

JOURNAL OF INTERDISCIPLINARY HISTORY OF IDEAS



2020

Volume 9 Issue 18

Item 4

– Section 2: Articles –

Epidemics, Regulations, and Aristotle's Physics of Motion

A Ballistic Perspective on a Current Debate

by

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JIHI 2020

Volume 9 Issue 18

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Epidemics, Regulations, and Aristotle's Physics of Motion

A Ballistic Perspective on a Current Debate

Alessia Pannese *

The current polarization in public debate surrounding governmental regulatory responses to the Covid-19 pandemic is often portrayed as conflict between individual freedom and state control. A recurrent trope has been the likening of regulation in response to the Covid-19 pandemic to the condition described in Thomas Hobbes's Leviathan, where citizens forego their individual freedom in exchange for protection by a mighty sovereign. In this sense, regulations introduced in response to the current pandemic have been viewed as threatening to expand state power and limit individual freedom. Whilst recognizing that epidemic-related regulations raise issues of state control and individual freedom, and hence resonate with Hobbes's political theory, here I suggest that the polarization in this public debate also subtends epistemic uncertainty, and struggle over the locus of authority for knowledge and the relation of knowledge to action. In this respect, Hobbes is relevant to the current pandemic-debate also (and perhaps most significantly) for his reflection on human knowledge and action. Elements of Hobbes's understanding of knowledge, as well as of the relation between knowledge and action, imply casting the human intellect in physical terms, and in particular in terms compatible with the Aristotelian physics of natural motion. I then bring this historical point to bear upon the current debate surrounding the Covid-19 pandemic, to suggest that the Hobbesian physics-inflected account of knowledge may offer a relevant—perhaps speculative, yet conceptually grounded and historically informed—perspective from which to reflect upon and responsibly assess, (dis)approve of, comply with, or challenge epidemic-related regulations.

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1 THE DEBATE about the current Covid-19 pandemic¹—in particular about the instrumental value, moral justification, and broader implications of regulatory action taken by governments across the globe in response to it, be it restrictions on movement, limitations on social interaction, tracking, surveillance, or any other form of control—tends to gravitate around two poles. Critics of lockdown and similar drastic policies see them as producing devastating effects on short- and long-term public health, including fewer cancer screenings, poorer cardiovascular disease outcomes, deteriorating mental health, and overall greater excess mortality, and preconise instead containment strategies that aim for the achievement of herd immunity.² At the opposite end, critics of herd immunity condemn its unreliability and dangerousness,³ and recommend policymakers take drastic containment measures urgently,⁴ given the virus’s high infectivity⁵ and fatality rate,⁶ the uncertainty about the duration of protective immunity⁷ and the frequency of re-infection,⁸ and the increasing evidence for cases of persisting illness after apparent clinical recovery.⁹

¹COronaVirus Disease 2019, the causative agent of which is the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). At the time of writing, the World Health Organization reports over 90 million confirmed cases, including two million deaths (<https://covid19.who.int/>).

²See for example the so-called “Great Barrington Declaration”, issued on Oct. 4 2020 (<https://gbdeclaration.org/>), which recommends policymakers focus protective measures on high-risk individuals, whilst easing restrictions on low-risk groups (with the aim to have them reach herd immunity through natural infection).

³See for example the so-called “John Snow Memorandum” (<https://www.johnsnowmemo.com/>).

⁴Nisreen A. Alwan *et al.*, “Scientific Consensus on the COVID-19 Pandemic: We Need to Act Now”, *The Lancet* 396, no. 10260 (October 31, 2020): E71-E72.

⁵Xingjie Hao, Shanshan Cheng, Degang Wu, Tangchun Wu, Xihong Lin, Chaolong Wang, “Reconstruction of the Full Transmission Dynamics of COVID-19 in Wuhan”, *Nature* 584, no. 7821 (August 2020): 420-24.

⁶Robert Verity *et al.*, “Estimates of the Severity of Coronavirus Disease 2019: A Model-Based Analysis”, *The Lancet Infectious Diseases* 20, no. 6 (June 2020): 669-77.

⁷Yuxin Chen *et al.*, “A Comprehensive, Longitudinal Analysis of Humoral Responses Specific to Four Recombinant Antigens of SARS-CoV-2 in Severe and Non-Severe COVID-19 Patients”, *PLOS Pathogens* 16, no. 9 (September 10, 2020): e1008796.

⁸Jane Parry, “Covid-19: Hong Kong Scientists Report First Confirmed Case of Reinfection”, *British Medical Journal* 370 (August 26, 2020): m3340.

⁹“Long COVID: Let Patients Help Define Long-Lasting COVID Symptoms” (editorial), *Nature* 586, no. 7828 (October 7, 2020): 170.

The debate between supporters of drastic regulation (e.g. those who advocate for lockdown and similar heavy interventions) and opponents (e.g. those who advocate for herd immunity) has often been portrayed as conflict between individual freedom and state control. Accordingly, one of the recurrent tropes in the (mostly conservative,¹ but also liberal²) Covid-19-related press and scholarship³ has been the likening of regulation in response to the present-day pandemic to the condition described in Thomas Hobbes's (1588-1679) political treatise *Leviathan*. In *Leviathan*, first published in 1651, Hobbes addresses the question of legitimate political governance, and argues for a social contract whereby an absolute sovereign rules upon citizens who willingly accept the restrictions imposed by the mighty state in exchange for protection. Hobbes's theory is predicated upon a view of human nature as inherently self-centred and conflictual, and of strong government as the only effective defence against the brute state of nature—that is, the war of all against all, where

there is no place for industry; because the fruit thereof is uncertain: and consequently no Culture of the Earth; no Navigations, nor use of the commodities that may be imported by Sea; no commodious Building; no Instruments of moving (...); no account of Time; no Arts; no Letters; no Society; and which is worst of all, continual fear, and danger of violent death; and the life of man, solitary, poor, nasty, brutish, and short.⁴

¹James Pinkerton, "With Coronavirus Comes the Hobbesian Leviathan", *The American Conservative*, 25 March 2020; Kevin D. Williamson, "The Coronavirus Will Be Leviathan's Enabler", *National Review*, 16 April 2020; Parsa Venkateshwar Rao Jr., "Return of the Leviathan? Argument for a strong state in the wake of Covid-19 is not morally persuasive", *Times of India*, 28 April 2020; John Horvat, "The Stunning Triumph of Thomas Hobbes in the COVID Crisis", *The Imaginative Conservative*, 16 August 2020.

²David Runciman, "Coronavirus Has Not Suspended Politics—It Has Revealed the Nature of Power", *The Guardian*, 27 March 2020; Bill Jordan, "COVID-19 versus Leviathan", *Centre for Welfare Reform*, 6 April 2020; "What would Hobbes say about the pandemic?", *The Washington Post*, 18 May 2020; Lea Ypi, "A Crisis of the Social Contract", *New Statesman* 149, (3-9 July 2020): 13-14.

³Calum Paton, "Insouciance and Inexperience: A Deadly Combination When Dealing with COVID-19", *The International Journal of Health Planning and Management* 35, no. 5 (September 2020): 983-87; Antony Bryant, "What the Web Has Wrought", *Informatics* 7, no. 2 (2020): 15; Marshall W. Meyer, "COVID Lockdowns, Social Distancing, and Fatal Car Crashes: More Deaths on Hobbesian Highways?", *Cambridge Journal of Evidence-Based Policing* 4 (December 21, 2020): 238-59. For an ironic take see Eileen Hunt Botting, "A Novel (Coronavirus) Reading of Hobbes's *Leviathan*", *History of European Ideas* 47, no. 1 (2020): 33-37.

⁴Thomas Hobbes, *Leviathan*, ed. J.C.A. Gaskin (Oxford: Oxford UP, 1996), 1, 13, §9; 84.

All this resonates powerfully with the current devastating effects on industry, transportation, arts and culture, as well as with the fear of death, that have characterised the past year, as the world has contended with the Covid-19 outbreak, and with the regulations put in place in response to it. In Hobbes's argument, acceptance of, and submission to sovereign-imposed limitations of individual freedom is part of a grand bargain to save the individual from the threat of a "solitary, poor, nasty, brutish, and short" life. Modern-day critics of regulation have contended that such bargain may not be as good a deal as Hobbes portrayed it to be: in the long run, the surrender of individual freedom in exchange for protection tends to be exacerbated, as, in times of crisis (e.g. wars, epidemics), individuals become willing to accept higher degrees of state-control under the illusion of the exceptional and temporary nature of such concession, never actually to recover the previous level of freedom.¹ In this respect, as the current Covid-19 pandemic constitutes a time of crisis, any regulations introduced as a temporary measure may be viewed as threatening to expand state power and limit individual freedom lastingly. In this vein, it has been argued that "when the conditions are right, epidemics can potentially create a medical version of the Hobbesian nightmare—the war of all against all",² and that "the COVID-19 disaster represents the triumph of the Leviathan nightmare".³



Whilst recognizing the pertinence of these observations, and the suitability of framing the opposition between supporters of regulation (e.g. those who advocate for lockdown and other drastic interventions) and their opponents (e.g.

¹Robert Higgs, *Crisis and Leviathan: Critical Episodes in the Growth of American Government* (New York: Oxford UP, 1987).

²Philip Strong, "Epidemic Psychology: A Model", *Sociology of Health & Illness* 12, no. 3 (1990): 249.

³John Horvat, "The Stunning Triumph of Thomas Hobbes in the COVID Crisis", *The Imaginative Conservative*, 16 August 2020.

those who advocate for herd immunity) in terms of struggle between state control and individual freedom, here I shift the focus on a different—and perhaps more critical and far-reaching—aspect of Hobbes’s relevance to the current debate on epidemics and regulations. Instead of focusing on the issue of freedom and control, I would like to suggest that the polarization in public debate surrounding governmental regulatory responses to the Covid-19 pandemic offers an opportunity to reflect upon the locus of authority for knowledge, and the relation of knowledge to action.

Along with freedom, knowledge is required for a person to be morally responsible.¹ Reflecting on the nature of knowledge and its relation to action is crucial in the current pandemic context because the dichotomy between criticism of regulations (e.g. advocates for herd immunity) and its defence (e.g. supporters of lockdown) permeates not only political and lay discourse but also specialist debate, fuelling public antagonism amongst experts within the scientific community. Taking a responsible stance under these circumstances—be it ideological (e.g. supporting or disapproving of regulations) or practical (e.g. resolving to issue certain regulations, or to comply with or resist against such regulations)—demands that one seek information, judge one’s own knowledge, and act accordingly. Such reflection on the role of knowledge and its relation to action lies at the core of what has been termed “epistemic responsibility”.² I will return to this later. For now, suffice it to say that it is in this respect that I regard Hobbes’s considerations as timely and valuable in the context of the current pandemic-related debate. I shall make two points, one historical, one critical. I will argue that elements of Hobbes’s—as well as his elder contemporary Francis Bacon’s (1561-1626)—understanding of knowledge, and of the relation between knowledge and action, imply casting the human intellect in physical terms, and in particular in terms compatible with the Aristotelian physics of natural motion, as reformulated by the scholastic tradition. I will then bring this historical point to bear upon the current debate surrounding the Covid-19 pandemic, to suggest that the Hobbesian physics-inflected account of knowledge offers a rel-

¹Alfred Mele, “Moral Responsibility for Actions: Epistemic and Freedom Conditions”, *Philosophical Explorations* 13, no. 2 (June 2010): 101-11; Philip Robichaud and Jan Willem Wieland, eds., *Responsibility: The Epistemic Condition* (Oxford: Oxford UP, 2017).

²Neil Levy, Julian Savulescu, “Epistemic Responsibility in the Face of a Pandemic”, *Journal of Law and the Biosciences* 7, no. 1 (January-June 2020): 1-17.

evant perspective from which to reflect upon and responsibly judge, comply with, or challenge regulations.



2 THE Early Modern period saw technological invention and scientific and geographic discoveries that redefined the understanding of mankind's place on Earth,¹ and in the universe.² Knowledge was a central preoccupation

¹The three great inventions of modern times—printing press, gunpowder, and magnet—had ushered in an era of rising literacy and scholarship (according to L. Febvre and H.-J. Martin, *The Coming of the Book: The Impact of Printing 1450-1800* [London: Verso, 1976], by 1500, an estimated twenty million volumes had been printed), shifting balances in military powers (e.g. new emphasis on infantry rather than cavalry), and geographical expansion into uncharted territories (e.g. through compass-aided transoceanic voyages). After Cardano's *Liber secretorum*, Bacon was the first who referred to these three inventions as having “changed the whole face and state of things throughout the world; the first in learning, the second in warfare, the third in navigation (...) no empire, no sect, no star seems to have exerted greater power and influence in human affairs than these changes” (*Novum Organum*, 1, §129; Francis Bacon, *The Works* [London: Longman, 1861-79; repr. Stuttgart-Bad Cannstatt: Fromman Holzboog 1963], 4:114). In addition to these three, between 1600 and 1700 an arsenal of new instruments—telescopes, microscopes, thermometers, barometers, air pumps, electric charge detectors—was introduced, which enabled measuring space, time, motion, and other change with increased precision (Jean-François Gauvin, “Instruments of Knowledge”, in *The Oxford Handbook of Philosophy in Early Modern Europe*, ed. Desmond Clarke and Catherine Wilson [Oxford: Oxford UP 2011], 315-337). Although there is no denying the impact of these innovations, it has been held that the crucial transformation during the Scientific Revolution consisted not so much in the discovery of new phenomena, but rather in the discovery of new ways of looking at old ones, which were brought about by conceptual transpositions occurring inside the minds of the scientists themselves, by their “putting on a different kind of thinking-cap” (Herbert Butterfield, *The Origins of Modern Science: 1300-1800* [London: Bell, 1949], 1).

²See: Alexandre Koyré, *From the Closed World to the Infinite Universe* (Baltimore: Johns Hopkins, 1957); James D. Fleming, ed., *The Invention of Discovery, 1500-1700* (Farnham: Ashgate 2011); Jean Seidengart, *Dieu, l'univers et la sphère infinie: penser l'infinité cosmique à l'aube de la science classique* (Paris: Albin Michel, 2013); Pietro D. Omodeo, *Copernicus in the Cultural Debates of the Renaissance: Reception, Legacy, Transformation* (Leiden: Brill, 2014).

in Early Modern thought. Throughout the Middle Ages and Renaissance, the acquisition of knowledge from the interpretation of nature had been regarded as part of the all-embracing enterprise of philosophy. During the 17th century, under the momentum of the scientific revolution and the development of the experimental method, the standard for what counted as ‘true’ knowledge was taken to a new, stricter level. In an age of political and social instability, natural philosophers, and their experimental method, rose to represent authority.¹ The works of Francis Bacon and Thomas Hobbes, each in their own right, offer opportunities to explore the ways in which natural philosophical thought negotiated the social and political turmoil of Early Modern Britain by appealing to the ‘compensatory’ form of stability offered by the newly acquired scientific knowledge. This urge to achieve stability, and the overall enterprise to reform and elevate knowledge to meet the new and stricter criteria for scientific certainty, are expressed in Bacon’s and Hobbes’s work through an explicit attempt to break away from the past.

The attitude to the past, and in particular towards ancient authorities, and their technological and moral achievements, is a critical aspect of the Early Modern debate within whose framework Bacon and Hobbes operated.² The discovery of ancient Greek and Latin manuscripts, made available to the European readership for the first time following their translation in the vernacular by the humanists of the fourteenth century, had fuelled unprecedented interest in classical antiquity.³ The wisdom found in the ancient texts had thus emerged from the Renaissance tradition as the supreme authority for knowledge. In the Early Modern period, attitudes to past authorities were transformed, and the ancient

¹An example of this raising authority is the establishment of the Royal Society of London in 1660.

²Other aspects include prophetic concerns about the impending end of the world, and a fascination with utopias as potential versions of the future thanks to the advances in knowledge (see Rob Iliffe, “The Masculine Birth of Time: Temporal Frameworks of Early Modern Natural Philosophy”, *The British Journal for the History of Science* 33, no. 4 [2000]: 427-53).

³The key event that triggered the burning desire to retrieve the classical past is Petrarch’s discovery, in 1345, of a manuscript of Cicero’s *Epistulae ad Atticum, ad Quintum fratrem, and ad Brutum*. See Rudolf Pfeiffer, *History of Classical Scholarship: 1300-1850* (Oxford: Clarendon, 1976); for a broader account of the ensuing impetus towards translating the ancient, see Valerie Worth-Stylianou, “*Translatio* and Translation in the Renaissance: from Italy to France”, in *The Cambridge History of Literary Criticism*, ed. G.P. Norton (Cambridge: Cambridge UP, 1999), 127-35.

texts began to lose their supremacy as sources of knowledge. Towards the end of the 16th century, a number of natural philosophers embraced a rhetoric that argued to “eschew textual resources and commune with nature alone”.¹ Contrary to the scholastic account, whereby knowledge was to be deduced from axiomatic principles transmitted in ancient texts, Bacon, Hobbes, and other Early Modern thinkers held that knowledge is best acquired by induction, starting from empirical observation, and based on the evidence of the senses: by reading nature, not books.² Such Early Modern determination to break away from a perceived scholastic tradition of deduction and armchair speculation, to embrace an empirical, evidence-based approach based on observation and induction involved rejection and estrangement from traditional sources of erudition.³

Although both Bacon and Hobbes were educated at traditional institutions,⁴

¹Iliffe, “The Masculine Birth of Time”, 428. As the author points out, the rejection of traditional sources was often justified on the ground that modern activities were ‘new’, hence not subject to improvement upon past wisdom. Bacon too breaks away from the idea that the ancient were superior, but his motivation is different: the crucial advantage of the modern is precisely that they *can* improve on past wisdom, *and* reap the benefits of their own experience as well. In this sense, he represents a transition figure: rooted in the past, but looking at the future.

²Thomas Kuhn, *The Copernican Revolution* (Cambridge, MA: Harvard UP, 1976) objects to such drastic juxtaposition, pointing out that Aristotle too insists on the need for close observation, and that methodological traditions emphasizing the importance of empirical observation were already in place since the thirteenth century. In Kuhn’s view, the essential qualitative differences between pre- and post-Baconian science is not the empirical approach, but rather the emphasis on experiments on previously unknown outcomes (as opposed to demonstration, expected to yield known outcomes), and on the active and forcible manipulation of nature in order to study it under different externally imposed constraints, and reveal more about it—what Bacon describes as the process whereby one shall “bring force to bear on matter, and shall vex it and drive it to extremities as if with the purpose of reducing it to nothing, then will matter (...) turn and transform itself” (*De sapientia veterum*, xiii; Bacon, *Works*, 15:118). My argument here (that certain Early Modern accounts of human nature seem to reflect rather than break away from Aristotelian and scholastic principles) goes in Kuhn’s direction.

³An example of the alternative forms of learning that broke the medieval university’s monopoly is the prolific production of technical manuals, printed treatises that gave unprecedented access to knowledge previously available only within the academic setting; for an example of technical manual of the time, see John Bate, *The mysteries of nature and art, contained in four severall tretises. Partly collected, and partly of the authors peculiar practice, and invention by J.B.* (London: Ralph Mab, 1634; repr. Norwood, NJ: Johnson, 1977).

⁴Bacon at Trinity College, Cambridge, in 1573-1575; Hobbes at Magdalen Hall, Oxford, in 1603-1608. Their connection was also personal: in 1618, when Bacon was Lord Chancellor, Hobbes acted

indications pointing to their antipathy towards the ‘Schools’ abound.¹ In his *Praise of knowledge*, where he defines the individual by his knowledge,² Bacon nevertheless does not recommend the “disputations of the learned” as the most likely place to discover truth.³ Similarly, in *Leviathan*, Hobbes rhetorically wonders “what has been the utility of those schools? What science is there at this day acquired by their readings and disputings?”⁴ This rejection of academia, already present in *More*,⁵ is largely derived from a distrust in words, seen not as sources of knowledge, but rather as generators of an inward-looking “whirl and eddy of argument”,⁶ where “errors in definitions multiply themselves (...) and lead men into absurdities”.⁷ Words, which “the philosophy of the Grecians (...)

as his amanuensis (John Gaskin, introduction to *Leviathan*, by Thomas Hobbes [Oxford: Oxford UP, 1996], xiv).

¹In Hobbes’s case, academia returned the favour: not only were both *De cive* and *Leviathan* burnt in Oxford in 1683 for being “Heretical and Blasphemous” (*The Judgment and Decree of the University of Oxford Past in their Convocation July 21, 1683*, quoted in Samuel I. Mintz, *The Hunting of Leviathan* [Cambridge: Cambridge UP, 1962], 62), but there was talk of burning Hobbes himself (B. Gert, introduction to *Man and Citizen*, by Thomas Hobbes [Indianapolis, IN: Hackett, 1991]).

²“My praise shall be dedicated to the mind itself. The mind is the man, and the knowledge of the mind; a man is but what he knoweth. The mind itself is but an accident to knowledge; for knowledge is a double of that which is. The truth of being, and the truth of knowing, is all one”. And also “Is not knowledge that doth alone clear the mind of all perturbations?” (*In Praise of Knowledge*, 1592; Bacon, *Works*, 8:123).

³“Many of these men [ancient philosophers] had greater wits, far above mine own, and so are many in the universities of Europe at this day. But alas, they learn nothing there but to believe: first to believe that others know that which they know not; and after themselves know that which they know not” (Bacon, 8:125).

⁴Hobbes, *Leviathan*, IV, 46, §11; 444. And again, appealing to his high opinion of Euclidean geometry: ‘Plato that was the best philosophers of the Greeks, forbad entrance into his School, to all that were not already in some measure geometricians’ (444). The rhetoric of Hobbes’s criticism seems to share much with that of Galilei (see, for example, his *Letter on Sunspots*, 1613).

⁵E.g. in *Utopia* (1516), More comments that “academic philosophy is pleasant enough in the private convezation of close friends, but in the councils of kings, where great matters are debated with great authority, there is no room for it”. Thomas More, *Utopia*, ed. George M. Logan and Robert M. Adams (Cambridge: Cambridge UP, 2002), 1, 34.

⁶*Novum Organum*, 1, §82; Bacon, *Works*, 4:80.

⁷Hobbes, *Leviathan*, 1, 4, §13; 24. In the same section, Hobbes compares those who (only) read books to “birds that entering by the chimney, and finding themselves enclosed in a chamber, flutter at the false light of a glass window, for want of wit to consider which way they came in”, and again, he speaks about “senseless tenets; which make those men who take their instruction from the authority of books, and not from their own meditation, to be (...) below the condition of ignorant

never failed to multiply”,¹ in Bacon’s and Hobbes’s accounts are at best an adornment, having no access to true, factual knowledge.² This is instead to be acquired chiefly through the senses,³ and secondly through a gradual generalization from the solid foundation of the (known) particular to the (still unknown) universal.⁴ Bacon’s inductive method is founded on the *interpretatio*—as opposed to (what Bacon considers) the pseudoscientific approach of the *anticipatio*—of nature, the latter employing speculative hypotheses that cannot be tested empirically,⁵ and therefore producing not knowledge, but rather obstacles to the acquisition of knowledge.⁶ By acting as a “control machinery” to verify the truthfulness of theories based on empirical observation, Bacon’s method seeks to loosen the ties between the knowledge of the natural world, which should strive to be unbiased, and a priori philosophical frames.⁷

men (...) for between true science and erroneous doctrines, ignorance is in the middle”. And again: “words are the money of fools, that value them for the authority of an Aristotle, a Cicero, or a Thomas”. Here, distrust in words and hostility towards academic tradition converge.

¹In *Praise of Knowledge*; Bacon, *Works*, 8:124.

²In the *Novum Organum* (the “new instrument” for the acquisition of knowledge), when discussing the “Idols of the marketplace”, Bacon emphasises the pernicious effect of errors arising from misunderstanding on the meaning of words, which often betray their own purpose and obscure the very thoughts they purport to express. Also, winning an argument in words does not mean that the argument’s truthfulness has been established. Here Bacon’s view is in line with the notion that rhetoric is void if not supported by true knowledge.

³Hobbes submits that knowledge of fact “is originally, sense; and ever after, memory” (*Leviathan*, 1, 7, §3; 42). In the context of Hobbes’s rejection of the academic philosophical tradition, and account of the “ideal” philosophy, as modelled after Euclid’s geometry, “the only science that it hath pleaseth God hitherto to bestow on mankind” (*Leviathan*, 1, 4, §12; 23), it seems fair to point out that without his being exposed to that very academic tradition, Hobbes would probably not have had the opportunity to encounter Euclid.

⁴Bacon intended to accomplish a large-scale renewal of the sciences by gathering all knowledge into one monumental work: his *Instauratio magna scientiarum* (the restoration of all knowledge) was never completed, but the extant components provide ample material documenting his method.

⁵See Mary Hesse, “Francis Bacon”, in *A Critical History of Western Philosophy*, ed. James O’Connor (London: Collier-Macmillan, 1964), and Lisa Jardine, *Francis Bacon: Discovery and the Art of Discourse* (Cambridge: Cambridge UP, 1974).

⁶Bacon claims that the minds of humans are corrupted by dogmas and prejudices—the so-called ‘idols’—which prevent the mind from receiving the truth, and recommends extirpating the causes of errors within the sciences and obstacles to the acquisition of knowledge by means of three refutations: of “natural human reason” (i.e. the idols), of “demonstrations” (i.e. syllogisms), and of “theories” (i.e. traditional philosophical systems) (*Novum Organum*, 1, §115; Bacon, *Works*, 4:103).

⁷Lorraine Daston and Katharine Park, eds., *Wonders and the Order of Nature, 1150-1750* (Brook-

Both Bacon and Hobbes insist on the notion of understanding causality as an essential requirement for true knowledge. Bacon, for example, submits that simply collecting facts is not enough: facts must be collected by methodical procedures, and arranged in a narrative that makes it possible to analyse cause and effect (especially through new experiments). Similarly, Hobbes distinguishes between the knowledge “original”, resulting from the effects of outer causes on the sensory apparatus, and proper “science”, resulting from the understanding of propositions.¹ Hence, in both Bacon and Hobbes, true knowledge is knowledge of the causes. A second key aspect shared in Bacon’s and Hobbes’s accounts of human nature and quest for knowledge is the emphasis on the instrumental and normative value of learning, whose merit is determined by its usefulness, especially with respect to the propagation of man’s power—be it over nature, as in Bacon, or over other men, as in Hobbes. In Hobbes’s account of society, the acquisition of knowledge and the refinement of reason are valued as abilities to calculate and use effective means to achieve ends. Following from this notion of means-to-end rationality, the most valued form of knowledge is the know-how, the knowledge that can be applied to the attainment of a practical end—be it reigning peacefully over one’s kingdom, negotiating political hurdles, or, more fundamentally, protecting one’s own life.² The superiority of practical invention

lyn, NY: Zone Books, 1998). Bacon sees human knowledge as proceeding most safely by negation and exclusion (the central elements of the inductive method), as opposed to affirmation and inclusion. Based on the emphasis on falsification, Bacon has been suggested as a forerunner of Karl Popper (Peter Urbach, “Francis Bacon as a Precursor to Popper”, *The British Journal for the Philosophy of Science* 33 no. 2 [1982]: 113-132).

¹“Of the powers of the mind there be two sorts, cognitive, or imaginative or conceptive; and motive” (*The Elements of Law*, 1640, 1, 1, §22). The object of the senses is the “knowledge the object imparteth to us of its nature” (II, 23). And, later, “There be two sorts of knowledge, whereof one is nothing but sense, or knowledge original (...) the other is called science or knowledge of the truth of propositions, and how things are called, and is derived from understanding. Both of these sorts are but experience; the former being the experience of the effects of things that work upon us from without; and the latter the experience men have of the proper use of names in language” (VI, 40). Thomas Hobbes, *The Elements of Law Natural and Politic*, ed. J.C.A. Gaskin (Oxford: Oxford UP, 2008)

²The natural laws, for example, are conditional to their end (the preservation of life), and are only justified if they are effective in achieving it (see, for example, Hobbes’s arguments about each individual’s right to defend one’s own bodily integrity: *Leviathan*, 2, 21, §§11-25). In the state of nature, where individual and collective interests clash, the natural laws are valid but not effective,

over intellectual reasoning is a dominant trait in Bacon as well.¹ Bacon's statements that "truth and utility are the very same things" and "human knowledge and human power meet in one" have led to his being ascribed to an epistemological tradition that postulates an intimate relation between objects of cognition and objects of construction, where the "knower" is, fundamentally, a "maker".² Bacon's instrumental approach to knowledge emerges conspicuously in the context of his "Great Instauration", a project aimed at reforming knowledge, which set itself the goal of rescuing human condition before the Fall, restoring human state of knowledge and power.³ Here the means to this end is to free—"deliver

calling for the need of an external authority to impose artificial laws in which it becomes individually rational to be collectively rational. From the same utilitarian principle it follows that morality (a desirable end of human learning and refinement) depends on immorality, as it requires political stability, which in turn can only be attained through immoral means.

¹"Are we the richer by one poor invention, by reason of all the learning that hath been these many hundred years?" And again: "The industry of artificers maketh some small improvement of things invented; and chance sometimes in experimenting, maketh us to stumble upon somewhat which is new: but all the disputation of the learned never brought to light one effect of nature before unknown". Also: "When things are known and found out, then they can descant upon them, they can knit them into certain causes, they can reduce them to their principles (...) But all this is but a web of the wit, it can work nothing". Reason and logic "rather cast obscurity, than gain light to the contemplation of nature". Bacon, *Works*, 8:124.

²See Antonio Pérez-Ramos, *Francis Bacon's Idea of Science: and the Maker's Knowledge Tradition* (Oxford: Clarendon Press, 1988), 49. This claim has been objected to, as it does not necessarily follow from Bacon's statement that "knowledge and power meet in one": as others have observed, power may express itself under different forms than "making" (Richard Kennington, Review of "Francis Bacon's Idea of Science and the Maker's Knowledge Tradition" by Antonio Pérez-Ramos, *The Review of Metaphysics* 43 no. 2 [1989]: 414).

³Bacon wanted to succeed in "kindling a light in nature (...) which should (...) illuminate all the border regions that confine upon the circle of our present knowledge; and so (...) bring into sight all that is most hidden (...) that man (I thought) would be the propagator of man's empire over the universe" (Proemium to *De interpretatione naturae*; Bacon, *Works*, 10:84-85; Latin original, 3:518). It is important to remember that Bacon's project is elsewhere expressed in more tempered terms, emphasizing the need to pursue knowledge not for personal profit or fame, but rather for charitable purposes: "I most humbly and fervently pray (...) that knowledge being now discharged of that venom which the serpent infused into it, and which makes the mind of man to swell, we may not be wise above measure and sobriety, but cultivate truth in charity. (...) Lastly, I would address one general admonition to all; that they consider what are the true ends of knowledge, and that they seek it not either for pleasure of the mind, or for contention, or for superiority to others, or for profit, or fame, or power, or any of these inferior things; but for the benefit and use of life; and that they perfect and govern it in charity. For it was from the lust of power that the angels fell, from

and reduce”—the mind from the deception of imagination, curbing its (the imagination’s) tendencies to yield distorted explanations of reality, and harnessing and deploying its potential in the framework of the new (inductive) “method”.¹ Bacon advocates the use of knowledge to attain mastery over nature² in order to propagate the human empire, extending its boundaries “to the effecting of all things possible”,³ and establishing the dominion of the human race “over the universe”.⁴

Therefore, although vast differences distinguish their accounts, both Hobbes and Bacon appeal to the “end”—be it survival, peace, or the mastery of nature—as a justification and purpose of the use of the “means”. In both accounts, knowledge and the intellect are “useful”, as they are the instruments to improve the human condition: in this sense, knowledge *is* power. But seeking to improve the human condition is not intended as an accidental epiphenomenon of the natural philosopher’s activity, which may or may not obtain: it is the philosopher’s moral imperative, and knowledge’s ultimate end—that for the sake of which it (knowledge) should be acquired. Hence, knowledge not only *is*, but also *ought to be* power, in that there is a moral obligation to leverage what one knows in order that the human condition may be improved. I will later return to this aspect, as it applies to current regulatory interventions in response to the

lust of knowledge that man fell; but of charity there can be no excess, neither did angel or man ever come in danger by it (Preface to *The Great Instauration*; Bacon, *Works*, 4:20-21).

¹The earliest version of Bacon’s programme aimed at the restitution of man’s reign on Earth appeared in *Valerius Terminus* (1603), where he appeals to the “restitution and reinvesting (...) of man to the sovereignty and power (...) which he had in his first day of creation (Francis Bacon, *The Philosophical Works*, ed. James Spedding, 3 [London: Longman, 1861], 222).

²“Shall we not as well discern the riches of nature’s warehouse, as the benefit of her shop? Is truth ever barren? Shall he not be able thereby to produce worthy effects, and to endow the life on man with infinite commodities?” (*In Praise of Knowledge*; Bacon, *Works*, 8:123). Andgain: “the sovereignty of man lieth hid in knowledge; wherein many things are reserved, which kings with their treasure cannot buy, nor with their force command. (...) now we govern nature in opinions, but we are thrall unto her in necessity; but if we would be led by her in invention, we should command her in action” (8:126). As it has been observed in Joseph Agassi, *The Very Idea of Modern Science: Francis Bacon and Robert Boyle*, 266 (Dordrecht: Springer, 2013), in Bacon’s view of the relation of knowledge to power over nature, domination conflicts with obedience: “we cannot command nature except by obeying her” (Bacon, *Novum organum*, 1, §129; Bacon, *Works*, 4:114).

³*New Atlantis* (1627); Bacon, *Works*, 3:156.

⁴*Novum Organum*, 1, §129; Bacon, *Works*, 4:114.

Covid-19 epidemic. In what follows, I will argue that both Bacon's and Hobbes's accounts, despite claiming to have broken away from the classic and scholastic traditions, seem to have retained elements of both. Specifically, the Baconian and Hobbesian understanding of human nature and quest for knowledge as involving causality and normative purpose is reminiscent of the Aristotelian principles of directed motion, particularly in their scholastic reformulation.

3 ARISTOTLE'S *Physics* takes nature—φύσις—as its object of study. For Aristotle, the study of nature revolves around three notions: matter, form, and privation. The transition of matter from privation to form is change. Change is a common feature of natural objects, the expression of their inherently mutable essence.¹ The quintessential change is the change of place, that is, motion.² The essential nature of motion is the acquisition of new forms by matter: motion occurs whenever matter that is in potentiality (i.e. in privation) towards some form acquires that form in actuality.³

A central feature of Aristotle's theory of motion is the idea that things have a "natural place" in the universe, and a "natural motion" to that place.⁴ All non-living things follow that natural motion to their natural place, unless prevented from doing so. For example, fire tends to move upwards; earth, downwards.⁵

¹Aristotle's treatment of change as possible object of knowledge marks a fundamental distinction from Plato, who instead regarded change—and mutable physical entities—as unknowable.

²"The most common and most fundamental kind of change is change of place, which is known as movement" (*Physics* IV, 1, 208a30). Rest is the privation of change, hence its opposite: "a thing that is undergoing any particular kind of motion, but though previously existent has not always undergone it, must previously have been at rest so far as that motion is concerned" (*Physics*, VIII, 7, 261b1-4); "the opposite of change of a particular kind is rest of the same kind" (*Physics* V, 6, 229b24-25).

³Change is the actuality of that which exists potentially, in so far as it is potentially this actuality"; for example "the actuality of the capacity for movement is movement" (Aristotle, *Physics* III, 201a9-18).

⁴Aristotle, *Physics* VIII, 4, 255b13-17.

⁵"Light things and heavy things move to their own places. And the reason is that it is their nature to tend in certain directions, that this is what it is to be light and heavy". (Aristotle, *Physics* VIII, 4, 255b14-17). Also: "The movement of the simple natural bodies (fire, Earth, and so on) shows not only that there is such a thing as place, but also that it [the place] has a certain power. For unless prevented from doing so, each of them moves to its own place, which may be either above or below where it was" (Aristotle, *Physics* IV, 1, 208b8-12).

Living things can initiate motion themselves, as a result of their thoughts and desires, which in turn are generated in response to external causes.¹ In living things, motion contrary to their nature must have an external cause;² whilst motion in accordance to nature has an internal cause, i.e. is caused by the moving thing itself.³ In all cases, “everything that changes (...) does so either thanks to its own nature or because it is forced to do so, contrary to its nature”. Hence, the principle of motion is intrinsic in all natural things (animate and inanimate), and causes them to move (actively) to—or be moved (passively) away from—certain specific places—their *own* places (τὸν αὐτῶν τόπον)—as it corresponds to their nature.⁴

A second key aspect of Aristotle’s account of motion is that it is embedded within a teleological view of nature, whereby things occur because they serve a purpose.⁵ Purposes are connected with goodness.⁶ This goodness is specific to the thing in question, and is the ultimate reason for its existence—its end (τέλος). Expressed in the context of nature’s matter-form duality, “since the end (τέλος) is form (μορφή), and everything else [i.e. change and motion] takes place for the sake of the end [i.e. the form], it is this form that is the cause, since it is that for the sake of which anything [i.e. any change/motion] happens”.⁷ Hence, Aristotle gives form priority over matter, and actuality priority over potentiality: “matter exists so it may attain its [own specific] form; and when it exists *actually*, then it is in its [own specific] form”.⁸ In terms of motion, the implication here is that things move naturally (i.e. have a natural disposition to move) towards an end (τέλος)—their own specific end.

¹Physics VIII, 4, 253a7-21.

²Physics VIII, 4, 254b24-7.

³Physics VIII, 4, 254b27-33.

⁴Physics VIII, 4, especially 255a24-256a3.

⁵The purpose is not necessarily conscious: for example, the features of animals and plants appear to be designed to serve the purpose of survival, unbeknownst to the animals and plants themselves.

⁶“The good (...) that at which all things aim”. Aristotle, *Nicomachean Ethics*, ed. and transl. by H Rackham, Tuft University’s Perseus Project (<http://www.perseus.tufts.edu>), I, 1, 1094a2.

⁷Physics, II, 8, 199a31-32. Original: “καὶ ἐπεὶ ἡ φύσις διττή, ἡ μὲν ὡς ἕλη ἢ δ’ ὡς μορφή, τέλος δ’ αὐτῆ, τοῦ τέλους δὲ ἔνεκα τᾶλλα, αὐτῆ ἂν εἴη ἡ αἰτία, ἢ οὐ ἔνεκα”.

⁸Aristotle, *Metaphysics*, IX, 8, 1050a14-15; ed. W.D. Ross (Oxford: Clarendon Press, 1924). Tuft University’s Perseus Project: <http://www.perseus.tufts.edu>, English transl.: *Books Γ, Δ, and Ε*, trans. by C. Kirwan (Oxford: Clarendon Press, 1971); *Books Ζ and Η*, trans. by D. Bostock (Oxford: Clarendon Press, 1994).

A third relevant point in the Aristotelian model is the notion of things actively “seeking”, “desiring”, “yearning for” (ἐφίεσθαι καὶ ὀρέγεσθαι) their end.¹ Aristotle posits that matter is opposed to form in the sense that form is that which matter “desires”, “longs for”.² The action of “seeking” the end is related to the quest for completeness: in virtue of having attained their end (i.e. when the potentiality of the substance has been actualised), things are complete—i.e. reach their natural completion. And motion ceases.³



4 THE ARISTOTELIAN *corpus* became available in Europe in Latin translation in the early 13th century. Following its rediscovery, the Aristotelian thought quickly rose to challenge the prevailing Neoplatonism of the time.⁴ The decisive thrust behind its rise in popularity came from the scholastic thought, especially as developed by Thomas Aquinas (ca. 1225-74). Aquinas wrote close textual commentaries on Aristotle’s work. In particular, his commentaries on the *Physics* and *Metaphysics* provide cogent accounts of Aristotle’s analysis of physical objects, place, time, and motion.⁵

¹*Physics*, I, 9, 192a15-20.

²“In the context of there being something divine and good and desirable (...) the opposite to this also exists, as does that which by its own nature desires and longs for it” (*Physics* I, 9 192a15-19), and again “it is the matter which does the desiring” (*Physics* I, 9, 192a21).

³This concept is expressed in the Aristotelian distinction between potentiality (δύναμις) and actuality (ἐνεργεία), in which the former is not the ability to produce a change *per se*, but rather that to reach a more complete state (*Metaphysics* IX, 6, 1048a25 and ff.).

⁴Attempts were made to accommodate and synthesise Platonic and Aristotelian themes, sacred and pagan knowledge. Grosseteste, for example, regards all knowledge—whether the result of Christian doctrine or of pagan reason—valuable illumination on God (Simon Oliver, *Philosophy, God and Motion* [London: Routledge 2005], 3, 60-61).

⁵As Kuhn, *Copernican Revolution*, points out, as a result of the scholastic analysis, local motion—which had previously been included in the general philosophical problem of change—became a

Aquinas's commentaries, however, are also texts of interest in their own right, as they present not only a translation, but also an original re-elaboration of the Aristotelian thought. A particularly salient instance of this re-elaboration has to do with the Aristotelian notion of "completeness" (τελειότης), which Aquinas interprets and transforms into the notion of "perfection" (*perfectio*).¹ The word "perfection" is absent from Aristotle's text. Aquinas takes Aristotle's definition of motion of the incomplete (ἀτελές) towards completion (τελειότης), and rephrases it in terms of motion of the imperfect (*imperfectum*) towards perfection (*perfectio*): "Motion is the actuality of an *imperfect* thing [as it is] tending towards *perfection*" (*motus est actus imperfecti tendentis in perfectionem*).² According to Aquinas's commentary, "that which is in a process of becoming appears universally as something imperfect [instead of the original 'incomplete'] and proceeding to a first principle".³ Likewise: "act is prior to potency, and the perfect to the imperfect (*actus est prior potentia, et perfectum imperfecto*).⁴ And again: "everything that is coming to be is, while it is coming to be imperfect [*imperfectum*] and tending [*tendit*] to its principle, i.e. to a likeness to the principle that made it, and which is naturally first".⁵ Also, Aristotle's "completeness and incompleteness of magnitude" (τελειότης μεγέθους καὶ ἀτέλεια) becomes Aquinas's "perfection and imperfection of magnitude" (*perfectum et imperfec-*

subject of study in its own right, quantitatively tractable, and subject to empirically discoverable laws. See Anneliese Maier, *Studien zur Naturphilosophie der Spätscholastik* (Roma: Storia e Letteratura, 1952-1968); Richard Sorabji, *Matter, Space, and Motion: Theories in Antiquity and Their Sequel* (Ithaca, NY: Cornell UP, 1988).

¹For an extensive discussion on this point, see David E Cohen, "The Imperfect Seeks Its Perfection": Harmonic Progression, Directed Motion, and Aristotelian Physics", *Music Theory Spectrum* 23, no. 2 (2001):139-169.

²Thomas Aquinas, *Commentary on Peter Lombard's Sentences*, in *Commento alle sentenze di Pietro Lombardo*, transl. R. Coggi (Bologna: Studio Domenicano, 2002), II, 11, q. 2, a. 1 (emphasis in text is mine). This is an earlier work, written in 1252-56 (i.e. before the *Metaphysics* commentary). The principle is recalled again later on in the same work as "every imperfect thing seeks its own perfection" (*omne autem imperfectum appetit suam perfectionem*) (IV, 49, q. I, a. 4a, sol. I, 658).

³Thomas Aquinas, *In octo Physicorum Aristotelis libros commentaria* (Venice: H. Scotum, 1552), VIII, 14, c. 7, §1085. Also consulted in English translation in: Books I-II, trans. by R.J. Blackwell, R.J. Spath and W.E. Thirlkel (New Haven, CT: Yale UP, 1963); Books III-VIII, trans. by P.H. Conway (Columbus, OH: College of St Mary of the Springs, 1958-1962).

⁴Aquinas, *In octo Physicorum*, §1090.

⁵Aquinas, §1094.

tum in magnitudine).¹ Hence, in Aquinas, form, actuality, and perfection are used as synonyms, and equated with (Aristotle’s original concept of) “completion of motion”; likewise, matter, potentiality, and imperfection are used as synonyms, and equated with (Aristotle’s original concept of) incomplete motion.² This terminological shift from Aristotle’s Greek ἀτελής and τελειότης to Aquinas’s Latin *imperfectum* and *perfectio*, coupled with the Aristotelian idea that the end of the motion—that is, its completion—is specific to the moving thing, leads to the reformulation of the Aristotelian principle of natural motion of the incomplete towards its completion in terms of the motion of the imperfect towards a specific kind of perfection: its own, predetermined perfection, proper to the moving thing.³



5 IT IS IRONIC that Bacon’s and Hobbes’s distaste for academic institutions should lead them to dismiss Aristotle’s natural philosophy as “a mere bond-servant to his logic (...) contentious and well nigh useless”,⁴ and the scholastic enterprise as “jejune scholastic logic and useless Aristotelian physics”.⁵ A closer look at Bacon’s and Hobbes’s own work seems instead to suggest that exposure to the scholastic and Aristotelian thought might have proven a rather useful—possibly defining—influence, as both the Aristotelian physics of natural motion and its scholastic reformulation appear prominently in it. Both Bacon’s and Hobbes’s accounts of human nature and all of its manifestations (including

¹Aquinas, §1097.

²See also Cohen, “The Imperfect”.

³As Aquinas comments: “I say ‘perfect’ in respect of the nature [*perfectam secundum conditionem propriae naturae*], for a different perfection of magnitude befits man from the one that befits a horse” (Aquinas, *In octo Physicorum*, VI, 13, c. 10, §880).

⁴*Novum Organum*, 1, §54; Bacon, *Works*, 4:59.

⁵Gaskin, introduction, xii.

the quest for—and use of—knowledge) seems to operate through a recasting in terms of physical phenomena, and the underlying governing physical laws. Hobbes’s statements that space and time are imaginary “phantasms of motion”,¹ and that “life itself is but motion” epitomise this tendency.²

Motion plays a crucial role in the way Bacon and Hobbes characterise the various manifestations (individual, social, political) of the human condition. Hobbes developed a cosmology based on mechanical motion,³ which took the form of a monistic ontology, in which “nothing exists (...) but particular objects in motion”, and again “nothing without us but bodies in motion, nothing within us but organic motions”.⁴ The mechanistic physiological element is all-pervasive: perception, imagination, and memory are explained in terms of motion of the senses (the former), and its decay (the latter two)⁵; mental discourse is conceived of as driven by motion in thoughts (i.e. thoughts in motion).⁶ Concepts developed to deal with natural phenomena are applied to moral norms, social

¹“SPACE IS THE PHANTASM OF A THING EXISTING WITHOUT THE MIND SIMPLY; THAT IS TO SAY, THAT PHANTASM, IN WHICH WE CONSIDER NO OTHER ACCIDENT, BUT ONLY THAT IT APPEARS WITHOUT US”; “TIME IS THE PHANTASM OF BEFORE AND AFTER IN MOTION” (BOTH QUOTATIONS FROM *DE CORPORE*, 2, VII, §§2-3; THOMAS HOBBS, *THE ENGLISH WORKS*, ED. WILLIAM MOLESWORTH [LONDON: J. BOHN, 1839-45; REPR. AALEN: SCIENTIA, 1966], 1:94-95; LATIN ORIGINAL IN THOMAS HOBBS, *OPERA LATINA*, ED. WILLIAM MOLESWORTH [LONDON: J. BOHN, 1839-45; REPR. AALEN: SCIENTIA, 1966], 1:83-84). FOR A SECONDARY ANALYSIS OF HOBBS’S ACCOUNT OF TIME AND SPACE SEE ALSO MICHAEL EDWARDS, *TIME AND THE SCIENCE OF THE SOUL IN EARLY MODERN PHILOSOPHY* (LEIDEN: BRILL, 2013), 165-166.

²I am not the first to notice similarities between Hobbes’s and Aristotle’s work despite Hobbes’s generally critical attitude towards Aristotelianism. For example, in *The Mechanization of Aristotelianism: the Late Aristotelian Setting of Thomas Hobbes’s Natural Philosophy* (Leiden: Brill, 2002), Cornelis Hendrik Leijenhorst notes that Hobbes’s critique of Aristotle does not include his *Rhetorics*, nor the deterministic and mechanistic strains in his biological works. This observation is consistent with Aubrey’s biographical notes on Hobbes (1679-1693), and lends plausibility to the similarities that I too have observed.

³Frithiof Brandt, *Thomas Hobbes’ Mechanical Conception of Nature* (Copenhagen and London: Levin & Munksgaard, 1928).

⁴Edwin A. Burt, *The Metaphysical Foundations of Modern Physical Science* (London: Kegan Paul, Trench, Trübner & Co., 1924), 121. Later on, Burt concludes: “We have observed that the heart of the new scientific metaphysics is to be found in the ascription of ultimate reality and causal efficacy to the world of mathematics, which world is identified with the realm of material bodies moving in space and time” (300).

⁵Hobbes, *Leviathan*, 1, 2, §3; 11.

⁶Hobbes, 1, 3, §§1-3; 16.

interaction, and political dynamics as well.¹ For Bacon, “merit and good work is the end of man’s motion; and conscience of the same is the accomplishment of man’s rest”.² Crucially, Bacon goes on to say that “for honour is, or should be, the place of virtue; and as in nature *things move violently to their place* and calmly in their place, so virtue in ambition is violent, in authority settled and calm”.³ This statement bears a remarkable similarity with Aristotle’s principle of natural motion, whereby things have a natural place, and a natural tendency to move towards that place.⁴ I would like to suggest that Bacon and Hobbes, each in their own way, seem to converge on the notion that the “natural place” of human intellect is knowledge.

6 THE DESIRE to know is for Hobbes a “lust of the mind” that distinguishes men from other animals, and that “by perseverance of delight in the continual and indefatigable generation of knowledge, exceedeth the short vehemence of any carnal pleasure”.⁵ The similarity with Aristotle’s account emerges forcefully here. The opening sentence of the *Metaphysics* states that “all men naturally desire to know”.⁶ Aristotle’s argument culminates with the full-fledged equation of the acquisition of knowledge with physical motion:

each thing has a natural inclination to perform its proper operation, as something hot is naturally inclined to heat, and something heavy to be moved downwards. Now the proper operation of man as man is to understand (...) Hence the desire of man is naturally inclined to understand, and therefore to possess scientific knowledge”.⁷

The metaphor of motion dominates Aristotle’s epistemic model: the acquisition of knowledge is when “the thinking part of the mind has come to a rest”. That is when we “know” and “understand”. And again: “Understanding and

¹Thomas A. Spragens, *The Politics of Motion: The World of Thomas Hobbes* (London: Croom Helm, 1973), 7.

²*Of Great Place* (1625); Bacon, *Works*, 6:399.

³Bacon, 6:401 (emphasis is mine).

⁴See, for example, Aristotle’s *Physics* VIII, 4, 255b13-17.

⁵Hobbes, *Leviathan*, 1, 6, §35: 37.

⁶“πάντες ἄνθρωποι τοῦ εἰδέναι ὀρέγονται φύσει” (Aristotle, *Metaphysics*, I, 1, 980a21).

⁷As quoted in Aquinas, *Commentary on Aristotle’s Metaphysics*, ed. J.P. Rowan (Chicago: Regenery, 1961), 1, 1-4.

knowledge come about as a result of the mind quietening down from its natural disturbance”.¹ In Chapter 7 of his *Physics*, Aristotle draws a parallel between the process whereby a person becomes educated, and the process whereby matter comes to acquire form. He argues that human nature is intellect, and the intellect’s ultimate cause (τέλος) is knowledge. Ignorance, therefore, is intellect’s incomplete (in Aquinas’s term, “imperfect”) potentiality.

This argument is also conveyed in the *Metaphysics*, where, according to Aquinas’s interpretation, Aristotle gives three reasons for man’s natural desire to know:

The first is that each thing naturally desires its own perfection. Hence matter is also said to desire form as any imperfect thing desires its perfection. Therefore, since the intellect, by which man is what he is, considered in itself is all things potentially, and becomes them actually only through knowledge, because the intellect is none of the things that exist before it understands them, (...) so each man naturally desires knowledge just as matter desires form.²

Thus, as matter lacking form seeks it, man in a state of ignorance naturally seeks (i.e. move towards) knowledge, actualizing its intellect’s potentiality. And this process is ‘predetermined’, in the sense that the quest for knowledge is an inherent feature of human nature—i.e. a natural motion towards its natural place. “A knower immediately has his knowledge consciously in mind unless prevented from doing so in the same way as something of a certain quantity spreads out unless prevented from doing so”.³ Hence, by pursuing knowledge, humans fulfil their natural motion towards their τέλος of knowing.

The metaphor of motion is equally prominent in Hobbes’s account of man’s acquisition of knowledge: “The Act of Understanding is a Motion of the Animal Spirits, by the Action of the brayne, qualified with the active-power of the externall object”.⁴ Hence, “understanding” (which is the act of acquiring knowledge) is cast in terms of motion towards the object (to be known), which somehow pulls the human mind towards itself, as if it wanted to be understood. Between

¹Aristotle, *Physics* VII, 4, 247b9 and 247b17.

²Aquinas, *Commentary*, ad 2.

³Aristotle, *Physics* VIII, 4, 255b22-23.

⁴Thomas Hobbes [attrib.], *A Short Tract on First Principles*, in *The Elements of Law*, ed. Ferdinand Tönnies (Cambridge: University Press, 1928; repr. New York: Routledge, 2013), 165.

the pulling power of the object of knowledge (the to-be-known), and the passive motion of the human mind towards it, there seems to exist a mediating factor: the natural human desire to know. The human mind is naturally drawn towards knowledge, and this disposition actualises in the pulling-attracting relation to each particular object of knowledge: in other words, when an object of knowledge presents itself, the mind's natural disposition to know turns into action, and the conditions for the acquisition of knowledge, the human intellect's final cause, obtain.

As for the kind of knowledge that one could hope to attain: in *The Advancement of Learning*, Bacon praises King Solomon's wisdom: since God created the physical world, the physical world is a legitimate—and possible—object of man's knowledge: "The glory of God is to conceal a thing, but the glory of the king is to find it out".¹ Bacon's epistemological optimism echoes the Aristotelian idea that sense-perception is correct, i.e. it represents the world as it is. This view implies the epistemological primacy of knowledge through the senses, holds that the external world possesses the qualities ascribed to it by the observer, and results in the idea that knowledge of it is possible. Hobbes holds a different view, one which resonates with the sceptical tenet that nothing can be known about the physical world, as any knowledge of it is vitiated by the unreliability of the human senses: "whatsoever accidents or qualities our senses make us think there be in the world, they are not there, but are seemings and apparitions only. The things that really are in the world without us, are those motions by which these seemings are caused. And this is the great deception of sense, which also is by sense to be corrected. For as sense telleth me, when I see directly, that the colour seemeth to be in the object; so also sense telleth me, when I see by reflection, that colour is not in the object".² Hobbes's suspicion of sensory knowledge echoes Montaigne, whose essay "On Experience" seems to operate a synthesis of Aristotelianism and scepticism: "There is no desire more natural than the

¹*Proverbs* 25:2, quoted in Bacon, *Valerius Terminus*, chap. 1; *Works*, 3:220. Bacon comments the passage so: "as if, according to the innocent play of children, the Divine Majesty took delight to hide his works, to the end to have them found out; and as if kings could not obtain a greater honour than to be God's playfellows in that game, considering the great commandment of wits and means, whereby nothing needeth to be hidden from them". Bacon's emphasis on—and confidence in—the human intellectual faculties is evident.

²Hobbes, *Elements of Law*, ed. Gaskin, 1, 2, §10.

desire for knowledge. We try all the ways that can lead us to it. When reason fails us, we use experience (...) truth is so great a thing that we must not disdain any medium that will lead us to it”.¹ Here the Aristotelian theme of “all men by nature desire to know” is blended with a moderate diffidence of the knowledge acquired through experience, which is nevertheless preferable to no knowledge at all. Hence, the sensorium is deceptive (here Hobbes is referring to optical illusions, dreams, and other perceptual fallacies). Hence, the emphasis on true knowledge as derived from sensory (observable) experience (e.g. in Bacon) co-exists with a suspicion of knowledge derived from sensory experience because the senses are irremediably fallible (e.g. in Hobbes).²

7 THE MOTION-LIKE quality of the process of acquisition of knowledge, as theorised by Bacon and Hobbes, mirrors the action-laden implications of the (logically subsequent) process of putting that knowledge to use. Although the two processes are treated as conceptually distinct,³ they both require some kind of action—be it the (metaphorical) motion of the intellect towards the object to be known, or the (actual) motion required for the practical implementation of a thought. And both are captured in the statement ‘knowledge is power’, as well as in the normative reformulation that I suggested earlier on: ‘knowl-

¹Michel de Montaigne, “On Experience” (3, 13), in *The Complete Essays of Montaigne*, transl. by D. Frame (Stanford: Stanford UP, 1958), 815. French original: “Il n’est désir plus naturel que le désir de connoissance. Nous essayons tous les moyens qui nous y peuvent mener. Quand la raison nous faut, nous y employons l’expérience, *per varios usus artem experientia fecit: exemplo monstrante viam*, qui est un moyen plus foible et moins digne; mais la verité est chose si grande, que nous ne devons desdaigner aucune entremise qui nous y conduise” (Villey edition of the ‘Bordeaux copy’ from the University of Chicago’s ARTFL Montaigne Project, <https://www.lib.uchicago.edu/efts/ARTFL/projects/montaigne/>). Here Montaigne, like Bacon, Hobbes, and Galilei, praises experience as useful. However, like the scholastics, he sees it as inferior to reason.

²“Experience concludeth nothing universally” (Hobbes, *Elements of Law*, 1, 4, §10).

³In Aristotle, for example, “someone who is learning something knows it potentially in a different sense from someone who already has that information but is not actually putting it to use” (Aristotle, *Physics* VIII, 4, 254a31). Also: “some who possesses knowledge but does not have it consciously in mind knows it potentially, but not in the same sense that he knew it potentially before he had learned it” (Aristotle, *Physics* VIII, 4, 254a35). Similarly, “a knower has his knowledge consciously in mind, unless prevented from doing so” (Aristotle, *Physics* VIII, 4, 254a35-b22). This latest statement suggests that the idea of intellect’s natural motion applies not only to motion towards knowledge, but also towards action.

edge ought to be power'.¹ The moral claim 'knowledge ought to be power' rests on the notion that knowledge ought to be transformed into action and put to the service of humanity. This way, not only is knowledge enabling to those who have it (i.e. knowledge *is* power), but those who have it have a moral obligation to make proper use of it in the interest of their own improvement and of that of the rest of humanity (i.e. this power *ought to be* used). The natural motion of the intellect towards knowledge is therefore counterpointed by a natural (and normative) motion of knowledge towards action.²

To nuance the previous point, it is worth noting that, despite the emphasis on utilitarian action, Bacon recognises that speculation and imagination too are essential for the advancement of knowledge. Speculation is an element of the interpretation of nature.³ So are deduction and abstraction, in that they are inherent in the processes of reduction and exclusion.⁴ Imagination too plays the central role of acting as an "agent or *nuncius* in both provinces [i.e. reason and action] (...) for the face towards reason hath the print of truth, but the face towards action hath the print of good".⁵ Furthermore, in Bacon's system, the universe is organised in correspondences, whose understanding requires applying analogy and similitude ("there is no proceeding in invention of knowledge but by similitude")—a position eloquently illustrated in Bacon's (and Hobbes's) own stylish and imaginative use of language, typical of the humanistic tradition. Likewise, contemplation appears to occupy a prominent position in Bacon's project. In a letter addressed to the Lord Treasurer Burghley in 1591, Bacon himself confesses to having "as vast contemplative ends, as (...) moderate civil ends: for [he has] taken all knowledge to be his province".⁶ If one recalls Aristotle's

¹"For good thoughts (...) are little better than good dreams, except they be put in act; and that cannot be without power" (*Of Great Place*; Bacon, *Works*, 6:399).

²In Aristotle's formulation: "the exercise of knowledge follows at once upon the possession of it unless something prevents it" (Aristotle, *Physics* VIII, 4, 255a31-255b5).

³Stephen Gaukroger, *Francis Bacon and the Transformation of Early-Modern Philosophy* (Cambridge: Cambridge UP, 2001). Speculation, however, can never outweigh facts, i.e. objective, empirical observations: in this sense, speculation "ceases where sight ceases" (Gaukroger, 123).

⁴William A. Sessions, *Francis Bacon Revisited* (New York: Twayne, 1996).

⁵*Of the Advancement of Learning* (1605), II, 147; Bacon, *Works*, 3:382.

⁶Bacon, *Works*, 8:109, although the passage later shifts to a mixed balance of idealism and more practical overtones: "and if I could purge it of two sorts of rovers, whereof the one with frivolous disputations, confutations, and verborities; the other with blind experiments and auricular traditions

notion of the primacy of knowledge for its own sake (*propter ipsum scire*) over knowledge for a secondary purpose (*propter necessitate actionis*¹), it becomes apparent why Bacon's stance—utilitarian on the surface (e.g. “knowledge and power meet in one”), but also laden with contemplative, speculative and imaginary traits—has been referred to as “non-Aristotelian Aristotelianism”.²

In sum, the understanding of knowledge developed from the early physics of natural motion (which takes physical reality *and* its inherently mutable essence—i.e. motion—as possible objects of knowledge), emerged from the challenge with medieval Neoplatonism (which treats physical reality, precisely because of its inherently mutable essence, as *not* knowable), to finally land, via its scholastic reworking, in Early Modern theorizations. My suggestion is that the understanding of knowledge expressed in Bacon's and Hobbes's writings reflects, challenges, and responds to the tension between the legacy of the Aristotelian physics of motion, its scholastic reformulation, and the intervening (Early Modern) advances in the natural sciences. Examples drawn from Bacon's and Hobbes's work suggest that elements of Early Modern thought reflect the very tradition from which they attempt to break away. Specifically, the recasting of the human mind and intellect in physical terms, and the understanding of the human quest for knowledge in terms of a constant desire of the intellect to fulfil its natural potential, reflect the scholastic reformulation of the Aristotelian principle of natural motion (of the incomplete towards its completion) in terms of the imperfect naturally moving towards (seeking, desiring, longing for) perfection—a predetermined perfection that is specific and proper to it.



and impostures, hath committed so many spoils; I hope I should bring in industrious observations, grounded conclusions, and profitable inventions and discoveries; the best state of that province. This, whether it be curiosity, or vain glory, or nature, or, if one take it favourably, the love of mankind; is so fixed in my mind, that it cannot be removed. And I easily see, that a place of any reasonable countenance, brings command of more wits than of a man's own; which is the thing I greatly affect”.

¹Aquinas, *Commentary to Aristotle's "Metaphysics"*, 1, 1, 14. The commentary refers to Aristotle's passage at 981b30.

²Pérez-Ramos, *Bacon's Idea of Science*, 113.

8 BACON AND HOBBS lived in an age of societal stirring, religious strife, civic unrest, and political violence. *Leviathan* was written during the English Civil War (1642-1651), and the theory of statecraft that it presents was developed in response to that warring historical context, where peace was felt as the supreme value and most urgent socio-political goal. They also lived through pandemics. In Hobbes's time London's so-called 'Black Death' was raging.¹ Commentators have invoked the Black Death as capable of reducing civilization to Hobbes's envisioned anarchic state.² Others have discussed Hobbes's parallel between body-politics and natural body in reference to the the Covid-19 pandemic.³ In chapter 29 of *Leviathan*, Hobbes characterises the Commonwealth as being susceptible to "infirmities", "diseases", "epilepsie", obstructed nerves, "convulsions", and "want of (...) Nourishment", "pleurisie", "fever", "lethargy", "consumption".⁴

Under those war- and plague-torn historical circumstances, given Hobbes's view of human nature as innately self-centred and conflictual, submission to government-imposed restrictions in exchange for protection was regarded as a rational deal for any individual who valued peace and their own survival. But Hobbes's reflections also remain relevant to this day, as they resonate in the context of the current Covid-19 pandemic, where submission to government-imposed regulations—e.g. restrictions of movement, imposition of economic losses, social distancing, increased surveillance—is framed as a necessary price to pay in exchange for defence against (or at least mitigation of) otherwise uncontrolled spread of the disease, and ultimately increased one's chances of survival. Like Hobbes's political theory, Aristotle's virtue ethics has been invoked in the press in relation to the current pandemic,⁵ and it has been observed that Aristotle's work contains references to Hippocrates's *Epidemics*.⁶ Bringing

¹See e.g. the various entries under the year 1665 in the diary of Samuel Pepys.

²Bill Bynum, "A Dark Epidemic: Responding to the Black Death", *The Lancet* 365, no. 9470 (April 30, 2005), pp. 1533-34.

³Sara Rushing, "On Bodies, Anti-bodies, and the Body Politic in Viral Times", *Theory & Event* 23, no. 4 (Supplement), (October 2020), S53-S60.

⁴Hobbes, *Leviathan*, 2, 29, §§1-22; 213-21.

⁵Rebecca Goldstein, "What Would Aristotle Do in A Pandemic?—Philosophy Can Help Us Navigate the Moral Dilemmas of the Covid-19 Crisis, from Rationing Medical Care to Restarting the Economy", *Wall Street Journal*, 18 April 2020, C, 4.

⁶Janine Bertier, "À propos de quelques résurgences des *Épidémies* dans les *Problemata* du Corpus

what has been discussed in the previous sections to bear upon the present-day arena, I would like to suggest that the current polarization in public debate surrounding governmental regulatory responses to the Covid-19 pandemic is reminiscent of Early Modern tensions in the understanding of the locus of authority for knowledge, and of the relation between knowledge and action. The current restrictions enforced through governmental regulations in response to the Covid-19 pandemic, as well as the clash between different attitudes vis-à-vis such regulations, lend Bacon's and Hobbes's concerns renewed urgency. And here is where the problem of epistemic responsibility, evoked at the start, arises.

Epistemic responsibility entails epistemic duties, that is the obligation to seek information and acquire knowledge of what one is reasonably expected to know. The duty is greater the greater the impact of one's choices and actions (e.g. public authorities who impose regulations upon millions have a greater epistemic duty than a private individual making choices of little consequence beyond herself). Epistemic duty entails that one ought to inform oneself before taking stance—e.g. issuing, assenting to, complying with, dissenting from, or resisting against regulations. In a recent essay,¹ Neil Levy and Julian Savulescu have argued that, faced with the current Covid-19 epidemic and related government-imposed regulations, non-epidemiologists (i.e. individuals with expertise outside the field of epidemiology) have an epistemic responsibility. Generally speaking, they argue, epistemic responsibility is fulfilled differently, depending on the matter at hand: faced with questions where scientific consensus exists, epistemic responsibility is best fulfilled through deference (i.e. by deferring to scientific consensus, as this is reliably formed and difficult to properly contest by those lacking specialist scientific training). Conversely, faced with issues on which science is not (yet) settled and consensus is only at best beginning to emerge, deference is inadvisable, and epistemic responsibility is instead best fulfilled through questioning, as this will contribute to stress-test emerging positions, so that reliable consensus may eventually emerge. They go on to argue that, in the case of the Covid-19 pandemic, insofar as the science is not

aristotélien", in *Die hippokratischen Epidemien*, ed. Gerhard Baader and Rolf Winau (Stuttgart: Steiner, 1989), 261-69.

¹Levy and Savulescu, "Epistemic Responsibility".

yet settled—it wasn't at the time of their writing, and it still largely isn't now, although more is known now than it was then, and vaccine development and administration is under way in Europe,¹ the USA,² and globally—non-epidemiologists should keep questioning, so that scientific hypotheses can be stress-tested through challenges from multiple perspectives, and a scientific consensus worth deferring to can be formed.³

As Levy and Savulescu observed, the challenge of the current Covid-19 pandemic is that, whilst scientific evidence is still limited, stakes are high.⁴ Regulations are often politicised and come under attack. Resistance to Covid-19-related regulations has taken different forms, ranging from blunt denial of there existing a pandemic at all, to more focused criticism against specific assumptions, rationale, modalities, and implications of governmental intervention. Whilst advocates of state-imposed regulation keep pointing out the magnitude of the pandemic, the gravity of the danger to society, and the life-saving potential of restrictive measures, opponents reject the latter—either specific measures (e.g. lockdown, school closure, business closures, etc.), or regulation *tout court* (e.g. proponents of herd immunity, or advocates for what one could call 'Darwinian' approaches that preconise letting the virus circulate freely so as to allow natural selection to run its course), be such rejection based upon utilitarian considerations (e.g. perceived lack of effectiveness in tackling the pandemic, or acknowledged effectiveness but excessive cost in terms of side effects), or upon ideological ones (e.g. perceived usurpation of fundamental rights), or upon any combination of the two. Whilst the opposition between supporters of regulation (e.g. advocates for lockdown and other heavy interventions) and their opponents (e.g. advocate for herd immunity) is often expressed in the language of a struggle between state-control and individual freedom, I would like to suggest that the current polarization within the Covid-19-related discourse reflects

¹Cornelius Hirsch and Arnau Busquets Guàrdia, "Coronavirus Vaccination in Europe—by the numbers", *Politico* 11 (January 2021), <https://www.politico.eu/article/coronavirus-vaccination-europe-by-the-numbers/>.

²Ben Guarino, Ariana Eunjung Cha, Josh Wood and Griff Witte, "The Weapon that Will End the War": First Coronavirus Vaccine Shots Given Outside Trials in U.S.", *The Washington Post*, 14 December 2020.

³Levy and Savulescu, "Epistemic responsibility", 2.

⁴Levy and Savulescu.

epistemic uncertainty, and, accordingly, expresses a struggle for the locus of authority for knowledge, and not (or not only) a struggle over freedom.

Individual responsibility involves a “freedom condition”, i.e. the possibility to choose otherwise, but also “an epistemic condition”, i.e. the awareness of the significance of one’s choice.¹ By ‘epistemic uncertainty’ I mean lack of clear evidence and/or solid intellectual references upon which to rely in order to form a belief (e.g. knowledgeable experts who can provide and generate (through mutual cooperation) reliable information through testimony,² and thereby guide non-experts’ belief-formation). In the context of the current pandemic, the evidence available—either on the disease, or on the effectiveness of regulations intended to combat its spread—is still relatively undeveloped, and at times contradictory. For example, studies found limited evidence that social distancing is effective in reducing the risk of exposure.³ Although the majority of infected individuals recovered, and vaccination campaigns are underway, the duration and extent of either disease- or vaccine-induced immunity are (by necessity, given the short time elapsed from the outbreak) unknown. Regulations (e.g. lockdown) intended to avoid the harm of infection have a cost that is difficult to measure, including economic recession, job losses, feeling of isolation, mental health toll of isolation.⁴ Some have argued that such regulations may be more harmful than the harm they are intended to avoid.⁵ Others have instead provided evidence in favour of restrictive measures (e.g. correlation between early lockdown and

¹Mele, “Moral Responsibility for Actions”; Robichaud and Wieland, eds., *Responsibility*.

²Elizabeth Fricker and David E. Cooper, “The Epistemology of Testimony”, *Proceedings of the Aristotelian Society*, suppl. 61 (1987): 57-83 and 85-106; Peter Lipton, “The Epistemology of Testimony”, *Studies in History and Philosophy of Science Part A* 29, no. 1 (March 1998): 1-31.

³Tom Jefferson, *et al.*, “Physical Interventions to Interrupt or Reduce the Spread of Respiratory Viruses”, *Cochrane Database of Systemic Reviews*, no. 7, Art. No. CD006207 (July 6, 2011), <https://doi.org/10.1002/14651858.CD006207.pub4>.

⁴Samantha K. Brooks *et al.*, “The Psychological Impact of Quarantine and How to Reduce It: Rapid Review of the Evidence”, *The Lancet* 395, no. 10227 (March 14, 2020): 912-20.

⁵John P.A. Ioannidis, “Coronavirus Disease 2019: the Harms of Exaggerated Information and Non-Evidence-Based Measures”, *European Journal of Clinical Investigation* 50, no. 4 (April 2020), e13222; Ioannidis, “Global Perspective of COVID-19 Epidemiology for a Full-Cycle Pandemic”, *European Journal of Clinical Investigation* 50, no. 12 (December 2020): e13423.

fewer deaths¹), and increasingly argued for the urgency² and efficacy of drastic regulations (e.g. national lockdown).³ Responsible choice and action in the context of the current (or any) pandemic—for example issuing, assenting to, complying with, dissenting from, or resisting against regulations—entails that one ought to inform oneself properly⁴ before choosing a stance. Hence, it demands knowledge, as well as freedom. At the time of writing, the information available on the Covid-19-pandemic is still fragmentary and partly based upon mathematical modelling that involve heavy assumptions.⁵ As indicated, Levy and Savulescu argue that the responsible attitude vis-à-vis unformed scientific consensus is to question and challenge emerging consensus until it becomes settled.⁶ I would add that the role of Covid-19-related regulations—and the question of whether one ought to issue, assent to, comply with, dissent from, or resist against such regulation—is a direct extension of the issue of epistemic uncertainty, taken to the next level, i.e. that of its implications for action. In other words, it is a question of relation between knowledge and action. And I suggest that Hobbes’s Aristotelian-physics-inflected account of human quest for knowledge in terms of natural motion may offer a speculative model that may help in envisioning such relation between knowledge and action. I will refer to this model as ‘ballistics’.

¹Christopher Dye, Russell C.H. Cheng, John S. Dagpunar and Brian G. Williams, “The Scale and Dynamics of COVID-19 Epidemics across Europe”, *Royal Society Open Science* 7, no. 11 (November 25, 2020): 2017-26.

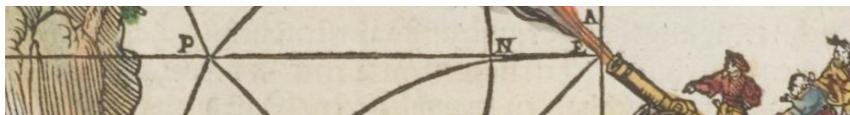
²Nisreen A. Alwan *et al.*, “Scientific Consensus on the COVID-19 Pandemic: We Need to Act Now”, *The Lancet* 396, no. 10260 (October 31, 2020): E71-E72.

³Edward S. Knock, *et al.*, “The 2020 SARS-CoV-2 Epidemic in England: Key Epidemiological Drivers and Impact of Interventions” (Report 41), Imperial College London (December 22, 2020), <https://doi.org/10.25561/85146>.

⁴A common misconception in this respect is the illusion of explanatory depth (tendency to overestimate one’s own understanding of complex phenomena). Leonid Rozenblit, Frank Keil, “The Misunderstood Limits of folk Science: An Illusion of Explanatory Depth”, *Cognitive Science* 26, no. 5 (September 2002): 521-62.

⁵See, for example: Adam J. Kucharski *et al.*, “Early Dynamics of Transmission and Control of COVID-19: a Mathematical Modelling Study”, *The Lancet Infectious Diseases* 20, no. 5 (May 2020): 553-58; Adam J. Kucharski *et al.*, “Effectiveness of Isolation, Testing, Contact Tracing, and Physical Distancing on Reducing Transmission of SARS-CoV-2 in Different Settings: A Mathematical Modelling Study”, *The Lancet Infectious Diseases* 20, no. 10 (October 2020): 1151-60.

⁶Levy and Savulescu, “Epistemic Responsibility”, 2.



9 I TAKE MY CUE from Richard Tuck’s characterization of Hobbes’s universe as a “ballistical system”.¹ Such is the universe within which Hobbes’s man operates, a universe of moving entities, each following their own path, and interacting with their surroundings (i.e. other moving entities) in various ways. I would like to suggest that Hobbes’s ballistic system, coupled with Aristotle’s physics of natural motion, may find timely resonance in the context of the epistemic uncertainty characterizing the current Covid-19 pandemic.

The Early Modern concept of motion, which I suggest bears relevance to the Baconian and Hobbesian account of human nature and quest for knowledge, was informed by the Copernican and Galilean models, and was therefore fundamentally different from the kind of motion dominating the Aristotelian physics. In the Aristotelian system, heavenly bodies were thought of as composed of a superior and immutable substance, and were therefore qualitatively different from physical objects on Earth.² Also, ancient Greek astronomers and pre-Galilean philosophers converged on the axiomatic notion that heavenly bodies moved around Earth in a perfectly circular motion—the only kind of motion that can be eternal.³ Galilei’s astronomical observations, first reported in 1610 in his *Sidereus nuncius*, and further developed in his 1632 *Dialogue Concerning the Two Chief World Systems*, overthrew the Aristotelian system, and ushered in a new understanding of knowledge as universal, i.e. applicable both to the earthly and heavenly spheres, as the same physical principles underlie celestial and terrestrial phenomena.⁴ Key to this paradigm shift is the discovery of the physical phenomenon of inertia: whilst Aristotelian physics takes rest as a

¹Richard Tuck, *Hobbes: A Very Short Introduction* (Oxford: Oxford UP, 2002), 63.

²Stillman Drake, ed., *Discoveries and Opinions of Galileo* (New York: Anchor Books, 1957).

³“Now, circular movement can be eternal, but no other kind of movement, and no other kind of change either, can be eternal, because they are bound to involve rest which means that the movement or change has ceased to exist” (Aristotle, *Physics*, VIII, 9, 265a26).

⁴Steven Shapin, *The Scientific Revolution* (Chicago: University of Chicago Press, 1996).

default state, and seeks to explain the generation of motion, Galilean physics takes motion as a given.¹

The paradigm of inertial motion penetrated Hobbes's understanding of human nature, and gave his social theories the status of "cosmological realities".² Reflecting Galilei's theory, Hobbes believes that all matter is in motion, unless acted upon by an external force: "when a body is once in motion, it moveth (unless something else hinders it) eternally";³ and again: "[w]hatsoever is at rest will always be at rest, unless there be some other body besides it (...) In like manner, whatsoever is moved will always be moved, unless there be some other body".⁴ By the time the *Short Tract on First Principles* was completed, a philosophical work attributed to Hobbes (likely either written by him or based upon his ideas), dating between 1630 and 1636,⁵ inertial motion had become intertwined in his psychological model, where the human urges for self-interest and self-preservation arise from what Spragens characterises as a "human equiv-

¹Alexandre Koyré, "Newton and Descartes", chap. 3 of *Newtonian Studies* (London: Chapman & Hall, 1965), 53-114; Edward Rosen, "Kepler's Harmonics and his Concept of Inertia", *American Journal of Physics* 34 (1966): 610-13; Allan Franklin, "Principle of Inertia in the Middle Ages", *American Journal of Physics* 44 (1976): 529-45; Max Jammer, "Force and the Rise of Classical Mechanics", chap. 6 of *Concepts of Force*, 2nd ed. (New York: Harper, 1962), 94-115; I. Bernard Cohen, "'Quantum in Se Est': Newton's Concept of Inertia in Relation to Descartes and Lucretius", *Notes and Records of the Royal Society of London* 19, no. 2 (1964): 131-55; Cohen, "Newton's Copy of Leibniz's *Théodicée*: With Some Remarks on the Turned-Down Pages of Books in Newton's Library", *Isis* 73, no. 3 (1982): 410-14; Ofer Gal, "The Invention of Celestial Mechanics", *Early Science and Medicine* 10, no. 4 (2005): 529-34; Ernan McMullin, "The Principle of Inertia", in *Galileo: Man of Science*, ed. Ernan McMullin (New York: Basic, 1967), 27-31; McMullin, "Kepler: Moving the Earth", *HOPOS* 1, no. 1 (2011): 3-22.

²Lisa T. Sarasohn, "Motion and Morality: Pierre Gassendi, Thomas Hobbes and the Mechanical World-View". *Journal of the History of Ideas* 46, no. 3 (1985):363-79, 363. Even before the exile in Paris, Hobbes had made three tours of the Continent (1610-15, 1629-30, 1634-6), which according to John Aubrey provided the opportunity to meet Galilei, and kindle his own enthusiasm for optics and the science of motion, and the way the different movements present in the natural world may affect senses, intellect and imagination (Gaskin, introduction).

³Hobbes, *Leviathan*, 1, 2, §2; 11.

⁴Hobbes, *De corpore*, 8, 19.

⁵For a discussion about the attribution and dating of the *Short Tract* see Brandt, *Hobbes' Mechanical Conception*; Perez Zagorin, "Hobbes's Early Philosophical Development", *Journal of the History of Ideas* 54, no. 3 (1993):505-18. It has been argued that the tract was written by Robert Payne (chaplain to the Cavendish family of Welbeck Abbey), based in part upon ideas expounded by Hobbes at Welbeck. See Timothy Raylor, "Hobbes, Payne, and *A Short Tract on First Principles*", *The Historical Journal* 44, no. 1 (March 2001): 29-58.

alent of the law of inertia”.¹ In an age dominated by the tension between the classic Aristotelian-scholastic optimism about human morality and capacity for knowledge, and the late 16th-century scepticism, which had called into question the possibility of ever truly knowing anything (or, in the extreme case of Descartes, the possibility of anything ever truly existing at all outside of man’s mind), Galilean physics came to represent a potential third alternative, as it embodied a combination of anti-Aristotelianism *and* anti-scepticism.² Hobbes’s system, modelled after the Galilean physics, offers just that. In the *Short Tract*, the author rejects the notion of an original principle of motion, and argues instead that both the natural world and people are entirely determined by natural necessity, which is the action of matter in motion. It is easily observed that Hobbes’s account of human nature rests upon a mechanistic physiology. This materialistic determinism pervades all aspects of human existence, all of which relate to types of motion:³ the brain, the soul, the appetite, the will are all passive, acting only in response to external agents.⁴ Hobbes is right when he points out that his model echoes the Aristotelian principles of directed motion:

This definition agrees well with Aristotle, who defines Good to be that, to which all things are moved; which hath bene metaphorically taken, but is properly true; as if we draw the obiect to us, whereas the obiect rather drawes us to it by local motion.⁵

But there is a fundamental difference between the Aristotelian and Hobbesian accounts: Hobbes applies the principle of motion to living entities in a

¹Spragens, *Politics of Motion*, 177. Expanding on Spragen’s analysis, it has been argued that Hobbes’s analogy between inertia and human behavior bears the mark of Cartesian physics: in the political sphere, humans act like “rectilinear inertially moving individuals” or “inertial egoists” (Michel Verdon, “On the Laws of Physical and Human Nature: Hobbes’ Physical and Social Cosmologies”. *Journal of the History of Ideas* 43, no. 4 [1982]: 653-663).

²Tuck, *Hobbes*, 19.

³Hobbes distinguishes between ‘vital’ and ‘animal’ motions, the former being involuntary processes that keep the body alive, such as breathing; the latter being voluntary acts, such as speaking or moving limbs. See *Leviathan*, 1, 6, §1; *Elements of Law*, 7, §§1-2; *De Corpore* 25, §§1-4. See also Gaskin, introduction, xxx.

⁴In this system, “sense [*sensus*] is a passive power of the Animal Spirits, to be moved by the species of an externall object suppos’d to be present” (Hobbes, *Short Tract*, 208); and again, “understanding (as a power) is a passive power”, and: “*Malum*, therefore, to everything is that which hath active power to repell it” (209).

⁵Hobbes [attrib.], *Short Tract*, 166.

way that excludes any possibility for them to act according to a superior moral drive. I would suggest that a stronger correspondence between the two theories is found elsewhere, and specifically in the Hobbesian notion that all voluntary actions are directed towards what is desired, i.e. towards what each individual perceives as their own good: “of the voluntary acts of every man, the object is some *good to himself*”.¹ This quest for one’s own specific individual ‘good’ seems to propose a utilitarian version of the scholastic principle whereby the imperfect seeks its (own, specific) perfection, as developed from the Aristotelian physical principle of natural motion of things towards their “natural place”. Hobbes’s “every man is desirous of what is good for him” essentially restates Aristotle’s idea that things “seek”, “desire”, “yearn for” their natural completion, the actualization of their potentiality, their form:² i.e. their “natural place”.³

I suggest that, in the face of epistemic uncertainty, Hobbes’s ballistic system, via Aristotle’s physics of natural motion, offers a model that casts human mind and behavior in terms of motion to natural places, where the “natural place” of the human intellect is knowledge, and the natural place of knowledge is action. In the context of the current pandemic and attendant regulations, the relation between knowledge and action may be taken as the relation of empirical evidence (e.g. microbiological and epidemiological data) to government-imposed regulations (e.g. lockdown). Of course I do not claim that such ballistic mechanism, physically drawing individuals to seek out knowledge and base their actions upon evidence, has an ontological reality. Rather, I suggest that it might offer a conceptual template, or merely a visualization aid, to reflect on belief-formation and decision-making in relation to their respective processes of coming into being, in particular their epistemic bases. This could then be applied to the current pandemic context.

¹Hobbes, *Leviathan* XIV, 8, 88 (emphasis is the author’s). Also “every man’s end being some good to himself” (Hobbes, *The Elements of Law* XXIV, 4, 139), as well as “every man is desirous of what is good for him” (*De cive* [1642]; English translation by the author: Thomas Hobbes, *The Citizen: Philosophical Rudiments Concerning Government and Society* [1651], in *Man and Citizen*, ed. B. Gert [Indianapolis, IN: Hackett, 1991], I, 7; 115). It is tempting to see a similarity with the title of Montaigne’s Essay 1.14, “That the taste of good and evil depends in large part on the opinion we have of them” (Montaigne, *Complete Essays*, 33 ff.).

²Aristotle, *Metaphysics* IX, 6, 1048a25 and ff.

³*Physics*, I, 9, 192a15-20.

Hobbes's account of man's acquisition of knowledge as "Motion of the Animal Spirits, by the Action of the brayne, qualified with the active-power of the externall object" casts the the object (of knowledge) as pulling the human mind towards itself, whilst the passive motion of the human mind towards it, mediated by the natural human desire to know. The ambiguity between the seemingly active disposition implied in the act of "desiring" (to know), and the passive connotation of the idea of being pulled by the desired object of knowledge creates a tension between two contrasting and simultaneously represented accounts of human nature: the one, dominated by agency; the other, by determinism. And here is the ballistic quality. In ballistics, one can exert some control over the initial thrust—e.g. by applying knowledge of the laws of physics to anticipate their effect on the trajectory—but, once the arrow is airborne, its trajectory is affected by mechanical forces beyond one's command. Likewise, in the face of epistemic uncertainty, Hobbes's ballistic system, via Aristotle's physics of natural motion, encourages to envision the human mind as tending, aiming towards knowledge, that is, its natural place, but being susceptible to deterministic forces beyond one's wilful control—like an airborne arrow or a projectile are susceptible to gusts of wind that will affect their trajectory beyond the archer's control. One needs knowledge in order to take responsible stance or action. Depending upon the quality of evidence available, one can calibrate the shot: well-investigated phenomena enable well informed choice and bold action; poorly understood ones—such as the Covid-19 pandemic—demand caution in thought and action. In a pandemic, the more evidence accrues, the more wisely one will be able to choose appropriate regulatory interventions, the more precisely will individual measures be tailored, the more effective the treatment and likely the recovery, despite the possibility of infection beyond one's control. Likewise in archery: the more evidence at one's disposal, the more wisely one can choose the atmospheric conditions, the more precisely one can aim and shoot, the better the chances to hit the target, despite the occasional gust beyond one's control.



10 EARLY MODERN accounts of knowledge emphasise the influence of humanism and the natural sciences in promoting a shift away from a speculative approach, typical of the scholastic tradition, and towards an empirical, evidence-based method, predicated upon a vision of nature as a well-ordered machine, whose rules are, in principle, entirely accessible for human discovery and control. Bringing into dialogue natural philosophy, intellectual history, and Aristotelian physics, I have examined how the Early Modern—especially Hobbes’s—understanding of knowledge reflects, challenges, and responds to the tension between advances in the natural sciences, and the legacy of ancient epistemic traditions. I have argued that the Hobbesian understanding of knowledge, as well as of the relation of knowledge to action, implicitly subtends a recasting of human nature and intellect in physical terms, and in particular in terms of the Aristotelian physics of natural motion, especially as reformulated by the scholastic tradition. Viewed through this physical recasting, the quest for knowledge acquires (in my view also normative) purpose: just like the Aristotelian incomplete tends towards its completion, and its scholastic reformulation as imperfect naturally moves towards (seeks, desires, longs for) perfection—a predetermined perfection that is specific and proper to it—so too the human intellect desires to fulfil its natural and proper potential. Equally, just like the human intellect desires to fulfil its natural and proper potential through the quest for knowledge, so too the acquired knowledge ought to be acted upon for the sake of improving the human condition. In Bacon such knowledge-driven improvement meant applying the ‘scientific method’ in order to gain mastery over nature; in Hobbes it meant applying political insights on the efficacy of absolute rule in order to maintain peace; in today’s Covid-19 pandemic it may mean applying empirical evidence in order to reduce the spread of the disease and improve the infected individuals’ chances of survival. Hence, the Aristotle-inflected, Early Modern concerns that occupied Bacon and Hobbes may be usefully brought to bear upon current debate on the locus of authority for knowledge, and on the legitimacy of governmental regulations in relation to the Covid-19 pandemic. Viewed through the Early Modern perspective, the current debate on restrictions enforced through governmental regulations in response to the Covid-19 pandemic acquires historical depth and moral urgency: if one accepts that the quest for knowledge involves a normative purpose to act upon such knowledge for the sake of improving the human condition,

then it becomes imperative to seek quality empirical evidence, and to act upon it in ways that are likely to promote individual and population health, according to the best available state of the art. Under these assumptions, and provided governments enforcing such regulations are subjected to proper and continuous scrutiny to ensure any restrictive measure is constantly adjusted and promptly lifted as soon as no longer essential, the tensions and polarization with regard to the locus and authority of knowledge observed in certain factions of the Covid-19-related discourse—as reflected, for example, in the dismissal of scientific expertise and rejection of empirical evidence involved in pandemic denial or conspiracy theories—would be regarded as empirically unsubstantiated and normatively unjustifiable.

Hobbes is often invoked in the press and scholarship on Covid-19-related regulations, but this invocation tends to focus upon the issue of individual freedom in the face of state control. However, as discussed, individual responsibility involves knowledge, as well as freedom. Whilst the opposition between supporters and opponents of regulation is often articulated and/or interpreted in terms of struggle between state-control and individual freedom, here I have suggested that the polarization in public debate surrounding regulatory responses to the Covid-19 pandemic also subtends epistemic uncertainty (itself due to the relatively early stage of research, lack of clear evidence or scientific consensus), and consequently a struggle over the locus of authority for knowledge and the relation of knowledge to action—and not (or not only) a struggle over freedom. In individual responsibility, freedom and knowledge interact.¹ Hence, whilst recognizing that references to Hobbes's political theory are fitting and timely, as epidemic-related regulations do raise issues of state control and individual freedom, here I have probed the Hobbesian relevance to the current pandemic beyond that trope. I have suggested that Hobbes is relevant to the current pandemic-related debate also—and perhaps most significantly—for his reflection on human knowledge and action. Bringing into dialogue natural philosophy, intellectual history, and Aristotelian physics, I have argued that elements of Hobbes's understanding of knowledge, as well as of the relation of knowledge to action, imply a casting of the human intellect in physical terms, and in particular in terms compatible with the Aristotelian physics of natural mo-

¹Robichaud and Wieland, eds., *Responsibility*.

tion, especially as reformulated by the scholastic tradition. I have then brought this historical point to bear upon the discussion surrounding the Covid-19 pandemic, suggesting that what is at stake in the current debate is not only (and perhaps not even predominantly) the problem of individual freedom and its state-imposed limitation through pandemic-related regulations, but rather the problem of knowledge (or, lack thereof, as in the early stages of the pandemic) and its role and potential in relation to action (where, in concrete terms, knowledge and action can be taken to translate as scientific evidence and regulatory intervention, respectively). I have finally suggested that the Hobbesian physics-inflected account of human yearning for knowledge, itself echoing Aristotle's physics of natural motion, may offer a relevant perspective—which I have characterised, following a suggestion of Gaskin's, as 'ballistic'—from which to reflect upon and responsibly assess, (dis)approve of, comply with, or challenge epidemic-related regulations. Taking a responsible stance vis-à-vis regulations—be it ideological (e.g. supporting or disapproving them) or practical (e.g. issue, comply with, or resist against them)—demands that one seek knowledge and act accordingly. The suggested—perhaps speculative, yet conceptually grounded and historically informed—ballistic view, envisions the intellectual dynamics of the pandemic-related debate in physical—more specifically, ballistic—terms, and conceptualises knowledge as that which the human mind seeks and desires, that towards which it aims, moves, and strives, the proper end to its trajectory, its form, its actualization, its perfection. In essence: its natural place. If not ontologically, one would wish at least normatively.



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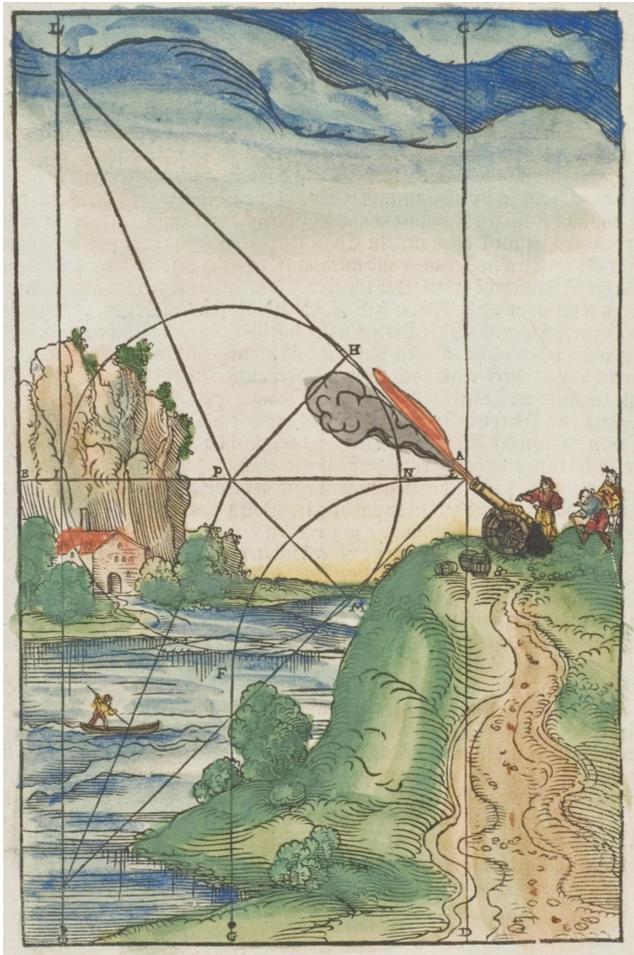
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Walther Hermann Ryff, *Der furnembsten, notwendigsten, der ganzen Architectur angehoerigen Mathematischen und Mechanischen kuenst eygentlicher bericht*, Nürnberg: Petreius 1547, f. 4v. *Digitale Sammlungen SLUB Dresden*, (<http://digital.slub-dresden.de/id263566811>).