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Hobbes's Unified Method for *Scientia*

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Hobbes locates the study of humans within the natural world. Not just our physical actions, but our passions, our desires, our willings and to a certain extent, our thoughts and deliberations, are determined by the same natural laws as everything else. To the degree that there is human freedom, it cannot involve actions that lie outside the deterministic course of nature. Hobbes was decried as a radical thinker in his day and is still considered a materialist atheist. A major source of resistance to his philosophy stemmed from the implications of his theory of human nature for the foundations of ethics and politics. How can we be held to moral laws without a personal divinity to hand these down, punish, and reward us, and without free will to overcome the animal drives nature determines in us? How can we secure political authority and stability if the right to govern does not derive from a providential God? Hobbes has an ingenious solution to this problem which is well-studied. If you know anything about Hobbes, you probably know that he was an early proponent of the social contract theory of government. On this theory, political authority derives from the voluntary transfer of the power each person has, by natural law, to preserve and protect his or her life to a commonly recognized sovereign. Hobbes's political theory influenced Benedict de Spinoza, John Locke, and beyond, and his contribution to politics is well researched. Less well-studied is the relationship between Hobbes's view of natural science and his political theory. A major source of confusion lies in his formal presentation of his philosophical and scientific method. Though Hobbes claims that it generates both types of knowledge, his works on physics and politics seem to employ different methods. This chapter examines the role and nature of Hobbes's method for science in its historical context to clarify how his theoretical and practical philosophy are unified.

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1.1 Method, Science, and Hobbes's Project

Hobbes's politics is commonly studied independently of his method and science. This is odd because, despite writing political works that can be read independently, Hobbes claims in the preface to his comprehensive work, *Elements of Philosophy* (EW I.viii–xi) to be the first to develop a *scientia civilis* (civil science), boasting that by securing true foundations, he has done the same for moral and political philosophy as Galileo Galilei did for physics and William Harvey for medicine. In the previously published preface to *De cive* (EW II.x–xi), Hobbes traces the source of all contention and bloodshed to the absence of a scientific foundation for morals among predecessors, a point he repeats in *De corpore*, Part I of his *Elements*: "therefore, from the not knowing of civil duties, that is from the want of moral science, proceed civil wars, and the greatest calamities of mankind" (EW I.10). To illustrate the source of prior philosophers' failure to provide this foundation, Hobbes likens the traditional justification of political authority by appeal to the divine to the ancient fable in which Ixion, a mortal, embraces the goddess Juno (EW II.xiii). His point is that past philosophical attempts to marry human judgments and apprehensions about justice to the divine are illusory. This approach can only beget empty, inconsistent opinions that produce political instability and bloodshed.

In his Dedication of *De corpore* to the Earl of Devonshire, Hobbes employs another analogy to make a similar point about Scholastic Aristotelian philosophy, characterizing it as the Empusa of the Athenian comic poet: "there entered a thing called *school divinity*, walking on one foot firmly, which is Holy Scripture, but halted on the other rotten foot, which the Apostle Paul called *vain*, and might have called *pernicious philosophy*" (EW I.xi). Hobbes proposes to exorcise this monster by distinguishing

> between the rules of religion, that is, the rules of honoring God, which we have from the laws, and the rules of philosophy, that is, the opinions of private men; and to yield what is due to religion to the Holy Scripture, and what is due to philosophy to natural reason. And this I shall do, if I but handle the Elements of Philosophy truly and clearly, as I endeavor to do. (EW I.x–xi)

He then announces the aim of this work:

> I intend now, by putting into a clear method the true foundations of natural philosophy, to fright and drive away this metaphysical *Empusa*; not by skirmish, but by letting in the light upon her. (EW I.xi)

To build a political structure that will prove stable and lasting, one first requires true foundations of natural philosophy. These are to be treated methodically, unadulterated by the mixing in of myths, fables, and religious writings. From the start, Hobbes presents his new moral and civil science as dependent on the true foundations his method provides for natural philosophy. Method is crucial to Hobbes's project.

Hobbes's purging of the non-natural from philosophy in order to base practical philosophy on the scientific foundations of natural philosophy does not imply that he rejects all religion and theology – note that the rotten foot is the philosophical one! Rather his colorful analogies trace the lack of progress in practical philosophy to the

intermingling of philosophy and religion. A methodical treatment of the true foundations of natural philosophy required for a moral science thus necessitates that one first cordon off the domain of philosophical activity, which *De corpore*'s Epistle to the Reader describes as "the natural reason of man, busily flying up and down among the creatures, and bringing back a true report of their order, causes and effects" (EW I.xiii). Fencing in natural reason prevents it from encroaching on and contaminating neighboring territories. The goal is not to obliterate religion, but to confine philosophy to what Hobbes regards as its proper domain, and thus to contain and purify both. He even suggests that philosophy (which, like René Descartes, he takes to reside confusedly within us) requires a method that keeps the contemplative order separate but parallel to the order of creation.[1]

Hobbes's characterizations of his project, reveal that his formal definition is designed to put Philosophy, and its practitioners, in their place. Philosophy is,

> such knowledge of effects or appearances, as we acquire by true ratiocination from the knowledge we have first of their causes or generation: And again of such causes and generations as may be from knowing their first effects. (EW I.2)

As Hobbes acknowledges afterward, this is a narrower definition than was typical of contemporaneous philosophers. It also equates natural reasoning with ratiocination, which Hobbes characterizes narrowly as computation, a mental composition and resolution of conceptual units which I discuss in the final section. Armed with his definition Hobbes deduces from it that the subject of philosophy is delimited to,

> every body of which we can conceive any generation, and which we may, by any consideration thereof, compare with other bodies, or which is capable of composition and resolution; that is to say, every body of whose generation or properties we can have any knowledge. (EW I.10)

Philosophy, and its activity of ratiocination, is thus confined to the domain of material things. Angels, being immaterial, are excluded, as is Theology, since God is unchanging and eternal. The narrowing of natural reasoning to computation also excludes subjects that rely on other forms of knowing from the domain of Philosophy. Hobbes thus rules history, revealed knowledge, doubtful doctrines like astrology, as well as the doctrine of God's worship out of bounds (EW I.10–11).

In sum, Hobbes places two constraints on philosophers that shape their method. First, he limits them to reasoning, which, equated with computation, brings in the second constraint. Such computation applies only to body, of which there are only two kinds: natural bodies, which are works of nature and the subject of natural philosophy, and the Commonwealth, an artificial body, made by the wills and agreement of humans, which is the subject of civil philosophy. To understand Hobbes's method for attaining a civil science that rests on true foundations, one must recognize that his natural philosophy encompasses both less and more than Scholastic natural philosophy and absorbs what we call STEM today. Chapter IX of the English edition of the *Leviathan* divides natural philosophy into knowledge of the consequences of the common accidents of bodies, and of the consequences of their qualities. The former is subdivided into First Philosophy,

Geometry, Arithmetic, Astronomy, Geography, Engineering, Architecture, and Navigation. The consequences of bodily qualities are studied by Physics, which is further subdivided into Sciography, Meteorology, Optics, Music, and Logic.[2] Unlike *De corpore*, the *Leviathan* places Ethics, and Astrology, Poetry, Rhetoric (all three of which *De corpore* excludes from Philosophy) plus what Hobbes calls "the science of the just and unjust" under Physics (2012, 130–1; 1651, 40–1). The *Leviathan* limits civil philosophy to knowledge of the consequences of "politic bodies" (2012, 130–1; 1651, 40–1) whereas *De corpore* further subdivides it into ethics, which treats of human dispositions and manners, and politics, "which takes cognizance of their civil duties" (EW I.11).

Regardless of which classification one follows, for Hobbes, natural philosophy consists in 1) knowledge of first principles, i.e., foundational definitions that provide the starting points for scientific demonstration (First Philosophy), 2) pure and applied mathematics, and 3) a varying collection of crafts useful to human life. Most Scholastics placed First Philosophy under metaphysics, and the rest either under pure and mixed mathematical sciences or under the arts.[3] Civil philosophy, for Hobbes, primarily concerns the commonwealth and the duties plus rights of its subjects. Ethics straddles natural and civil philosophy; insofar as it studies human manners and dispositions as qualities of human bodies it belongs to physics, insofar as it draws from them the rights and duties of subjects, it belongs to the new civil science. Contrary to our natural/normative divide, Hobbes places theoretical and practical philosophy on a continuum, with ethics in mid-range. Scholastic metaphysics, as the science of being *qua* being, and parts of Aristotelian natural philosophy that challenge theology, like the study of the first cause of motion, biology, and the soul (*qua* principle of life) have been purged.[4]

With the Empusa exorcised, philosophy confined to the study of body and traditional metaphysics firmly under religious control, Hobbes then broadens natural philosophy to include mathematical sciences. Thus the reach of philosophical ratiocination is extended to crafts, like mechanics and engineering, that renaissance philosophers had elevated to *scientiae*.[5] Like his contemporaries, Hobbes defines *scientia* as knowledge consisting in deductive proofs known as syllogisms. In the ideal type of scientific syllogism, which takes the form of *propter quid* demonstrations discussed in Aristotle's *Posterior Analytics*, one reasons deductively from a premise that identifies the cause or explanatory factor (typically a definition), to its effect or consequence. Aristotle developed rules for constructing logically valid syllogisms, which the beginning of *De corpore* like most contemporaneous textbooks, covers summarily. Hobbes follows textbooks that combine Aristotelian and Ramist logic, adding a chapter on Method to his Logic. There he makes the standard claim that the deduction of causes through valid syllogistic reasoning is what scientific knowledge aims at:

> The end of science [*scientia*] is the demonstration of the causes and generations of things; which if they be not in the definitions, they cannot be found in the conclusion of the first syllogism, that is made from those definitions; and if they be not in the first conclusion, they will not be found in any further conclusion deduced from that. (EW I.82)

In *Leviathan* Hobbes spells out how a methodical process of connecting names into propositions, and propositions into deductive proofs known as syllogisms, results in *scientia*. Reason, he says, is:

> attayned by Industry; first in apt imposing of Names; and secondly by getting a good and orderly Method in proceeding from the Elements, which are Names, to assertions made by Connexions of one of them to another; and so to Syllogisms, which are the Connexions of one Assertion to another, til we come to a knowledge of all the Consequences of names appertaining to the subject in hand; and that is it, men call SCIENCE. (2012, 72; 1651, 21)

When Hobbes claims to have inaugurated a *scientia civilis*, he means a body of conclusions about the commonwealth that can be deduced syllogistically from methodically attained premises that ultimately derive from definitions. Hence, though I will follow convention and translate "*scientia*" and the corresponding verb, "*scire*," as "scientific knowledge" and "to know scientifically," I do not thereby speak of experimental science in our sense. For other forms of knowing, which Hobbes labels *cognitio*, I employ the broader term "cognition."

1.2 Hobbes's Method for Scientific Knowing

With the domain of philosophical ratiocination clearly delimited, Hobbes in Chapter 6 of *De corpore* derives what every method has in common from his definition of Philosophy. This generic definition of method superficially echoes Scholastic views of scientific demonstration.

> Therefore, the *Method* of philosophizing is *the shortest investigation of the effect through causes having been cognized, or of the causes through the effect having been cognized*. We are then said to *know* a certain effect *scientifically* [*scire*] *when we both cognize its causes* [*and*] *that they are; and in which subject they inhere, and in which subject they introduce the effect, and in what manner they make it*. Thus, scientific knowledge is τοῦ διότι or of causes; every other cognition which is called τοῦ ὅτι is sense, or imagination or memory remaining from sense. (Hobbes 1999, 57–8; OL I.58–9, translations of this edition are mine)[6]

τοῦ διότι is Aristotle's term for *propter quid* demonstrations whereby effects/consequences are syllogistically deduced from causes/reasons. Methodical philosophizing thus produces *scientia*, i.e., valid causal syllogisms, in the shortest way possible. Hobbes signals that though the final demonstration will be *propter quid*, the methodical process of arriving at such proofs can take its starting point either from the cognition of causes and deduce their effects, or from the cognition of an effect, and deduce its (possible) causes.[7] The mere non-deductive cognition of something lies outside the domain of scientific knowledge although, as Hobbes highlights, ratiocination or computation must begin from the cognition we acquire by sensation that there is an object. Knowing the nature of its causes, that the causes exist, where they reside, and where/how they generate the effect, however, cannot be attained by experience alone. It requires syllogistic demonstration, which Hobbes regards as computation. Hobbes broadens *scientia* by applying scientific reasoning to the commonwealth, as well as natural bodies, thus yielding conclusions in practical philosophy that have the same status as knowledge of the natural world. But his *scientia* is narrower than our science since experiential forms of cognition, though they provide starting points for syllogisms, are not themselves part of scientific knowledge. The latter affirms prior Aristotelian views, the former breaks with it.[8]

Hobbes also replaces the starting points of syllogistic deductions typical of Scholastic scientific knowledge. Scholastic principles are universal claims about existing things known by means other than proof and consist in fundamental truths about the most general kinds of being. These include definitions of corporeal versus incorporeal substance that are further qualified to yield definitions of animate versus inanimate corporeal substances, and eternal versus finite incorporeal substances, and so on down the line. At each level, one can, taking the appropriate definition as one's first premise, then demonstrate *propter quid* the properties that are implied by the essence captured by the definition of that species of being. Accordingly, from the definition of a human being as a rational animal, one can infer that humans are both mortal and capable of understanding. From such properties contained in the essence of a human being one then deduces further effects. There were, naturally, many obstacles to doing this in practice as well as doubts raised about the accurate capturing of essences by definitions. However, in principle, one could, by syllogizing, eventually deduce a comprehensive, consistent structure of true conclusions about the natural world, all ultimately derived from the same first principles. Hobbes's characterizations of scientific knowledge and method signal that he retains this structure but rejects the existing foundation as untrue. Removing Scholastic metaphysics, and incorporeal substance from the domain of philosophy allows Hobbes to replace Scholastic definitions based on genera and species of substance with a "true foundation," consisting in definitions of geometrical objects.[9]

Hobbes further rejects Euclid's definitions of the simplest geometrical entities, like point and line, instead embracing genetic, or generative definitions given by Hero of Alexandria.[10] So, Hobbes not only proposes a different foundation from which syllogistic reasoning begins, but his foundational definitions or first principles are not standard Euclidean definitions, like the definition of a line as a breadthless length. Hobbes could be averting the criticism that the most basic Euclidean definitions do not capture the essential properties of geometrical entities. If Hobbes's foundational geometrical definitions correspond to essential features of bodies, as did the first principles of the Scholastic structure of scientific knowledge, then his move is to recast essences as procedures or recipes for the production of an object.[11] Following Hero, the proper definition of a geometrical object spells out how it is constructed: "a line is made by the motion of a point, superficies by the motion of a line, and one motion by another motion, & c" (EW I. 70–1). Based on such generative definitions, the passages quoted suggest that Hobbes regards scientific knowledge as a unified structure of conclusions ultimately deducible from generative definitions of geometry. As he outlines, one begins with lines or lengths generated from points in motion, and surfaces generated from long bodies – which once demonstrated, then allow one to construct definitions of the more complex phenomena of the science of motion, itself produced by the effects of one body's motion on other bodies. Next, the science of motion provides the starting points for demonstrating the phenomena of physics, which are produced by the motions of the parts of bodies, including our sense organs. Likewise, *De corpore* suggests that having arrived at definitions of human passions, we can progress all the way up to civil science. Hence demonstrative knowledge of all sciences, including politics, will necessarily be generated from geometrical foundations and form a unified whole.

Interpreting Hobbes's method as this kind of a generative construction fits one sense of "demonstration." When discussing the proper method of demonstration in teaching, which he holds to be the same as the method of discovery, Hobbes invokes the original sense that "demonstration" had in ancient geometry:

> that which the Greeks called ἀποδέιξις, and the Latins *demonstratio*, was understood by them for that sort only of ratiocination, in which, by the describing of certain lines and figures, they placed the thing they were to prove, as it were before men's eyes, which is properly ἀποδεικνύειν, or to *shew* by the figure; (EW I.86)

If scientific knowledge consists in demonstrations that prove effects from definitions specifying generative causes, in this geometrical sense of making objects visible (concretely or in the imagination) through construction, then Hobbes's hierarchical structure of knowledge appears as a successive placing before our eyes of ever more complex objects that are built up from previously shown objects, just as a square is constructed from four lines, and the lines, in turn, are drawn by moving a point.[12] The Commonwealth would sit at the pinnacle of this hierarchy, as the most complex object, built up of human bodies (themselves complex bodies generated by motions) whose passions and desire for peace make a social contract necessary. Two mechanical analogies suggest that Hobbes employs demonstration in this sense to methodically arrive at civil science. But since only artificial bodies of geometry and politics can be thus constructed this would imply that either physics lies outside of science, or Hobbes has distinct methods for theoretical and practical science.[13] I argue, instead, that Hobbes has one method, but not a constructive method in this sense.

Hobbes's use of mechanical analogies give the impression that civil science employs a method of mechanical construction at odds with method in physics. In *De cive*, Hobbes claims to have started from the matter of civil government "and thence proceeded to its generation and form, and the first beginning of justice. For everything is best understood by its constitutive causes" (EW II.xiv). Immediately thereafter he makes an analogy to a watch, which one must take apart to understand the matter, shape, and motion of the wheels. Similarly,

> so to make a more curious search into the rights of states and duties of subjects, it is necessary, I say, not to take them insunder, but yet that they be so considered as if they were dissolved; that is, that we rightly understand what the quality of human nature is, in what matters it is, in what not, fit to make up a civil government, and how men must be agreed amongst themselves that intend to grow up into a well-grounded state. (EW II.xiv)

In *Leviathan*, the Commonwealth or State is likened to an artificial person, which one can dissect into its component parts by analogy to the parts of an automaton. This analogy likewise suggests a kind of reverse-engineering methodology not possible with natural phenomena. Here too Hobbes employs Aristotelian notions of a form that is generated, and the matter, or constitutive causes, which once extracted through resolution, can then be recomposed in the correct way. A common interpretation equates Hobbes's reference to resolution in this passage with his method of analysis in *De corpore* and aligns the re-composition with synthesis. Next I show that analysis and synthesis in *De corpore* are not a material resolution and re-composition. Here I argue that these analogies are rhetorical.

The automaton analogy precedes Hobbes's description of the structure of his work, the *Leviathan*. He frames it in terms of the four causes familiar to his Aristotelian-schooled readers. First he treats of human beings, the matter, i.e., material cause, of this artificial body. Next, Hobbes invokes how the commonwealth is made by covenants, which to his readers would evoke its efficient cause. The last two sections of the book explain what a Christian commonwealth is and what the kingdom of darkness is, i.e., the final and formal causes (2012, 18; 1651, 2). Hobbes's automaton analogy is a rhetorical visualization for the organic structure of his work, informing readers that he will present his theory starting from material and efficient causes and concluding with final and formal causes of the Commonwealth. Just as he does not thereby commit himself to a method that employs Aristotelian causes, his mechanical analogies do not commit him to a method of geometrical construction. Indeed, Hobbes's *De corpore* clarifies that knowing scientifically is to syllogize from cause to effect.

The section that follows Hobbes's etymological tracing of "demonstration" back to the ancient Greek geometrical term reveals a different sense of "demonstration":

> It is proper to methodical demonstration, First, that there be a true succession of one reason to another, according to the rules of syllogizing delivered above.
>
> Secondly, that the premises of all syllogisms be demonstrated from the first definitions. (EW I.87)

The formal definition of "demonstration" Hobbes gives just before he invokes its ancient origins confirms that it is "a syllogism, or series of syllogisms, derived and continued, from the definitions of names, to the last conclusion" (EW I.86). Hobbes's recounting of the ancient geometrical sense of "demonstration" is thus a historical side bar to motivate putting geometry at the foundation of scientific knowledge by appeal to the ancients. Once geometry makes visible its foundational definitions, scientific reasoning proceeds syllogistically.

The rhetorical purposes of the watch and automaton analogies, combined with Hobbes's formal definitions of scientific knowledge and "demonstration" caution against taking mechanistic resolution and re-composition as Hobbes's method for civil science.[14] Nonetheless, *De corpore's* analogy between all definitions and geometrical ones reinforces the impression that Hobbes's method of demonstration is one of construction:

> But definitions of things, which may be understood to have some cause, must consist of such names as express the cause or manner of their generation, as when we define a circle to be a figure made by the circumduction of a straight line in a plane, & c. (EW I.81–2)

But Hobbes also affirms the Scholastic view that principles are indemonstrable, adding that there are no principles aside from definitions (EW I.80, 82). Properly speaking, definitions are *not* demonstrated; hence their generation is *not* scientific ratiocination or computation. So, though one might make visible the definitions of natural and civil philosophy in a way that parallels geometrical construction of a figure, this is only a demonstration in a loose, analogous sense. Hobbes's analogies thus do not support the bifurcation into a demonstrative method of construction in civil science *versus* the physicist's method.

With this confusion removed, can we now articulate a unified method that would legitimize Hobbes's claim to inaugurate a moral *science* based on the true foundations of natural philosophy? Even having restricted scientific knowledge derived from the primary geometrical definitions to Hobbes's narrow sense of *propter quid* demonstrations, this remains challenging. If the success of Hobbes's project rests on the capacity of his method to provide a true foundation of definitions or principles about universal causes from which, through a unified chain of syllogisms, ever more specific and complex effects are deduced, then it seems to fail. Notwithstanding that all scientific knowledge is knowledge of bodies, there are key differences between the aspects of body that each individual science takes as its object.

Natural philosophy scientifically knows what follows from the accidents of natural bodies whereas civil philosophy scientifically knows what follows from the accidents of the artificial body that is the commonwealth. Within natural philosophy, geometry, which lies at the base of the hierarchy in *De corpore*, takes as its object the accidents common to all bodies whereas physics takes as its object qualities, i.e., accidents of bodies as sensed by humans. This implies that the application of Hobbes's generic method varies with object. As scholars have long realized, Hobbes's actual procedure in physics differs from that of geometry and civil science since we are not privy to the underlying causes of the bodily qualities we sense.[15] In physics one cannot define a quality by mentally constructing it, as one does with the generative definition of a square or when one imagines a commonwealth coming into being. Rather one must begin from observed effects, like the reddish hue of the setting sun or the passion of joy we feel when we watch it, and reason hypothetically to their possible causes. Since physics lies in the middle of the hierarchy of scientific knowledge providing the bridge between geometry and practical philosophy, *if* one assumes that unity means the sciences present a unified content, via an axiomatic-deductive method whereby all their conclusions trace back through a seamless chain of deduction to the same foundational definitions, then the divergent methodical procedure necessitated by the objects of physics appears to disrupt the unity of the whole.

In the face of these problems, one can 1) deny that Hobbes maintains a unity of theoretical and practical philosophy or 2) affirm a looser unity by denying that it is conditioned upon an axiomatic-deductive method. Advocates of 2) present evidence of Hobbes's commitment to a non-deductivist unity. I draw on two recent views of this unity to propose a third. 2a) reads Hobbes's sciences as unified not by a systematic content ultimately deduced from first principles, but by a common "demonstrative" method analogous to the geometrical method of construction.[16] This strikes me as the correct strategy; however, though one finds procedures resembling constructions throughout Hobbes's works, they cannot, as per his formal definitions constitute *scientific* demonstrations. Hence though they loosely connect practical philosophy with geometrical procedures, they cannot account for a moral *science* in Hobbes's sense. 2a) also excludes physics from science. 2b) holds that Hobbes maintains the possibility of scientifically deducing a consistent body of theoretical and practical knowledge from first principles but includes alternative starting points and methods for non-philosophers to gain knowledge of practical philosophy.[17] This too is promising, but to the extent that there is one method, it is an ideal that does no work. In practice, Hobbes proceeds as though physics and politics are independent domains with their own methods.

Despite these problems, 2) is better supported than 1). Hobbes's view of scientific knowledge and generic definition of method point to one type of cognitive activity that constitutes scientific knowledge of all philosophical subjects. Regardless of whether one studies natural or artificial bodies, starts from cognitions of causes or effects, formal definitions or true cognitions attained by introspection, the process of methodical computation that charts the shortest route between causes and effects should be identical. This fits Hobbes's aim of inaugurating a civil *science* to exorcise the Scholastic philosophy Empusa. Absent a unity of method for science, the boundaries between practical philosophy and religion will blur as non-scientific forms of cognition can then be invoked to confuse the rights and duties of subjects. Hobbes's approach to identifying and removing the source of civil strife then falls apart. Hence overall 2) is the correct approach. I now draw on Hobbes's context to propose a third variation, 2c).

Key is recognizing that Hobbes's generic definition of method is just that. He next distinguishes method into what his contemporaries call universal method versus a method of proof for solving particular problems, known as particular method. Universal method was typically a preliminary hierarchical ordering of the concepts and definitions required for the discovery or teaching of knowledge of a subject, or both. It is distinct from method as a set of rules for scientific proofs, as found in Aristotle's *Posterior Analytics*.[18] Nonetheless, the two methods go hand in hand since universal method provides the systematic framework within which one generates different kinds of proofs by the particular method. This provides a third kind of unity for *all* scientific knowledge, rooted in method, with universal method providing a hierarchically ordered set of principles and definitions one requires as starting points for the deductive arguments one then makes in different domains to answer particular questions. Interpretation, 2c), allows for one computational activity that unifies all the sciences: namely, the rules of syllogistic reasoning for making valid *propter quid* demonstrations once one has the true principles, and applies the relevant definitions to the problem at hand. But to avoid willy-nilly attempts at deduction from any definitions, Hobbes's method includes a preliminary methodical resolution of ideas and orderly composition into definitions, starting from the simplest concepts of geometry. This ensures unity at the level of first principles and the definitions one is permitted to take as starting points for scientific demonstrations at each level of inquiry. 2c) has been overlooked because just as Hobbes uses "demonstration" equivocally, he characterizes both activities as "computation" and labels methodical procedures that make up both the ordering computation and the syllogizing computation as analysis and synthesis.[19] The two branches of method have thus been confused for one. I now disentangle them.

1.3 Analyses and Syntheses Reinterpreted in Context

The bifurcation of philosophical method into a universal ordering of subject matter and a particular method of demonstration was commonplace in the logic textbooks of Hobbes's intellectual context (Hattab 2014). Hobbes makes a similar distinction: "Philosophers either seek scientific knowledge [*Scientia*] simpliciter or indefinitely, that is, having posed no certain question, they [seek to] scientifically know as much as they can …" (Hobbes 1999, 59; OL I.60) in which case they employ a method that is strictly

resolutive and analytical to arrive at universal notions compoundable by synthesis into definitions; or they seek to scientifically know

> the cause of some certain phenomena, or to at least discover something certain, such as whatever would be the cause of *light*, *heat*, *heaviness*, *a proposed shape*, and similar things; or in which subject a certain proposed accident would inhere, or for the purpose of a certain effect which is proposed to be generated from many accidents, which [ones] would conduce most powerfully towards it; or in which manner for the producing of a certain effect, the proposed particular causes ought to be conjoined. On account of this variety of things sought, sometimes the Analytic method, sometimes the Synthetic, and sometimes both is to be summoned. (Hobbes 1999, 59; OL I.60–1)

Method aimed at unqualified knowledge uses resolution/analysis and composition/synthesis in the Scholastic sense to holistically know as much as possible about body. Here computation is conceptual ordering, which Scholastic contemporaries distinguish into "analysis" and "synthesis." Hobbes next turns to the method for answering specific questions about the causes and inherence of particular accidents of body, which may be analytic, synthetic or both, depending on the inquiry. But here he uses the Scholastic terms pertaining to the ordering method for another set of operations, including syllogistic deductions. The second branch of his method gives Hobbes the flexibility to tailor the procedure for the shortest route between causes/explanations and effects/consequences to the context of inquiry. But Hobbes misleadingly uses "analysis" versus "synthesis" plus their derivatives to label procedures that take distinct forms in the particular method. I will thus refer to its operations as analysis2 and synthesis2.[20]

At root, analysis and synthesis, the basic operations of philosophical reckoning, are for Hobbes akin to mathematical subtraction and addition, respectively. Recall that he separates scientific knowledge from experience. Experience consists in sensing or remembering that there is something but cannot yield a causal explanation of it. Hobbes's example is that I see something approaching me and as it gets closer my senses detect a certain shape and motion. All I know by experiential cognition is that this thing exists; I don't know what it is and what its causes are. For that I require computation, which begins with something like subtraction, the mental operation of resolution or analysis. As when we subtract one number from another, analysis in the universal method separates out distinct features from the individual nature that encompasses them to arrive at the simple components of things – the elements. This happens in stages. As a person approaches me, I first separate out body from my perception of the individual, then the property of being animated, and finally rational, in the order of most universal to least[21] (EW I.4). For Hobbes these elements are not physical parts of a thing – resolution is not the mechanistic reduction of a watch or automaton into its component parts (EW I.67). Nor need the elements be linguistic entities, since we can ratiocinate without words (EW I.14). Analysis is a step by step conceptual separating out of general features, contained in an individual concept, from the concept as a whole (EW I.4–5).[22]

Hobbes later gives two examples to illustrate the strictly analytical method that yields the universal notions we need to attain unqualified knowledge of things. Both begin with an idea, from experience, as when we see something approaching, but now resolved from less general to more:

1) My idea of this square is resolved or analyzed into "plain, terminated with a certain number of equal and straight lines and right angles." I can then resolve or analyze these concepts further into the properties common to all material objects: "line," "plane," "angle," "straightness."
2) My conception of gold is resolved into ideas of "solid," "visible," "heavy," I can then further resolve or analyze these ideas into successively more general ones, like "extension" and "corporeity" until I arrive at the most general one: motion.

Once you have analyzed down to the most general, also the simplest, conceptual elements of your ideas you will have the causes of individual concepts of a square and gold. Hobbes's use of the term "cause" suggests that the resolution of gold is a mechanistic reduction into the physical parts of gold. For how can concepts *cause* our ideas? However, Hobbes uses "cause" in the Aristotelian sense of one or more explanatory factors, since he also claims that the causes of concrete names like "body" are abstract names like "extension."

The explanatory factors attained by resolution are common accidents of natural and artificial bodies. Recall that such accidents are the object of scientific knowledge for Hobbes. He explains:

> but we seek this itself, *what is an accident?* in which we seek that which we understand and not that which we should seek. For who does not always and in the same manner understand him who says any thing is extended, or moved, or not moved? But most men will have it be said that *an accident is something*, namely some part of natural things, when, indeed, it is no part of them. To satisfy these men, as well as may be, they answer best that define an *accident* to be *the manner by which any body is conceived;* which is all one and the same as if they should say, *an accident is that faculty of any body, by which it works in us a conception of itself*. (Hobbes 1999, 83; OL I.91)

An accident is not a real thing in the broad Scholastic sense of a *res*, which differs from substance in that it can only naturally exist by inhering in a substance. Rather accidents are the ways in which we conceive of bodies, as well as the faculties bodies possess to cause us to conceive of them in certain ways, e.g., our conception of a moving body plus the power of a body to cause us to sense motion. Basic accidents, like motion, need not be defined since everyone understands them. Hobbes refers to these self-evident ways of conceiving of bodies as "universals," "universal notions," and "simples," despite denying that universals have any existence beyond the names we apply to groups of individuals. Through definitions we acquire "an universal notion of the thing defined, representing a certain universal picture thereof, not to the eye, but to the mind"[23] (EW I.84). Definitions are thus key to the universal claims of science.

According to Hobbes, based on similarities among individual ideas, we signify common accidents with abstract names or universals, e.g., "extension" for similar sensations of bodies being extended, and "corporeity" for similar ideas of existing corporeal things. As long as we do not consider abstractions like extension and corporeity as existing apart from bodies, abstract names are used correctly and are the only means by which we can reason philosophically. Hence, just as we can analyze our concept of an individual square, piece of gold, and person into their conceptual parts, we can analyze the concrete name "body" into abstract names corresponding to the conceptual elements of the

idea for which the name is a sign. For example, being extended is an accident we can subtract from our idea of an individual body. The corresponding abstract name "extension" is through resolution identified as a cause/explanation of the concrete name "body." That does not mean abstract extension is thereby reified; it is not something over and above the idea of particular bodies being extended. Nor is extension the cause of the bodies themselves. The abstract name "extension" is an explanatory factor that is revealed when we resolve the idea signified by the concrete name "body." Concrete names resolved into abstract names give us definitions. When a word stands for a compounded conception, like a person, a square or gold, rather than a simple conception, like motion,

> the definition is nothing but a resolution of that name into its most universal parts. As when we define man, saying *man is a body animated, sentient, rational*, those names, *body animated, & c.* are parts of that whole name *man*; (EW I.83)

But how does such an analysis into abstract terms, which combine to form definitional propositions, explain persons in the world, as experienced by us?

Since accidents are both the manner in which we conceive bodies, and the faculties by which bodies produce these conceptions in us, explanations of names obtained by resolution map on to bodily powers via the conceptual parts of ideas to which abstract names attach.[24] The strictly analytical method gives us the definitions of things by separating out the conceptual parts, or explanatory factors that make up our complex ideas of individuals. That is, the abstract name "humanity" is a sign for a conception of an individual body that can be resolved into accidents of being animated and being rational. Via similarity to past ideas of such bodies the abstract names of "animality" and "rationality" attach to these conceptual parts. This allows us to compound these names into propositions, including universal ones like "Every human is a rational animal." Hobbes claims that, without words, specifically, abstract names that stand as markers to remind us of past ideas of similar individuals, "our inventions perish, nor will it be possible for us to go on from principles beyond a syllogism or two, by reason of the weakness of the memory" (EW I.79). Employing the universal method, one combines abstract names into propositions by synthesis.

The particular method is instead a method of demonstration in which one employs synthesis2 to connect propositions by the rules for a valid syllogism. For example, from one's definition of humanity one can deduce a consequence of rationality that is fundamental to civil science:

> All human beings are rational animals.
> Rationality includes the capacity to make compacts.
> Therefore, human beings have the capacity to make compacts.

Hobbes ambiguously uses the terms "computation" and "synthesis" for both the process of methodically compounding the results of strict analysis into definitions, as well as the deductions by which we later connect propositions into syllogisms to answer particular questions. However, properly speaking, scientific knowledge involves syllogistic computation. The analysis and synthesis by which one arrives at definitions is preparatory to natural and moral science. The main feature of universal method for unqualified scientific knowledge is that the analysis of ideas/concrete names and combination of conceptual

elements into definitions must proceed in the correct order, so that we resolve step by step from the most complex and particular, to the simplest and most universal ones until we arrive at the most universal explanatory factor signified by the abstract term "motion." We then synthesize definitions following the reverse order. Provided we know where on this hierarchy the definitions relevant to a particular inquiry are located, we can take short cuts when applying particular method.[25] The hierarchically ordered definitions attained by Hobbes's method for unqualified scientific knowledge supply the principles one deduces from in particular method. The latter can be analytic2, synthetic2 or a combination of both. In the methodical pursuit of particular scientific inquiries, computation is not the generation of ordered definitions that follows analysis into universal notions but fits Hobbes's identification of scientific knowledge with deductive reasoning.

This is clear from Hobbes's example of using analysis2 and synthesis2 to inquire after the subject of an accident.[26] The question is: In what subject is the splendor and apparent magnitude of the sun? The methodical steps are:

1) Analysis2: matter in general [*materia universa*] is divided into parts, e.g., object, medium and sentient or "by some other division which seems most suitable to the proposed matter [*rem*]" (EW I.76).
2) Synthesis2: "Next, the individual parts are to be examined according to the definition of the subject; and those which are not capable of those accidents are to be rejected" (EW I.76).
    i) For example, we rule out the body of the sun as the subject by discovering that the sun is greater than its apparent magnitude and hence that magnitude is not in the sun; we discover this through knowledge of optics:
    ii) "if the sun be in one determined straight line, and one determined distance, and the magnitude and splendor be seen in more lines and distances than one, as it is in reflection and refraction, then neither that splendour nor apparent magnitude are in the sun itself, and, therefore, the body of the sun cannot be the subject of that splendour and magnitude" (EW I.76).
    iii) We rule out the air and other parts by the same reasons until we are left with the sentient as the subject of the splendor of the sun.

Synthesis2 is not an aggregation of concepts/names into definitions but a methodical use of prior definitions that universal method orders as more basic (like principles of optics) and other bits of prior knowledge to narrow down possibilities and deduce the correct conclusion.[27] Physicists may require observations to exclude some possibilities whereas geometers or civil scientists may employ constructions and thought experiments before making deductions. These are differences in application, not in the essence of the particular method.

1.4 Conclusion

In this chapter, I have argued that Hobbes's philosophical method is integral to his project of separating philosophy and religion so as to put morals on a true scientific foundation. I have clarified what Hobbes means by "science," "method," and

"demonstration," showing that the common attribution of a mechanistic method of resolution to Hobbes is incorrect. Building on recent views regarding whether Hobbes has a unified method for theoretical and practical philosophy I add to available interpretations by drawing on Hobbes's context. Like contemporaneous methods, Hobbes's method comprises a universal and a particular method. This distinction sheds light on how analysis and synthesis function in each branch of Hobbes's method in a way that serves to unify and place both theoretical and practical philosophy on a scientific basis.

Notes

1 Hobbes exhorts those with a sincere desire to be philosophers to "let your reason move upon the deep of your own cogitations and experience; those things that lie in confusion must be set asunder, distinguished, and every one stamped with its own name set in order; that is to say your method must resemble that of the creation. The order of the creation was, *light*, *distinction of day and night*, the *firmament*, the *luminaries*, *sensible creatures*, *man*; and after the creation, the *commandment*. Therefore, the order of contemplation will be, *reason*, *definition*, *space*, *the stars*, *sensible quality*, *man;* and after man is grown up, *subjection to command*" (EW I. xiii).

Hobbes echoes the appeal to two parallel, but separate, sources of insight into truth prevalent in seventeenth-century Calvinist Scholastic textbooks and Francis Bacon's work: the book of nature and Holy Scripture. Schmidt-Biggemann explains that for seventeenth-century Calvinist Scholastics, "Knowledge was understood as an inventory of the Revelation made available to humankind, as knowledge found in the Bible, History, and Nature. These three 'books' were the field of experience which according to God's creation plan is inventoried in knowledge" (Schmidt-Biggemann 2001, 394; translation mine).

2 Meteorology, Optics, and Music were all mixed mathematical sciences in the Scholastic tradition; logic was considered the instrument of philosophy, not part of natural philosophy proper.

3 See Hattab (2009, 93–8).

4 Hobbes's division most resembles that of early seventeenth-century Calvinist Scholastic textbooks in which "The framework of metaphysics was theological, not the other way around. Hence one counted metaphysical concepts within natural theology and in this way, natural philosophy and metaphysics were made broadly coextensive" (Schmidt-Biggemann 2001, 394, translation mine). For Hobbes, likewise, topics of traditional Aristotelian metaphysics, like the first cause, its eternity, and the immortality of the soul are relegated to Theology. Remaining metaphysical topics, like the nature of substance, its accidents and causation are absorbed into natural philosophy under Hobbes's First Philosophy.

5 Alessandro Piccolomini and subsequent Aristotelian mathematicians reclassified mechanics, the art of machines, which was traditionally considered a craft, as a mixed mathematical science (Hattab 2009, 93–8). Marcus Adams discusses Hobbes's treatment of physics as a mixed mathematical science, which following the Aristotelian tradition of such sciences, borrows its principles from the more fundamental science of geometry, and applies them to nature to deduce physical effects (Adams 2017, 84–6). This is also the sense in which Descartes considers his natural philosophy mathematical and mechanical and appears to be a common thread in the so-called early modern "mechanists" (Hattab 2009, 120–35, 2019).

6 The English edition misleads since it mistranslates *cognitio* with "science" in the last sentence, falsely implying that Hobbes counts experience as scientific knowledge: "But we are

then said to know any Effect, when we know, *that there be Causes of the same, and in what Subiect those Causes are, and in what Subiect they produce that Effect, and in what Manner they work the same*. And this is the Science of Causes, or as they call it of the διότι. All other science, which is called the ὅτι, is either Perception by Sense, or the Imagination, or Memory remaining after such Perception" (EW I.48–9).

7 This aspect of the generic method generates a persistent misreading of Hobbes's specific method of analysis as akin to the first phase of Jacopo Zabarella's *regressus*, which further gets conflated with a different sense of method in which Zabarella appeals to analysis. For example, see Hanson (1990, 587–626), MacPherson (1968, 25–9), Röd (1970, 10–15), Hungerland and Vick (1981, 25–7), Watkins (1973, 63–5), and Duncan (2003). J. Prins demonstrates how differences between Hobbes's and Zabarella's views on logic affect their views on method and scientific knowledge (Prins 1990, 26–46). Jesseph revised his view noting that any number of extant views on analysis and synthesis could have influenced Hobbes's (Jesseph 2004, 191–211). I show that the *regressus*, a proof enabling one to deduce a possible natural cause from observed effects, and then in turn, deduce that the possible cause is the actual cause of the natural effect, does not map onto Hobbes's method. Linking the two stems from substantive confusions between the *regressus* and what Zabarella calls "method as order." Zabarella only discusses "analysis" in the context of method as order. Wherever Hobbes gets this label, his sense of "analysis" is unrelated to the *regressus* and closer to later Scholastics uses than Zabarella's (Hattab 2014).

8 Most Scholastic Aristotelians accept Aristotle's claim at the start of *Nicomachean Ethics* that practical matters do not allow for the same precision as theoretical matters and hence require a distinct method (Aristotle 1984, 1730).

9 Zabarella notes, when we define mathematical entities, our definitions are advanced as principles "since they are heard and understood at the same time, and are known *per se*" (Zabarella 1597, 159). This is because things like "line" and "surface" are simple accidents, so the declaration of merely the word suffices to signify the essence. In other words, in mathematics, nominal and essential definitions of the object coincide; thus, in mathematics, one has a perfect definition once one obtains a nominal definition. This view was shared by seventeenth-century mathematicians, like the Jesuit Josephus Blancanus, who claims that most mathematical definitions bear the advantage of being both nominal and essential definitions: "when it is said that an equilateral triangle is one having three equal sides, at once you see the cause for both the name and the thing" (Blancanus 1996,181). Blancanus's work is cited in Marin Mersenne's early publications, making it likely that Hobbes was exposed to Blancanus's mathematical theory, via the Mersenne Circle. On this theory, definitions of mathematical objects carry the distinct advantage that their names concurrently tell you how the object is caused.

10 As Karl Schuhmann points out, both Hobbes and Spinoza appear to adopt Hero of Alexandria's generative approach to defining geometrical objects (Schuhmann 1987, 72).

11 Marcus Adams, following Pérez-Ramos, calls this "maker's knowledge" and argues that it constitutes the causal knowledge of *scientia* for Hobbes. On his interpretation, Hobbes's commitment to maker's knowledge accounts for why geometry and civil science are the only instances of science for Hobbes (Adams 2019, 2). Since both the geometer and the political philosopher construct their actual object, the same procedure can be applied in these domains, a procedure not available to the physicist who studies objects generated by natural processes.

12 Oddly, Hobbes's example to reveal the parts into which we resolve our conception of the individual nature of a square does not indicate that these parts would combine to generate the square in the same manner. "Plane" and "line" do not generate a square in the way a

point in motion generates a line. The same can be said of the definition of a triangle that Hobbes introduces in *De corpore*, I, vi.11 and again in *Leviathan* chapter 4 (2012, 54; 1651, 14). Adams (2014, 55–8) proposes a possible explanation for these two different kinds of definitions.

13 Adams gives the strongest defense of the first implied possibility, arguing that the simple conceptions at the foundation of both natural and political philosophy enable an ensuing construction in both that can be thought of as a demonstration, in the sense that Hobbes regards the construction of a geometrical figure, like a square, from its elements as a "demonstration." Adams concludes, "The structure, in civil philosophy and geometry, of thought experiment, definition by explication, and generative definitions allows Hobbes to see himself as providing a demonstration by synthesis in both cases" (Adams 2019, 19). Physics, which does not admit of this kind of geometrical demonstration, lies outside *scientia*. However, Adams also defends the view that physics counts as a science for Hobbes in the Aristotelian sense of a mixed mathematical science (Adams 2017, 84–6). Others embrace the second possibility pointing to inconsistencies in Hobbes's texts (see Sorell 1999).

14 Moreover, seventeenth-century works were rife with analogies between the natural world and machines. As I show in Hattab (2011), they often did not signal a commitment to what we mean by mechanistic explanations. For different seventeenth century senses of "mechanics" and "mechanical demonstration," see also Gabbey (1993) and Hattab (2019).

15 Sorell sums up the apparent tensions within Hobbes's texts (1999, 5–7, 14–15), and Adams (2014, 4–6) gives a good overview of the two previous main lines of interpretation, which he calls the "deductivist" and the "disjoint" accounts – neither resolves the tensions. Sorell's solution is to argue that civil science can be autonomous, resting solely on experiential foundations: "There is a philosophical or scientific understanding of the motions of the mind, arrived at from a prior acquaintance with principles given in physics. There is also a pre-scientific understanding, available to anyone who bothers to introspect and observe within himself the passions that move him" (Sorell 1999, 7). Adams is more sensitive to the fact that merely arriving at the same insights through alternative means does not qualify the result as *scientia* since a certain methodical procedure is integral to Hobbes's view of scientific knowledge. Adams argues that natural and civil philosophy are unified, on the one hand, by a common method, borrowed from geometry, for constructing their definitions, and on the other, in that each science borrows its principles from more fundamental science in the way that Aristotelian mixed mathematical sciences relied on the principles of pure mathematics (Adams 2014, 6–7).

16 Adams advances 2a) in combination with a looser structural unity than strict deductivism.

17 Sorell advocates 2b) arguing for "the autonomy thesis" (Sorell 1999, 7–13). Adams agrees that Hobbes is not committed to the idea that, for every context of inquiry, the same foundational principles constitute the absolute starting points for a hierarchically ordered series of deductions in each branch of philosophy: "if we understand Hobbes as holding that the simples for a science are determined by our explanatory needs – a materialism that does not privilege a single level for explanations – then we can understand why Hobbes grounds civil relations in human bodies apart from civil relations" (Adams 2019, 20). However, Adams also advocates 2a) arguing that the simple conceptions at the foundation of first philosophy and civil science are attained by a common method of thought experiments following fixed steps (Adams 2019, 19).

18 For example, Zabarella's seminal writings on logic divide method, taken broadly, into order and method properly speaking. The task of method in the proper sense is to lead us from a known thing to knowledge of another, unknown thing, as when we are led from substantial change to knowledge of prime matter or, from eternal motion to knowledge of an eternal

unmoved mover. By contrast, method as order does not cause us to infer one thing from another, but rather arranges (*disponere*) the things to be treated, as when the order of teaching demands that we first discuss the heavens and then the elements. It arranges the parts of a discipline. Order takes precedence because one must divide a discipline into parts, before one can articulate the method that will lead us from the known to the unknown that is sought within each part (Zabarella 1597, Vol. I, 139). Scholastic Protestant philosophers, known as systematics, took up Zabarella's teachings to develop a middle path between Aristotelian and Ramist systems of logic. Bartholomaeus Keckermann and Franco Burgersdijk wrote logic texts in this tradition that were influential in England at the time Hobbes wrote the first part of *De corpore*. They make the same distinction between universal and particular method as Zabarella (Burgersdijk 1626, 380; Keckermann 1613, 578–9). Burgersdijk, like Hobbes, claims that the order of discovery is the same as the order of teaching (Burgersdijk 1626, 380–1).

19 Sorell notes of analysis and synthesis "Neither method trades on specialized knowledge" and describes what Hobbes does in *Elements of Law* and *Leviathan* as follows: "One way in which the doctrine is supposed to improve on what we know already, is by imposing an order on it. From a mass of moral lore, common sense psychology, rudimentary information about law and the average citizen's knowledge of which people in the state hold offices of authority, Hobbes purports to sift out what is basic and what is not, what has to be known before other things are known … Relations of dependence are thus revealed between truths that might otherwise seem on the level" (Sorell 1999, 11). He then adds: "But deductive or demonstrative order is not the whole story" (Sorell 1999, 12). Sorell recognizes that the purpose of analysis and synthesis is to order knowledge but reconstructs the rest of the story differently than I do. Adams likewise identifies two different levels at which Hobbes unifies sciences but takes as central a method of construction that enables the explanations one finds in the mixed mathematical sciences (Adams 2014, 7).

20 A third sense of analysis and synthesis found in logistica, Hobbes's geometrical method, lies outside the scope of philosophical method. William Sacksteder and Richard Talaska concur that, for Hobbes, analysis and synthesis do not function, in philosophy, as they do in geometry. Philosophical propositions arrived at, through analysis, are not, as in geometry, convertible in the corresponding synthesis (Sacksteder 1980, 131–46; 1988, 643–7; Talaska 1988, 207–37).

21 Keckermann and Burgersdijk likewise take the natural order to be one where what is most universal is both prior by nature and prior to us (Burgersdijk 1626, 380; Keckermann 1613, 582–3).

22 As Adams (2019) shows, one may have to employ thought experiments to get at the most universal features of all.

23 It is odd that Hobbes speaks of "universal notions" and "pictures" since universals appear to be neither real things nor abstract general ideas. He writes, "when a *living creature, a stone, a spirit*, or any other thing is said to be *universal*, it is not to be understood that any man, stone, & c. ever was or can be universal, but only that these words, *living creature, stone, & c.* are *universal names*, that is, names common to many things; and the conceptions answering them in our mind, are the images and phantasms of several living creatures or other things" (EW I.20). Such universal notions or pictures could consist in several particular ideas that we link to each other and to an abstract name.

24 Hobbes seems to assume that our universal notions mirror the underlying faculties of real things. He shares this assumption with the Portuguese Jesuit philosopher, Pedro da Fonseca, and early seventeenth-century German Scholastics influenced by Fonseca's metaphysics. Walter Sparn observes of the latter, "Their approach assumes ontologically that *subtilitas*

[acuteness/mental penetration] is suited to experienced things, i.e., there is kinship and internal reference to God, both among things and in relation to the human intellect, by virtue of which they [things] exist in it [the human intellect] as especially representable and abstractable into general concepts. In this manner, the first principles of their knowledge can be drawn from the proportional being of things" (Sparn 2001, 481, translation mine).

25 Notably, Hobbes claims that in moral science, instead of proceeding from the definitions of human will and passions obtained in physics, we can directly resolve our conception of an unjust action into "*fact against law*" and the notion of law into "the *command* of him or them that have *coercive power*" (EW I.74). Power will be further resolvable into the wills and passions of humans constituting the power, but these can be cognized by experience rather than demonstrated from the principles of physics. Hobbes also uses thought experiments to get clear on basic concepts, like space, possibly because simples are not resolvable. Adams draws an interesting parallel between the annihilation thought experiment in *De corpore* and the state of nature device to reveal the concept of equality (Adams 2019, 9–11).

26 It is, admittedly, less clear how one would deduce natural laws using this particular method. This requires more research.

27 Nor is analysis2 a resolution into universal notions since a medium and sentient body are both more specific than matter in general. However, it loosely resembles strict analysis in that it distinguishes something complex into parts.

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