory experience because such an idea would have an external cause. By contrast, I propose a Baconian reading of Spinoza's position, according to which Spinoza did not discard the possibility of establishing through experiments that nitre has turned into another kind of matter, he demands a crucial instance, i.e. an experiment that would refute the hypothesis that nitre has merely changed its state. My reading provides evidence for the emerging interpretation of Spinoza's epistemology, according to which an idea in the human mind can be adequate even if it has an external cause, and which challenges the mainstream interpretation.

I proceed in six sections. In the next section, I present the current debate between the mainstream and the emergent readings of Spinoza's epistemology. I argue that the point of contention is the possibility of non-essential representation determining the idea's reference, i.e. an idea that picks out its object unambiguously without representing its essence. The mainstream interpretation denies, and the emergent reading accepts the possibility of determinate non-essential representation. Since every sensory idea in a finite mind picks out its object by non-essential representation, the debate is, by extension, about the possibility of a finite mind having an adequate sensory idea. In the third section, I briefly recapitulate Spinoza's controversy with Boyle about the interpretation of the experiment with nitre. I argue that the controversy is about the possibility of having an idea with determinate non-essential representation, i.e. whether we can know (in the full-blown sense) *that* two pieces of matter are identical or not without knowing *what* their essence is. In the fourth section, I survey the most important interpretations of Spinoza's position in the controversy. I argue that those interpretations implicitly follow the mainstream reading by construing the two available types of representation as underdetermined sensory experience and rational knowledge of essences or laws. They see the debate between Spinoza and Boyle as being about the possibility of knowing the essence of nitre and interpret Spinoza's position as a rationalist scepticism denying that possibility. In the fifth section, I argue that these readings misconstrue the point of the debate, which is not about knowing what the essence of nitre is, but rather about knowing whether nitre ceased to be nitre through heating, which is something that can be decided by what Bacon calls a crucial instance even in the absence of knowledge of the essence. In the sixth section, I argue that a Baconian reading of Spinoza's second kind of knowledge can

accommodate determinate non-essential representation in Spinoza's epistemology. I conclude by answering two objections.

## 2. Two readings of Spinoza's epistemology

The mainstream reading of Spinoza's epistemology can be helpfully summarized on the basis of Michael Della Rocca's claim that epistemic adequacy tracks the determinateness of representational content. According to his view, adequate ideas represent a determinate object, whereas inadequate ideas are too confused to represent a single object unambiguously (Della Rocca, *Representation*, 111). Confusion consists in the idea representing more than one object without the mind distinguishing those objects. Della Rocca's example is the idea 'Senator McCarthy' which represents features that uniquely belong to Senator Joseph McCarthy as well as features that uniquely belong to Senator Eugene McCarthy. If the subject having the idea 'Senator McCarthy' is unaware of there being two senators, the idea 'Senator McCarthy' does not have determinate content because it does not represent a determinate object for her: it does not pick out a single object, there is nothing in nature that the idea represents (Della Rocca, *Representation*, 61).

Unlike inadequate ideas, adequate ideas have determinate content, i.e. they pick out their object unambiguously. The central claim of Della Rocca's reading is that having determinate content is only possible if the idea represents the object's essence. This is due to the role that Della Rocca attributes to the Principle of Sufficient Reason in Spinoza's philosophy. For each idea of an object  $x$ , one can raise the question of why the idea is of object  $x$  rather than of object  $y$ . An answer to this question is only self-justifying if the idea represents the essence of its object: only if the idea represents the essence of  $x$ , is it silly to ask the further question of why the idea is an idea of object  $x$  rather than  $y$  (Della Rocca, *Representation*, 62; see also Della Rocca, *Spinoza*, 98–99).

It is uncontentious that every essential representation is determinate, but it is less clear whether every determinate representation is essential. Della Rocca argues for the latter claim with his example of the idea of the first person to run one mile in less than four minutes. Assuming that it does not pertain to the essence of Roger Bannister that he was the first person to run one mile in less than four minutes, this idea picks him out uniquely but not by representing his essential property. Why does this idea not have determinate content if it picks out its object uniquely? Because the reference of non-essential representations is not determined by the content of the idea alone. Having this idea, one can still ask the sensible question of why the idea of the first person to run one mile in less than four minutes is an idea of Roger Bannister rather than of someone else. And there is an informative answer to

that question specifying the causes that led to Roger Bannister being the first person to run one mile in less than four minutes and prevented others from achieving the same feat. To put it differently, even if one has an idea of the first person to run one mile in less than four minutes, it is possible to discover the reference of this idea (or the lack of it); such a discovery is not possible in the case of an idea that represents the essence of Roger Bannister. Therefore, the idea of the first person to run one mile in less than four minutes, when considered on its own, does not have a determinate content (Della Rocca, *Representation*, 96–99).

Rejecting the possibility of non-essential representation determining the content of an idea has dramatic consequences for Spinoza's epistemology because it entails that no sensory idea (i.e. an idea with an external cause) can be unconfused. Unlike an intellectual idea representing the essence of its object, a sensory idea represents its object because the idea of its object features among the causes of the idea (i.e. the sensory idea's *objectum* features among the causes of the corporeal image that is the *ideatum* of the sensory idea).<sup>1</sup> For example, my sensory idea is of this apple rather than some other identical-looking apple because it is this apple that features among the causes of my corporeal image. This seems to suggest that a sensory idea in a finite mind – i.e. in a mind that does not have ideas of the infinitely many causal antecedents of the corporeal image – cannot have its reference determined by its content alone (see also Della Rocca, *Representation*, 91–94).<sup>2</sup> Therefore, no finite mind can have an unconfused sensory idea according to Della Rocca's reading. The majority of the existing interpretations of Spinoza's epistemology embrace the sceptical implications of this reading and deem it impossible for a finite mind to form an adequate sensory idea, i.e. an adequate idea that has an external cause (Renz, "Doxastische Selbstkontrolle", 483; see also LeBuffe, *From Bondage*, 55–56; Bennett, *A Study*, 177–78; Curley, *Behind*, 77–78; Nadler, *Spinoza's Ethics*, 168–69). In this paper, I refer to such readings as the mainstream interpretation.

This paper challenges the mainstream interpretation by arguing that Spinoza accepted determinate non-essential representation. Readings of Spinoza's epistemology, according to which only ideas of the third kind represent essences, constitute the starting point of my interpretation. According to those readings, ideas of the second kind of knowledge are adequate but represent non-essential properties (Wilson, "Spinoza's Theory of

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<sup>1</sup>For the distinction between *objectum* and *ideatum* in Spinoza's theory of ideas, see: Garrett, "Representation, Misrepresentation", 435; see also Radner, "Spinoza's Theory of Ideas".

<sup>2</sup>One might wonder whether an infinite mind could have an adequate sensory idea on this reading: an infinite mind would have adequate ideas of all the causal antecedents of the corporeal image and thus its idea would be adequate according to Della Rocca. But that would also mean that the idea is internally caused since all the causal antecedents of the idea are in the mind. Thus, the idea would not be a sensory but rather an intellectual idea.

Knowledge”, 116; Renz, “Spinoza’s Epistemology”, 162–176).<sup>3</sup> This indicates that Spinoza did not embrace the claim that the only determinate representation is essential representation.

In this paper, I argue that non-essential representations can determine reference when they form part of a scientific practice leading to a Baconian crucial instance, according to Spinoza. In a nutshell, a Baconian essence or form is a fixed law describing the actions (i.e. non-essential properties) performed by the individual (Schliesser, “Newtonian Emanation”, 457–458). The Baconian notion of essence is echoed by Spinoza’s notion of essence, which he describes sometimes as a fixed ratio of motion and rest (definition of the individual after E2p13s), sometimes as the laws of one’s nature (E2p3s2). For Spinoza, the law of one’s nature describes those actions that can be understood as one’s own (E4d8). One way of having an unconfused idea of the individual is by representing its essence, i.e. having an intellectual idea of the fixed law. Another way of having an idea that picks out the individual unambiguously (suggested in different contexts by Hübner, “Spinoza on Essences” and Hutchins “Non-Essentialist”) is by representing so many of its actions (i.e. non-essential properties) that they – taken collectively – are no longer compatible with any other essence than the one the individual actually has. This way, one does not know *what* the individual’s essence is, but one knows *that* the individual has that essence. To take a mathematical example, even if one does not know the formula which generates a circle in a coordinate system, one can be in a position to tell circles and squares on the basis of their shape – the ‘actions’ described by their respective laws – apart.

This is possible because the essence is identified indexically in the case of determinate non-essential representation (see also Sprigge, “Spinoza on Indexicals”; Renz, “Finite subjects”). For example, one can know, on the basis of the individual’s relevant non-essential properties, that *this* individual has the same essence as *that* other individual without being able to specify what that essence is. Indexical identification is required both when the two individuals are separated by space (determining type identity) or time (determining token identity over time) (see also Renz, *Was denn bitte*). Such an indexical identification is implicitly given in every idea of imagination. As Spinoza describes in E2p17, the nature of the external cause is “involved” by the corporeal image that the idea of imagination represents. Of course,

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<sup>3</sup>There is an influential alternative reading, according to which ideas of the three kinds of knowledge are distinguished not by their object but rather by their justification, i.e. all ideas represent the same kind of objects – essences – but have different kinds of justification (Curley, “Experience”; Nadler: *Spinoza’s Ethics*, 173–85). My claim that there is non-essential determinate representation in Spinoza is compatible with this interpretation as a claim about the source of justification rather than the type of object: an idea of the second kind of knowledge does not derive its justification from the representation of the essence itself – which is why it is not intuitive and which would be required by Della Rocca’s definition of essential representation – but rather from the representation of properties of the object.

this involvement is confused, and thus, the idea of imagination does not allow the mind to identify the nature of the external object. But the involvement is permanent enough to give rise to epistemic error: even if the external object has changed its nature, the mind still imagines the *same* object as present. Spinoza's example is Paul who can mistakenly regard Peter as present even after Peter ceased to exist, i.e. Paul thinks that the *same* person he has encountered previously is still alive (see also Renz, "Spinozist Cognitive Psychology").

According to my reading, the Baconian methodology aims to make explicit the indexical identification of the essence implicitly given in every idea of imagination in order to avoid epistemic error. If the indexical identification (of type or token) can be part of the content of an idea, the content of an idea alone can determine its reference even if the idea does not represent the essence of its object, i.e. to have an adequate sensory idea of an object even in the absence of the representation of the object's essence. The idea of *this* person who was the first person to run one mile under four minutes is as determinate as any essential representation. As we will see, Spinoza's controversy with Boyle is about the question of whether the empirical evidence suffices for justifying the claim that the indexically identified objects (where indexical identification refers to types and not tokens) – *this* thing and *this* thing – exhibit such non-essential features that make it impossible that they share the same essence, whatever that essence might be. This is a debate about knowing *that* they have the same essence (or not) and not about *what* their essence is (or is not).

My reading thus lends support to an emergent reading of Spinoza's philosophy of mind that puts emphasis on the epistemic value of the first-person experience of spatiotemporally located particulars (Jaquet, "From the Self"; Sangiacomo, *Spinoza on Reason*, 123–29; Renz, *Explainability of Experience*, 183–187). To formulate this claim in the anachronistic language of contemporary analytic philosophy: due to the nature of the external body being involved in the corporeal image, the idea of imagination makes the subject nonconceptually acquainted with the external body in a way that can determine the reference of the idea even in the absence of a definite description (essential representation) in the conceptual representational content of the idea.

### 3. Spinoza's controversy with Boyle

Spinoza's controversy with Boyle took place through the mediation of Oldenburg, who visited Spinoza in Rijnsburg in 1661 (see also Nadler, *Spinoza: A Life*, 185). Spinoza and Oldenburg started a correspondence discussing metaphysical themes in Spinoza's philosophy. Oldenburg also reported about the foundation of the Royal Society (Ep.3), and then sent Spinoza a copy of the

Latin translation of Boyle's two recent publications in order to illustrate the scientific research done by members of the Society (Ep.5). Although Oldenburg explicitly asked Spinoza to let him know his judgement, he could have hardly anticipated the outsized commentary on Boyle's treatise that Spinoza sent back in his next letter (Ep.6). Just how outsized that commentary was in the context of Spinoza's correspondence with Oldenburg is illustrated by the fact that Spinoza's reports about his own metaphysics in Letters 2 and 4 combined fill five pages of the Gebhardt edition (C 1:164–168, G 4:7–9; C 1:170–172, G 4:12–14), whereas Spinoza's commentary on Boyle's work covers twenty-one pages of the same edition (C 1:173–188, G 4:15–36). Whatever Spinoza's intentions were, his commentary demonstrates that he was able to understand Boyle's scientific treatise; he shows himself to be a competent scientist conducting scientific experiments to evaluate Boyle's claims and was able to formulate a hypothesis alternative to the one suggested by Boyle (Nadler, *Spinoza: A Life*, 193).

In the following, I would like to focus on one controversial claim essential for the interpretation of Boyle's experiment about the reconstitution of nitre. This claim is that nitre was decomposed into two kinds of matter, none of which is nitre. For the sake of brevity and since the focus of this paper is Spinoza's position in the controversy, I present Boyle's experiment on the basis of Gabbey's reconstruction of it and restrict myself to the aspects relevant to this controversial claim (Gabbey, "Spinoza's natural", 220–22). In his experiment, Boyle wanted to refute the scholastic hypothesis that the essence of particular bodies is constituted by their substantial forms. First, he decomposed nitre (saltpetre, potassium nitrate) by heating into a solid salt-like part ("fixed niter", potassium carbonate) and a gaseous part ("spirit of niter", nitric acid). He interpreted "fixed niter" and "spirit of niter" as two bodies different in kind both from each other and from nitre itself, i.e. he took "spirit of niter" to be neither "fixed niter", nor nitre. Next, he recombined "fixed niter" and "spirit of niter", by which he could produce the same amount of nitre ("reconstitute niter") with which he started the experiment. His claim was that a change in kind was involved in both steps.

In this paper, I put aside the question of how effective Boyle's argument is against a hylomorphic philosopher and focus on his assumption that neither "spirit of niter", nor "fixed niter" is nitre. Showing the truth of this assumption was a necessary requirement for his argument to be successful. His point is that the decomposition of nitre is a change in kind, which the scholastic hypothesis would interpret as a substantial change. The scholastic hypothesis understands substantial change as involving the destruction of the substantial form. Therefore, the scholastic hypothesis would predict – according to Boyle – that reassembling the material parts of nitre without the substantial form should not suffice for reconstituting nitre. If nitre was reconstituted without the substantial form, the scholastic hypothesis has been refuted.



However, if no change in kind occurred (which the scholastic hypothesis would interpret as a substantial change), then the scholastic hypothesis was not refuted by the experiment (even according to Boyle's own standards), since the substantial form was never removed from the mix. That is, unless Boyle shows conclusively that neither "fixed niter", nor "spirit of niter" has the same nature as nitre (whatever that nature is), he has not shown what he intended to show.<sup>4</sup>

Spinoza's contention is that Boyle has not shown that a change in kind has occurred because the empirical evidence is compatible with the interpretation that "spirit of niter" is nitre, and "fixed niter" is an impurity in nitre. Therefore, Spinoza proposes to conduct further experiments to see whether it is possible to turn "spirit of niter" into nitre without adding "fixed niter" (C 1:173–174, G 4:16,14–17,6). Spinoza elucidates later in his exchange his proposition by the example of water and steam: just as both water and steam belong to the same kind of matter – i.e. have the same nature – even if their state and sensible properties differ radically, it is perfectly possible that "spirit of niter" and nitre belong to the same kind of matter – i.e. have the same nature – even if their sensible properties differ radically (C 1:212, G 4:69,1–3). Therefore, one cannot simply assume by observing the different sensible properties of "spirit of niter" and nitre that these bodies differ in kind, it is possible that they are the same kind of matter in different states.

#### 4. Current interpretations of Spinoza's exchange with Boyle

Spinoza's position has been characterized in the literature as one defending a sceptical position against Boyle's experimental science. It is argued that Spinoza denies on rationalist grounds that empirical investigations can yield knowledge of the essences of bodies, whereas Boyle defended the experimental scientific doctrine that essences can be known through experiments.

David Savan in his 1986 "Spinoza: Scientist and Theorist of Scientific Method" argues that Spinoza uses hypothetical explanations in his correspondence with Boyle. On Savan's reading, Spinoza and Boyle agree that the explanation of the chemical change must proceed by invoking the fundamental mechanical properties of bodies. On Savan's reconstruction:

Their disagreement is on the particular causal explanations. While Boyle attempts to explain the phenomena of nitre on the hypothesis that nitre is a heterogeneous body, Spinoza maintains that the hypothesis that it is homogeneous is simpler, and better confirmed by experimental results.

(Savan, "Spinoza: Scientist", 117)

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<sup>4</sup>I would like to thank an anonymous reviewer for pressing me on this issue.

Although Savan sees Spinoza's ambition of supporting his hypothesis through experiments, Savan interprets Spinoza as denying that the general explanatory principles can be proven by empirical experiments. It is only possible to form hypotheses and establish that these are confirmed by experiments "to a certain extent" (Savan, "Spinoza: Scientist", 117), without establishing secure knowledge. Savan's final evaluation of Spinoza's position is clear: "Spinoza is more sceptical than the sceptical chemist. [...] In his later terminology, our knowledge of specific causes is inadequate" (Savan, "Spinoza: Scientist", 118). That is to say, empirical experiments cannot yield knowledge of the essences of different bodies involved in the experiment, experiments can merely strengthen or weaken the hypotheses about them.

Alan Gabbey argues in a similar manner that

Spinoza valued experimentation, because it reveals new phenomena and new qualities of things. But it cannot uncover the nature of things: sensory knowledge belongs to the imagination, knowledge of essences and causes to the intellect alone.

(Gabbey, "Spinoza: Scientist", 219)

Gabbey is more critical of Boyle's position than Savan:

To prove Boyle's claimed specific differences between the substances would have meant showing that their particles have different geometrical forms. Instead, Boyle was content to show their different chemical properties, without explaining how they derive from the presumed corresponding corpuscular states, though he had no doubt that that was their origin.

(Gabbey, "Spinoza: Scientist", 218)

Therefore, "Spinoza's insistence on the epistemological insufficiencies of the experimental way" does merit further consideration (Gabbey, "Spinoza: Scientist", 222). Still, Gabbey seconds Savan's criticism that Spinoza does not have a clearly defined method to know essences: Spinoza vaguely hints at constructing Baconian natural histories, but it is not clear how he could proceed to knowledge of essences on the basis of those histories. That is, Gabbey agrees with Savan's diagnosis that Spinoza's philosophy allows for formulating probable hypotheses but not for scientific knowledge of the essences of particular bodies.

Eric Schliesser is also sympathetic to Spinoza and gives credit to Spinoza for having actually performed the experiments described by Boyle and offering experimental evidence against Boyle's conclusions (Schliesser, "Spinoza and the Philosophy of Science", 161). On his view, Spinoza presents an immanent critique of Boyle's position by making explicit the theoretical commitments necessary for interpreting the experiment the way Boyle did (Schliesser, "Spinoza and the Philosophy of Science", 171). Still, Schliesser also construes Spinoza's position as denying that there is an unambiguous interpretation of experiments: "Spinoza does not use empirical knowledge

as a touchstone for true, rational knowledge. Rather, in the manner of Descartes, intellectual conception is a constraint on how deliverances of the senses can be interpreted” (Schliesser, “Spinoza and the Philosophy of Science”, 166). According to Schliesser’s reading of Spinoza’s position, experiments yield probabilities and not knowledge: “Spinoza distinguishes sharply between useful, empirical knowledge, which is always merely probable, and durable and certain theoretical (or as I argue later) rational self-knowledge” (Schliesser, “Spinoza and the Philosophy of Science”, 171). That is, knowledge of the essences of particular bodies is not possible, the most humans can know about those essences are hypotheses more or less confirmed by experiments. Schliesser reads Letter 10 as claiming that “experience cannot teach us anything about the essences of things” (Schliesser, “Spinoza and the Philosophy of Science”, 161), probably because knowledge of essences “is purely intellectual knowledge” (Schliesser, “Spinoza and the Philosophy of Science”, 169).

In a similar manner, Alison Peterman argues that experiments “cannot show anything about the true nature of bodies or the forces governing their motions” (Peterman, “Spinoza and Science”, 1996). “Spinoza blocks straightforward generalization from experience because we can never know all the causes that contribute to a local phenomenon” (Peterman, “Spinoza and Science”, 1998).

Filip A. A. Buyse also sees a fundamental epistemological reason at the heart of Spinoza’s scepticism. Buyse shows convincingly that Spinoza was not hostile to or inept in chemistry. On the contrary, Spinoza was probably at least as familiar with the experiment of reconstitution of nitre as Boyle himself. According to Buyse’s conjecture, Spinoza knew Glauber’s description of the experiment with nitre earlier than reading Boyle’s book since Spinoza was acquainted with members of the Hartlib circle, to which Glauber belonged (Buyse, “Boyle, Spinoza and Glauber”, 69; Buyse, “Boyle, Spinoza and the Hartlib Circle”).<sup>5</sup> Still, knowledge based on sensory experience is, according to Spinoza’s theory of knowledge, “necessarily inadequate and necessarily leads to inadequate ideas” (Buyse, “Boyle, Spinoza and Glauber”, 66). The starting point of all adequate knowledge is the knowledge of mechanical laws rather than experimentation.

Stephen Harrop also seconds the widespread agreement that experiments cannot provide adequate knowledge. As he writes: “Spinoza believed that experimental science simply was not up to the task of doing what true science is supposed to do” (Harrop, “Essence, Experiment, and Underdetermination”, 448), i.e. to yield knowledge of essences. This is because sensory experience must always remain underdetermined and open to multiple interpretations. For this reason, experience – including experiments – can

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<sup>5</sup>I would like to thank Filip Buyse for discussing his interpretation with me.

never suffice to fix facts about the essences of particular things: “whenever we attempt to discover the nature and essence of any particular thing or class of things by experiment alone, we will be unsuccessful” (Harrop, “Essence, Experiment, and Underdetermination”, 468). Experiments are still useful because they can put the observer in a position where powerful imaginative ideas generated by the experience of observation can destroy the observer’s weaker beliefs (Harrop, “Essence, Experiment, and Underdetermination”, 480). Even if experience generated in the course of experiments can give rise to ideas that can overpower weaker beliefs, they cannot generate secure knowledge of essences because sensory experience cannot play any evidentiary role unless determined by the intellect (Harrop, “Essence, Experiment, and Underdetermination”, 478–79).

Despite their difference in emphasis and approach, all authors agree on some common claims about Spinoza’s position in his correspondence with Boyle: (1) sensory experience belongs to the imagination, according to Spinoza, which is unreliable, underdetermined, and produces inadequate ideas; (2) for this reason, experiments based on sensory experience can make hypotheses more or less probable and give rise to subjective conviction but can never produce adequate knowledge of essences; (3) adequate knowledge results from knowledge of general laws of mechanics or rational self-knowledge, which belong to the intellect rather than to imagination. Even if not all of the above-discussed authors agree with every detail of Della Rocca’s reading, these common claims are all in line with the core assumption behind the mainstream reading that sensory ideas cannot be adequate *because* they cannot have determinate content.

In line with the mainstream reading, all interpretations of the correspondence construe an opposition between intellectual and certain knowledge of essences and mechanical laws, on the one hand, and sensory experience of particulars that can yield useful and probable hypotheses, on the other hand. Even if some readings accept that we can know essences through the intellect (for example: Schliesser, “Spinoza and the Philosophy of Science”, 169–170), that *this* particular body has *this* particular essence can only be known as a probable hypothesis. If the two options of certain intellectual knowledge of essences and probable sensory experience of particulars are exhaustive, experiments – involving sensory experience – obviously can merely yield probable rather than certain knowledge (see also James, “Creating Rational Understanding”).

In the next section, I argue for an interpretation of the controversy according to which the two options are not exhaustive, and Spinoza allows for certain and not merely probable knowledge that is *about* the essences without being *of* the essences. Both Boyle and Spinoza agree that knowing the essence of nitre is not a realistic aim at the then current stand of science, but experiments can provide secure knowledge about the identity

or difference of essences, i.e. whether ‘spirit of niter’ and nitre have the same nature or not. Even if we will never know through experiments the corpuscular forms or the laws constituting the essence of nitre, we can still know – with absolute certainty – through experiments whether ‘fixed niter’ is nitre or not. The debate is about the question of whether the experiments have already yielded such knowledge about the identity or difference of essences or not, i.e. whether the experiment that Bacon would call crucial instance has been provided or not.

## 5. Spinoza’s Baconian argument

To begin with, we should note that nowhere in his controversy with Boyle does Spinoza express his view that experiments are generally not able to yield secure knowledge about essences and therefore Boyle’s attempt to refute the scholastic hypothesis is futile (Ep.10 is not part of the controversy and written in a different argumentative context, to which I come back in the conclusion). Recall that Boyle’s refutation of the scholastic hypothesis is predicated on the truth of the claim that ‘spirit of niter’ is not nitre, i.e. that the truth of the claim that these two pieces of matter do not have the same essence is proven. Instead of denying that the truth of that claim could be proven by experiments, Spinoza emphasizes his agreement with the experimental methodology and argues for the need to conduct more experiments. His argumentation was dishonest if he thought that sensory experience is necessarily underdetermined and that experiments cannot fix facts about the natures of particulars. No matter how many experiments are conducted, it would never be possible to determine whether ‘spirit of niter’ is nitre in that case.

Given Bacon’s well-established influence on Spinoza’s epistemology (Curley, “Experience in Spinoza”, 35; Gabbey, “Spinoza: Scientist”, 172; Schliesser, “Spinoza and the Philosophy of Science”, 159; Nadler, *Spinoza’s Ethics*, 18; Lærke, *Spinoza and the Freedom of Philosophizing*, 174; D’Agostino, *Esercizi spirituali*; Schliesser, “Angels and Philosophers”; James, *Spinoza on Philosophy*, 145–46; James, *Spinoza on Learning to Live Together*, 44–45; Van Cauter–Schneider, “Spinoza”), as well as on Boyle (Dumitru, “Crucial Instances”), I contend that Spinoza does not express a rationalist sceptical position, as attributed to him by the literature, but rather follows a Baconian methodology that he could reasonably expect to share with Boyle. For this reason, Spinoza’s strategy can be considered as an immanent critique holding up Boyle’s scientific practice to his own Baconian standards. Spinoza asks Boyle to provide an experiment that would refute the hypothesis that ‘spirit of niter’ is nitre and thereby refute the Aristotelian hypothesis. Such an experiment refuting the alternative hypothesis is what the Baconian method calls a crucial instance. Note that Spinoza can consistently ask for

such a crucial instance – without using the vocabulary – even if he does not think that empirical investigation can yield knowledge *of* essences. It suffices that Spinoza thinks that empirical investigation can yield absolutely secure knowledge *about* essences, i.e. the knowledge that ‘spirit of niter’ and nitre do not have the same nature. Sensory experience may fix facts about the essence without specifying the essence.<sup>6</sup>

And Spinoza indeed asks for a crucial instance in the correspondence (without using the vocabulary). After having identified Boyle’s hypothesis as the claim that nitre is a composite of “spirit of niter” and “fixed niter”, none of which is nitre, Spinoza writes that:

for this conclusion to be regarded as valid, a further experiment seems to be required, which would show that Spirit of Niter is not really Niter and cannot be solidified or crystallized without the aid of the alkaline salt.

(C 1:173–174, G 4:16,14–17,3)

Spinoza’s argument does not aim at establishing that Boyle’s experiments belong to the wrong kind of operation required for knowing whether ‘spirit of niter’ is nitre. Rather, Spinoza’s argument aims to establish that a further experiment is needed, which would establish that ‘spirit of niter’ is not nitre. An experiment that rules out one of the two hypotheses compatible with the empirical evidence currently available is what Bacon calls a crucial instance.

A crucial instance is crucial “in the sense of bringing us to a signpost at a crossroads (a *crux* in Latin) that separates the competing explanations and helps to point the way forwards” (Schwartz, “Experimentum Crucis”, 647). When Spinoza says that a further experiment is needed in order to decide whether ‘spirit of niter’ is nitre or whether ‘spirit of niter’ differs in kind from nitre, he asks for a crucial instance to be provided. Even if a crucial instance cannot confirm a hypothesis, it can refute the alternative hypothesis (i.e. refute the hypothesis that ‘spirit of niter’ is nitre), which is precisely what Spinoza asks Boyle to do, what Boyle claims to have done, and what Boyle needs to do in order to refute the scholastic hypothesis. Given that it was Boyle who claimed to have shown by the experiment that ‘spirit of niter’ is not nitre, Spinoza did not need to propose a concrete experiment as a candidate for being a crucial instance, all he needed to show was that no crucial instance has been provided yet and therefore the question was not settled, contrary to what Boyle claims (see also C 1:208, G 4:64,32–65,6 to be discussed later).

Spinoza wanted to show that the question was not settled yet by introducing his alternative hypothesis not as an explanation of the observed phenomena, but rather explicitly as a hypothesis that is only supposed in order to see whether it can account for the same phenomena as Boyle’s interpretation of the experiment:

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<sup>6</sup>I would like to thank an anonymous reviewer for pressing me on this point.

To explain this Phenomenon as simply as possible, then, I shall posit no other difference between the spirit of Niter and the Niter itself except what is manifest enough: the particles of the Niter are at rest, whereas those of the spirit of Niter, having been considerably stirred up, keep one another in motion.

I shall suppose that the fixed salt does nothing to constitute the essence of Niter, but shall consider it to be the impurities of Niter (from which I find that not even the spirit of Niter is free: though reduced in size, the impurities float in it abundantly enough).

(C 1:174, G 4:17,13–18,2)

Spinoza introduces his hypothesis as an explanation that is simpler than the hypothesis of Boyle. As Buyse has argued convincingly, it is unlikely that Spinoza proposes his alternative hypothesis as a serious explanation of the experiment. Rather, his aim is to highlight the missing crucial instance and thereby increase the pressure on Boyle. If Boyle cannot provide the crucial instance, there are two alternative hypotheses that can equally account for the observed phenomena, out of which Spinoza's is the simpler one.

Admittedly, when Spinoza elaborates on the interpretation of Boyle's experiment along the lines of his proposed alternative hypothesis, he is easily read as actually arguing for his hypothesis. This is especially the case since he introduces additional experiments that are yielding results apparently in favour of his alternative hypothesis. However, it is part and parcel of the Baconian methodology of natural history to conduct experiments yielding results against one's own hypothesis because doing so can discipline the experimenter's mind and habituate it to be open to surprising possibilities (Jalobeanu, *The Art of Experimental*, 74–75). Providing further experimental evidence for an alternative hypothesis that Spinoza takes to be false but defends for methodological reasons could thus be intended not as an argument for Spinoza's alternative hypothesis but rather as a performative gesture aiming to help Boyle overcome the prejudices that prevented him from recognizing the need for a crucial instance.

That Spinoza did not actually hold his alternative hypothesis to be true is further evidenced by his explicit claim that it was not his intention to argue for his alternative hypothesis, only to highlight the need for further experiments:

So I wanted by my explanation to show – and I think I did show more than adequately – that we can very easily explain all the Phenomena of Niter, or at least all the Phenomena that I know, even if we don't grant that Niter is a heterogeneous body, but regard it as homogeneous. Hence it was not my task to show that the fixed salt is an impurity in Niter, but only to suppose it, to see how the Distinguished Gentleman could show me that that salt is not an impurity but is absolutely necessary to constitute the essence of Niter, without which Niter could not be conceived.

(C 1:208, G 4:64,32–65,6)

Spinoza frames his experiments not as demonstrating the truth of his hypothesis but rather as challenging Boyle's hypothesis. This is again in line with the ideal of Baconian science. One key aspect of Baconian scientific practice is the communitarian character of doing experiments since the presence of others keeps the experimenter's mind in check and thereby has a disciplining effect on the experimenter's mind (Jalobeanu, *The Art of Experimental*, 125–28). Spinoza's alternative hypothesis can be understood as an objection from a peer experimenter whereby the shaky evidential ground of Boyle's interpretation of his experiment is highlighted. This, again, can be interpreted as a friendly gesture aimed at helping Boyle overcome his prejudices that made him jump to conclusions.

Spinoza is thus not sceptical about the evidential value of experiments but tries to show – by proposing the alternative hypothesis – that Boyle's interpretation of the experiment is unjustified by the available empirical observation and a further experiment, a crucial instance is needed in order to fully justify it. Just as Boyle complains that Spinoza does not understand that his aim was not to make claims about the nature of nitre, but rather to disprove the scholastic hypothesis (see also Harrop, "Essence, Experiment, and Underdetermination", 467), Spinoza complains in the quotation above that Boyle does not understand that his aim is not to prove that 'spirit of niter' is nitre in a different state, but rather to put his finger on the insufficiency of the experimental evidence for Boyle's claim that 'spirit of niter' is not nitre and to argue that a crucial instance is needed. Boyle takes Spinoza as aiming for knowledge of the essence of nitre, whereas Spinoza actually aims to show that, without a crucial instance, no knowledge about the essence of nitre is possible, no fact was fixed yet.

Boyle's reply to Spinoza amounts to the statement that he has provided the crucial instance, even if neither Spinoza, nor Boyle uses this vocabulary. As Oldenburg reports about Boyle:

our Author says that his Experiment with Niter was more than enough to show that the whole body of Niter was resolved by Chemical Analysis into parts differing from one another and from the whole, but that afterwards it was reunited out of the same parts and so reconstituted that only a little of the original weight was lacking. He adds that he has shown *that* the thing occurs thus, but has not discussed *how* it occurs, which seems to be the subject of your conjecture.

(C 1:197, G 4:49,2–8)

Boyle makes three claims: (1) unlike Spinoza, he does not make claims about the way in which the essences of the matters involved give rise to the observable phenomena; (2) his aim is to show that the observable phenomena rule out the possibility that the essence of 'spirit of niter' is the same as the essence of nitre; (3) he has achieved his aim.<sup>7</sup> That is, he has already provided

<sup>7</sup>These claims are independent of the further question of what the essence consists of. Boyle, Bacon, and Spinoza may have differing views on this issue. However, since neither Boyle nor Spinoza claims to know the essence of nitre, and the debate is about the question of whether we can make claims about the identity and difference of essences on the basis of empirical experiments without



what Baconian science would call a crucial instance refuting Spinoza's alternative hypothesis proposed.

Boyle's reason for believing that he has provided what Baconian science would call a crucial instance was that 'spirit of niter' and nitre shared none of their sensible properties. Boyle argued that the observation of two bodies having no shared sensible properties refutes the hypothesis the two bodies have the same nature. As Oldenburg reports:

He did not at all take it on himself to teach the nature of Niter nor even to reject what anyone can maintain about the homogeneity of matter and about the differences of bodies arising only from motion, shape, etc. He says he had only wished to show that the various textures of bodies produce their various differences, that from these proceed quite different effects, and that so long as the resolution to prime matter has not been accomplished, Philosophers and others rightly infer some heterogeneity from this.

(C 1:217, G 4:74,10–17)

Spinoza proposed the counterexample of water and ice to the claim that the lack of shared sensible properties rules out the identity of nature, since water and ice also have very different sensible properties and share the same nature. Boyle, however, contends that both water and ice are odourless and thus do have a common sensible property signalling a shared nature (C 1;217, G 4:74,28–32).

Thus, the controversy between Boyle and Spinoza became an idle back and forth. Boyle effectively argued that the crucial instance has been provided, whereas Spinoza doubted that what Boyle considered as a crucial instance was indeed a crucial instance:

I willingly confess that this reconstitution of Niter is indeed an excellent experiment for investigating the very nature of Niter when we first know the Mechanical principles of Philosophy and that all the variations of bodies happen according to the Laws of Mechanics. But I deny that these things follow more clearly and evidently from the experiment just mentioned than from many other readily available experiments, *from which, however, this is not proven.*

(C 1:210, G 4:66,33–67,5)

Spinoza denies that Boyle is justified in assuming that the lack of shared sensible properties between 'spirit of niter' and nitre rules out the hypothesis that they have the same nature. Unless Boyle can show why such an assumption holds, his experiential evidence does not refute Spinoza's alternative hypothesis and, therefore, does refute the scholastic hypothesis of substantial forms. Unless Boyle can show how the laws of mechanics rule out the possibility of the same nature exhibiting completely different sensible properties

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knowing the essences themselves, I bracket this issue in this paper. I would like to thank an anonymous reviewer for pressing me on this issue.

under different circumstances, Boyle's experiment cannot play the role of a crucial instance.

At this point of the debate, only a shared experimental practice could help according to the Baconian methodology. The communitarian approach to conducting experiments is a central element of the Baconian methodology of natural history because the presence of peers observing the same experiment or reproducing the experiment in their own laboratory trains the experimenter's mind to always have an impartial view on the phenomena and not to try to fit their experience to their preconceptions (Jalobeanu, *The Art of Experimental*, 127–28). By challenging Boyle's position and proposing experiments that yield surprising results from the perspective of Boyle's position, Spinoza could reasonably take himself to be a good member of a Baconian scientific community. Participating in an experimental practice guided by the methodology of natural history requires scrutinizing the results of one's peers. Thus, Spinoza could reasonably expect that pointing out the deficiency in Boyle's experimental practice is received as a service rather than as an offence.

Against this background, we can understand Spinoza's disappointment with Boyle's answer, who obviously offered his interpretation of Spinoza's experiments without himself conducting them. Spinoza describes Boyle's answer as written "in passing, and as if doing something else" (C 1:208, G 4:64,24), which can indicate that Spinoza takes Boyle as failing to live up to the Baconian standards. Experiments are valued according to the Baconian methodology of natural history not for the results but rather for their effects on the experimenter's mind (Jalobeanu, *The Art of Experimental*, 104). Since those habituating effects do not come about without actually conducting the experiments and making the sensory experience, Spinoza could reasonably expect Boyle to conduct his experiments (the same way as Spinoza conducted Boyle's), by which Boyle could habituate his mind and remove his disposition to fit his experience to his preconceptions. Given Boyle's unwillingness to conduct the experiments and his persistent repetition of his position, Spinoza could reasonably take Boyle as not wanting to engage in a serious scientific discussion.

## 6. Crucial instance in Bacon's methodology of natural history

In the second section, I have argued that the point of contention between the mainstream reading and the emergent reading is the possibility of a non-essential representation determining the reference of an idea. The mainstream reading holds that every adequate idea has its determinate reference due to it representing the essence of its object. As we have seen in the fourth section, the existing literature interprets Spinoza's position in his controversy with Boyle along these lines: they understand Spinoza as being sceptical

about Boyle's knowledge claims based on experiments because experiments are the wrong kind of operation by which knowledge of the essences could be gained. Unlike the mainstream reading, the emergent reading holds that indexical reference to token or type can be part of the content of ideas, which allows for non-essential representation determining the reference of the idea. As I have argued in the fifth section, Spinoza's controversy with Boyle can be better interpreted along these lines: Spinoza does not deny that experiments can yield knowledge about the identity or difference of essences, he just denies that the experimental evidence provided by Boyle does that, i.e. that it qualifies as what Baconian science would call a crucial instance. In this section, I support my reading by arguing that a Baconian reading of Spinoza's second kind of knowledge can make room for ideas of which reference is determined by non-essential representation.

According to Bacon's epistemology knowledge always starts with sensory experience (Jalobeanu, *The Art of Experimental*, 70). Sensory experience results from the mind being affected by particulars. These particulars are stored in the memory as likenesses of individuals. These likenesses are, however, not like seals in the wax, but rather constructed actively by the mind from elements already in the memory. The elements used to construct these likenesses are chosen by the mind on the basis of the resemblance that the individual affecting the mind has to elements already stored in the mind. If the resemblance is based on the disposition of the mind, the resulting likeness of the particular is the work of imagination; if the resemblance is based on the nature of the particular, the likeness is the work of reason (Jalobeanu, *The Art of Experimental*, 204–5).

In a similar manner to Bacon, Spinoza's account of sensory experience starts with the external particulars affecting the human subject. Even though Spinoza's mind–body parallelism makes his vocabulary somewhat complicated, the claim that memory and the mind's ideas have an impact on the resulting sensory idea is well-documented in Spinoza. As he describes in E2p16, the essence of the human body and the essence of the external body affecting the human body together determine the human body's affection. As he describes in E2p17, this affection is the corporeal image, with which an idea of imagination is identical in the mind, and through which the mind can have sensory experience of the external body that has affected its body (Renz, "Spinozist Cognitive Psychology"). Since the nature of the mind is constituted by its ideas, personal history and cultural habituation have an impact on the idea of imagination (Moreau, *Experience and Eternity*). As Spinoza describes in E2p18, personal history influences experience through the subject's memory. Memory consists of habituated chains of idea associations that shape the interpretation of sensory ideas that become part of those chains: the farmer will think, when seeing a horse's traces, about harvest, the soldier about war (Toth, "Memory, Recollection").

These chains of ideas can follow the common order of nature, but also the internal order of reason. Echoing Bacon's distinction between imagination and reason, Spinoza explains in E2p29cs that the adequacy of sensory ideas depends on the order into which the new idea is integrated:

the mind has, not adequate, but only confused knowledge [...] of external bodies so long as it perceives things from the common order of nature, i.e. so long as it is determined externally, from fortuitous encounters with things, to regard this or that, and not so long as it is determined internally, from the fact that it regards a number of things at once, to understand their agreements, differences, and oppositions.

(C 1:471, G 2:114,19–26)

If the sensory idea becomes part of a chain of idea associations constituting a memory where the association of ideas reflects the chronological order in which the subject was affected by external causes, the sensory idea is inadequate. If, however, the sensory idea is part of a chain of idea associations constituting a memory where the association of ideas reflects the characteristics of the objects represented, “their agreements, differences, and oppositions”, the sensory idea can be adequate.

That Spinoza took understanding the agreements, differences, and oppositions of things to be a condition for having adequate sensory ideas, indicates that implicitly he was referencing Bacon's method of natural history. Natural history, in its more specific sense, refers to complex texts describing specific features and phenomena common to a number of individuals (e.g. winds, life and death, density and rarity) (Jalobeanu, *The Art of Experimental*, 229). The text of natural history describes the experience in the right order and also includes instructions for conducting practices that can bring the mind in a position, where it can have a well-ordered experience. It is a storehouse of information and a set of instructions on how to order that information according to axioms. The ordered experience is then further digested into tables of discovery (Jalobeanu, *The Art of Experimental*, 71), and finally concluded by provisional rules (Jalobeanu, *The Art of Experimental*, 231). This indicates that what Spinoza describes as ideas being integrated in the chain reflecting the characteristics of external bodies, are the “proper” common notions described in E2p39 (Sangiaco, *Spinoza on Reason*, 112) that should be understood as specific features and phenomena common to some individuals, which can be studied with the help of the method of natural history.<sup>8</sup>

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<sup>8</sup>Eric Schliesser proposed an innovative interpretation of ‘general’ common notions described in E2p37–38 being about the intrinsic modal properties that are common to all modes of a given attribute. According to his reading, these ‘general’ common notion give access to the nature of bodies rather than to the foundation of science (Schliesser, “Spinoza and the Philosophy of Science”, 184–5). Since my interpretation focuses on the ‘proper’ common notions specific to some groups of modes,

This reading is further supported by the similarity of Spinoza's distinction between the first two kinds of knowledge to Bacon's distinction between random experience – which is the work of imagination – and literal or learned experience – which is the work of reason – the method of natural history allows the mind to transform its random experience into learned experience (Jalobeanu, *The Art of Experimental*, 300). Spinoza uses the same terms to describe the first two kinds of knowledge in E2p40s2. There, the first kind of knowledge is called imagination, which comes either from signs, or random experience. The second kind of knowledge is called reason, which comes from common notions. Contrary to Gabbey's claim that experience for Spinoza cannot be the source of knowledge about essences (Gabbey, "Spinoza on Natural Science", 218), I argue that experience – when integrated to the right order of ideas and thereby interpreted according to common notions – can be the source of knowledge *about* essence even if not *of* essences. Sensory experience can yield ideas that have determinate non-essential representation, it can yield the secure knowledge that *this* piece of matter and *that* piece of matter are not the same kind of matter.

## 7. Conclusion

I conclude by answering two possible objections to the proposed interpretation. The first possible objection departs from Spinoza's claim in Ep.10, which is often quoted as proving Spinoza's hostility towards the experimental way (Schliesser, "Spinoza and the Philosophy of Science", 161; Harrop, "Essence, Experiment, and Underdetermination", 269):

we need experience only for those things which cannot be inferred from the definition of the thing, as, for example, the existence of Modes (for this cannot be inferred from the definition of the thing); but not for those things whose existence is not distinguished from their essence, and therefore is inferred from their definition. Indeed no experience will ever be able to teach us this, for experience does not teach any essences of things. The most it can do is to determine our mind to think only of certain essences of things.

(C 1:196, G 4:47,7–15)

However, Spinoza does not say in this passage that experience cannot yield knowledge, he merely states that experience cannot yield knowledge of essences. This is compatible with the proposed interpretation, according to which the knowledge of essences belongs to the knowledge of the third kind, whereas knowledge of the second kind is about the non-essential properties of things which serves as the basis for inferences about the identity or difference of essences. It is not entirely clear what Spinoza means when he

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the two readings are compatible. I would like to thank an anonymous reviewer for pressing me on this point.

talks about essence: sometimes he sounds as if the whole of extension had just one essence and the diversity of different particulars having different essences was an illusion (E1p15s3); sometimes as if natural kinds had essences that can be multiply instantiated by particulars (E1p8s2); sometimes as if each particular was identical to its own essence (E3p7). Yet, it is clear that the existence of modes – what is not a *causa sui* – is known by experience. And Spinoza's theory of perception suggests that the subject does not merely know by experience that the proposition 'mode *x* exists' is true, but rather that '*this* thing that I perceive as existing is mode *x*'. This is because sensory ideas show their object as 'present', i.e. as existing (E2p17; see also Renz, "Spinozist Cognitive Psychology"). Thus, whether it is homogenous matter, the natural kind nitre, or the particular piece of nitre that has essence, that *this* is nitre and *that* is not nitre, is something we know by learned experience ordered according to the order of reason, rather than by random experience, which is underdetermined. This is how I read the last sentence of the quotation: experience can determine us to think of the same essence (or not) when thinking of *this* and *that* body, not to think what that essence is.

The second objection departs from Spinoza's claim in E3p57, where Spinoza states:

Each affect of each individual differs from the affect of another as much as the essence of the one from the essence of the other.

(C 1:528, G 2:186,12–14)

This claim suggests that similar properties of individuals that have different natures are actually different properties. This suggestion is supported by Spinoza's examples in the scholium of this proposition:

Both the horse and the man are driven by a Lust to procreate; but the one is driven by an equine Lust, the other by a human Lust. So also the Lust and Appetites of Insects, fish, and birds must vary.

(C 1:528, G 2:187,9–12)

The worry is that it might not be possible to know any property of the individual, or fix any fact about the individual without knowing the essence of the individual if the essence of the individual is constitutive to the property or fact. If the similarity between equine and human lust is merely superficial, it seems that one cannot know any token lust without knowing the essence of the individual, to whom it belongs. It seems that 'lust' is a confused representation that represents human and equine lust indeterminately. One can generalize the worry thus: any idea of a property of an individual that does not make reference to the essence of the individual is indeterminate, which would make knowledge of properties without knowledge of essences impossible. In that

case, it would be impossible to fix a fact about a thing without knowing the essence of that thing.

However, we should distinguish between the ideas of ‘lust’ and ‘*this* lust’. I concede that the idea of lust cannot be anything but a universal notion with indeterminate reference described in E2p40s1. By contrast, ‘*this* lust’ has content that determines its object. On my reading, the Baconian method of natural history is predicated on the possibility of the indexical reference serving as a surrogate for knowledge of the essence. In a natural scientific practice, one can only compare different manifestations of the same phenomenon and thereby understand their agreements and differences, if one is able to reliably identify what one is comparing with what. One cannot identify phenomena by knowing their essence since one does not (yet) know that. Therefore, one has to identify them indexically, as items in one’s sensory experience.

To summarize, Boyle interpreted his experiment as involving a change in nature. On his interpretation, nitre was analysed in ‘spirit of niter’ and ‘fixed niter’, neither of which was nitre, and from which nitre was reconstituted in the second step. Spinoza’s objection to Boyle concerns his interpretation of the experiment as involving a change in nature. Spinoza argues that the available experimental evidence is consistent with the interpretation that ‘spirit of niter’ is nitre. The existing interpretations take Spinoza as arguing from a rationalist sceptical position, according to which experiments can never yield knowledge about essence because sensory experience is always underdetermined. According to this reading, Spinoza does not think that any amount of experimenting could conclusively show that ‘spirit of niter’ is nitre or not. I have argued for an alternative interpretation of Spinoza’s position along the lines of a Baconian methodology of natural history. According to my reading, Spinoza can only accept Boyle’s experiment as an argument against the scholastic hypothesis of substantial forms if a crucial instance, i.e. an experiment that would refute the hypothesis that ‘spirit of niter’ is nitre, is provided. Without a crucial instance, Boyle has not shown what he intended to show. A crucial instance can fix a fact about the essence of a particular body, namely the fact that ‘spirit of niter’ is not nitre but something else, without determining the exact nature of ‘spirit of niter’. By pointing out the weakness of Boyle’s interpretation as an act of immanent critique of Boyle’s position, Spinoza could take himself to be a good member of a Baconian scientific community. According to the methodology of natural history, experiments are not valued for the results, but rather for their effect on the experimenter’s mind. Peers’ scrutiny and conducting experiments with results apparently contradicting one’s own hypothesis can contribute to habituating the mind so that its experience is transformed from a random experience to a learned one. Spinoza was not hostile to the experimental way, he tried to engage

Boyle according to the rules of the Baconian scientific community and was disappointed by Boyle's unwillingness to play along.

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