A "PHYSIOGONY" OF THE HEAVENS: KANT'S EARLY VIEW OF UNIVERSAL NATURAL HISTORY

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From 1754 to 1756 Kant wrote on such central, related topics as the axial rotation of the Earth, the theory of heat, and the composition of matter, focusing on space, force, and motion. It has been noted that each of these topics pertains to his 1755 *Universal Natural History and Theory of the Heavens*, in which he drew on extant cosmogonies and the analogical form of Newtonianism developed by naturalists including Buffon, Haller, and Thomas Wright. How does Kant build on these various sources? This article aims to provide a nuanced account of specific features of the relation between natural history and natural philosophy in Kant's early developmental theory of the universe and to illuminate the strategy that guides his innovative, selective appropriation of contemporaneous insights.

1. Introduction

Some existing literature regards Kant's use of the sources that inspired his sketch of developmental natural history in his early cosmogony as mere eclecticism and syncretism.[1] Others, like Cooper (2020), highlight Kant's novelty,

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1. See De Bianchi (2013, 17); Mensch (2013, 52); Falkenburg (2020, 12).

arguing that the "full significance" (78) of his 1755 achievement lies in distinguishing radically his *Naturgeschichte* from the prevailing descriptive view of natural history in the early eighteenth century. Here I develop a nuanced account of the strategy guiding Kant's appropriation of sources for framing his hypothetical genetic and explanatory natural history of the heavens. Corroborating Cooper, in sections 2 and 3 I argue that in presenting a phenomenological theory of lawful features of physical development grounded on the agreement between analogical inference and observation, Kant indeed breaks with a previous prevalent attitude concerning the sole descriptive task of natural history. Then, augmenting Cooper, I contend that Kant develops his approach to natural history by drawing on an early seventeenth-century conception of this notion, which seeks more accurate insight into causes and principles for understanding the changing states and diversity of natural phenomena, in mutual interplay with natural philosophy as knowledge of the causes and effects of nature (Bacon), and which seeks a lawful deductive way to make intelligible the present order of the universe (Descartes). In section 4, I highlight specific ways in which Kant reacted to his contemporaneous sources, showing that his alleged eclecticism and syncretism are instead an original, carefully selective, if speculative, appropriation of the most relevant insights of his time. By showing how Kant's 1755 achievement builds on various legacies, I reassess Kant's hypothetical developmental conception of natural history, which accords with the use of rational theology in natural philosophy, opposing materialism, hylozoism, and any immediate, direct presence of God in creation, although without dispensing with God's action. Kant's unified project is no arbitrary combination of elements of opposing, competing theories that analogically extends natural history into a philosophical theory of nature, if and insofar as observation and theory correspond to support each other completely.

2. Kant's Early Cosmogony: Natural History as a Conjectural Science of the Origin of the Universe

As he concludes his 1754 essay on the rate of axial rotation of the Earth, the topic of the 1752 prize essay posed by the Prussian Royal Academy of Sciences of Berlin, Kant himself reveals how he reflected for years on cosmogony to complete a forthcoming work on this topic:

> This also allows us to see that the Moon is a later heavenly body added to the Earth after the latter had already given up its liquid state and taken on a solid state. . . . This last remark can be taken as a sample of a natural history (*Naturgeschichte*) of the heavens, in which the initial condition of nature, the generation (*Erzeugung*) of planets and the causes of their

systematic relations, ought to be determined from the characteristics (*Merkmaalen*) that the relations of the world edifice display unto themselves (*an sich*). . . . I have devoted a long series of reflections to this issue and have combined them into a system which will shortly be published under the title: *Cosmogony, or an attempt to derive the origin of the universe, the formation of the heavenly bodies and the causes of their motion from the universal laws of motion of matter in accordance with Newton's theory*. (Kant 1754/2012, 163–64; translation revised by author)

Despite this announcement, the actual title of Kant's 1755 work, *Allgemeine Naturgeschichte und Theorie des Himmels*, with its ill-fated editorial history,[2] forgoes unifying the two perspectives of systematic scientific theory and general natural history under the common heading of 'cosmogony', and it maintains the usual distinction between historical and theoretical inquiries. Note that the first part of the main 1755 title seems to echo Abraham Kästner's 1750 translation into German (with Haller's preface) of Buffon's *Historie naturelle*, rendered as *Allgemeine Historie der Natur*.[3] In the closing passage of the essay *Rotation of the Earth* quoted above, Kant uses *Naturgeschichte* to indicate a tentative genetic explanation of the formation of heavenly bodies through the proper consequences of fixed laws (of efficient causality), analogically inferred from distinctive traits observable at present:[4] a systematic attempt, both theoretical and historical, to reconstruct origins and causes, both concealed from direct inquiry, through their actual visible effects.[5] He also uses *Historie*, in relation to our Earth, to cover the

2. See Grillenzoni (1998, 200–201). For a list of early German editions of Kant's 1755 work, see Albrecht and Delfosse (2009, xliii). Note that the excerpts added to the 1791 German translation of Herschel's *On the Construction of the Heavens* contain significant variants especially regarding the mechanical genesis of Saturn's rings with the introduction of chemical attraction (see Grillenzoni 1998, 204 n. 54, 318–19 n. 419; Ferrini 2004, 278–84, 301–4). Another edition with Kant's "eignen neuen Berichtigungen" appeared in 1797. On the variants between the 1755 and 1797 editions, see De Franco (2001); on the scientific findings of Bode's astronomy (in the 1786 *Astronomisches Jahrbuch*) as confirming Kant's 1755 conjectures according to the 1797 edition, see Scrimieri (2004). On aspects of continuity from Kant's 1755 cosmology and theory of matter to the 1786 *Metaphysical Foundations of Natural Science*, see De Bianchi (2013, 27–33).

3. According to Zammito (2018, 177), Kant was aware not only of Buffon's work and title but also of Leibniz's 1749 theory of the formation of the world in his *Protogaea* and Louis Bourguet's 1749 *Lettres philosophiques* containing a long appendix on the epigenetic process of the formation of the *méchanisme organique* of the Earth. Wilson (2006, 378–79) recalls Bernard de Maillet's cosmogony sketched in the Third Conversation of his 1748 *Telliamed*, in which he offers a model for an eternal universe passing through cycles of births and rebirths.

4. See Albrecht and Delfosse (2009, xiii).

5. Massimi (2014) points out that the young Kant proposed a governing conception of natural laws of dispositional essentialist flavor, i.e., laws that are not just descriptions of occurrent states of affairs but are prescriptive by physical necessity and imposed by a lawgiver.

same range of aspects, comparing the reliability of these reconstructions on larger and smaller scales to the empirical description of the present state of our Earth, later designated as *Naturbeschreibung*.[6] In 1756, Kant distinguishes between *Geschichte* as narrative (*Erzählung*) of personal, moving stories of misfortune and distress, and *Geschichte* as tentative causal explanation of the work of nature in a terrible event (the 1755 Lisbon earthquake), correlating (not contrasting) the latter with the description of the accompanying natural circumstances (*Naturbeschreibung*; Kant 1756/2012, 342).[7] The issue returns in Kant's 1788 reply to Forster's (1786/1991) criticism of Kant's attempt to investigate origins in nature. Forster challenged Kant's distinction between history and description of nature. Kant (1788/2007, 197) remarks that if these two meanings are conflated, and by natural history one understood "a *narrative* (*Erzählung*) of events in nature not to be reached by any human reason," then indeed *Naturgeschichte* "would be, as Forster puts it, a science for gods." However, in defending the need as well as the possibility of derivative inferential inquiries into first origins, Kant restates a main epistemological feature of his precritical approach: natural history would only consist in "tracing back, *as far as the analogy permits*, the connection between certain present-day conditions of the things in nature and their causes in earlier times according to laws of efficient causality, which we do not make up but derive from the powers of nature as it presents itself to us now" (197).[8] Within this context, Kant refers to the natural history attempted also

6. De Bianchi examines the epistemology underlying the cluster of Kant's precritical essays on the theory of the Earth in the two complementary writings of 1754 on the axial rotation (its motion) and the Earth's aging, i.e., its evolution, including a theory of planetary formation (see Laywine 2004). De Bianchi (2018, 59) stresses that the question of whether the Earth is aging not only includes a theory of planetary formation; it also involves the interaction between human beings and the environment. Linnaeus's innovative reading of the history of nature is in terms of a naturalistic interlacement of geological and biological issues: see his 1744 *Oratio de Telluris*, in which the history of living beings is presented in relation to the Earth's evolution and God is rationally deduced as the first cause (Linnaeus 1744, 15). In his 1757 *Sketch and Announcement of a Course in Physical Geography*, Kant (1757/1968, 8.5) mentions Linnaeus's theory of the Earth in relation to the *Geschichte* of the great changes our planet suffered in the past; he also considers the theories of the Earth of Woodward, Burnet, Whiston, Leibniz, and Buffon (8.29–30). On Kant's interest in Linnaeus's theory of the Earth and his *regnum lapideum* (in the *Systema naturae*), see Marcucci (1992/2010, 59, 68–69).

7. In the title of his 1756 essay on descriptive geography, Kant used the term *Naturbeschreibung*, but not in contrast to *Naturgeschichte* (Sloan 2006, 633 n. 19). In Kant's *Physical Geography* we read, "The history of occurrences (*Geschichte*) at different times—and this is true history (*Historie*)—is nothing other than a consecutive geography" (Kant 1802/2012, 449). See Marcuzzi (2011, 118–19).

8. According to Egerton (2007), in Linnaeus's conception of natural history, biotic interrelationships were designed by God to work harmoniously and permanently and for the benefit of humanity; moreover, Linnaeus's systematic approach to the *oeconomia naturae* involved the study of how the parts contributed to the functions of the whole, implying an "analogy" between organs in an animal and species in a biotic community: "By the 'Oeconomy of Nature' we understand the all-wise disposition of the Creator in relation to natural things, by which they are fitted to produce general ends, and reciprocal

in Linnaeus's theory of the Earth.[9] In a footnote, Kant proposes the term "physiography" for the description of nature and "physiogony" for natural history (198). In the body of the text, he remarks, "The word *history* (*Geschichte*), taken to mean the same as the Greek *historia* (narrative, description) has been in use too much and too long for us easily to tolerate that it be granted another meaning which can designate the investigation of origin in nature" (198). This reinforces the surmise that by calling his 1755 analogical inquiry into the mechanical origin of the cosmos *Allgemeine Naturgeschichte* and not *Allgemeine Historie*, Kant sought to distance his scientific hypothesis from any merely descriptive narration of natural events.

According to Cooper (2020, 78), in his 1755 *Naturgeschichte*, Kant's general account of the present diversity of nature as resulting from developmental processes embodied "a radically different conception of what natural history is meant to achieve," for "the prevailing view of natural history during the early eighteenth century still envisaged a descriptive project that provides natural philosophy with a storehouse of facts." As he states in the abstract to his article, Cooper situates Kant's 1755 essay "within the analogical form of Newtonianism developed by a diverse range of naturalists" (77), including Buffon, Haller, and Wright, who developed a systematic structure for investigating nature understood as universal natural history: "one that accounts for the diversity of natural phenomena as the result of a single causal nexus" (78). Cooper claims that "the full significance of Kant's achievement is . . . to transform what it means to provide a natural history from constructing a logical system of classification to providing an explanation for the present diversity of natural products according to laws" (78). Cooper's framework casts a different light on the significance of Kant's approach that deserves further elucidation.

In the following section, I refine Cooper's claim by considering Kant's physical and hypothetical cosmogony in connection with Bacon's general project for an integrated natural history, generating knowledge of nature insofar as it also illuminates causes and axioms of natural processes. Bacon undercuts any cleft between descriptive natural history and the physical part of natural philosophy, showing how they mutually influence each other. I further stress how Kant's natural history of the current configuration of the universe through the stages of its formation returns to an extent to a Cartesian generative theory of matter. Kant recasts Descartes's lawful deductive way of explaining the present order of

uses" (quoted in Egerton 2007, 81). On Kant's and Linnaeus's common attention to the connection between individual organisms and their habitat in their projects in natural history, see Wells (2020).

9. On Kant's criticism of the descriptive nature of Linnaeus's system (and his appraisal) in the critical period, see Marcucci (1992/2010, 62–85).

the universe within Kant's present concern to develop a cosmogony that requires no theology of Newton's natural philosophy.

3. Kant's 1755 History of Nature against the Backdrop of Bacon, Newton, and Descartes

In his 1605 *Advancement of Learning*, Bacon (1605/1876) distinguished between natural history, which describes the variety of things (114)—which, as all histories, is related to the memory of human understanding (85)—and natural philosophy, generally divided into the speculative "inquisition of causes" and the operative "production of effects" (111, 114), which as philosophy has reference to reason. History of nature regards the ordinary course of generation and production, as well as the largely incomplete or defective histories of "nature errying and varying" and of "nature altered or wrought," as is the case in agriculture or the manual arts (86). The first branch of natural philosophy, the inquiry into causes, in turn, is the object of physics, regarding material and efficient causes of particular things (being and moving), and the object of metaphysics, regarding formal and final causes (114). In Bacon's view, knowledge forms pyramids, based on history: "So of natural philosophy, the basis is natural history; the stage next the basis is physic; the stage next the vertical point is metaphysic" (117). In this way, Bacon apparently indicates a natural history that merely describes regular varieties and processes and that nourishes natural philosophy with observed facts and data, without bearing either on theoretical explanations according to cause and axioms or on devising experiments (the second branch of natural philosophy). However, Bacon cautions that "generally let this be a rule, that all partitions of knowledge be accepted rather for lines and veins than for section and separations; and that the continuance and entireness of knowledge be preserved" (129). Indeed, physics "is situated in a middle term or distance" between the memory primarily operating in natural history and the rational general concepts of metaphysics (114). Thus, speaking of the still-defective kinds of natural history, Bacon outlines a future research program focused on mechanical accounts (*historia mechanica*), for the advantages of explaining phenomena and benefiting human techniques and practices to forge nature. This will raise the history of nature varying (or erring) from the lamentably weak and unsatisfactory state in which it is. Bacon writes, "The use of history mechanical is of all others the most radical and fundamental towards natural philosophy" (98). In particular, Bacon points to a history of nature "wrought or mechanical" (88), in order to achieve "*a more true and real illumination concerning causes and axioms*. . . . For like as a man's disposition is never well known till he be crossed, nor Proteus ever changed shapes till he was strained and held fast; so the passages and variations of nature cannot appear so fully in the liberty of nature as in the trials and vexation of art" (89–90; emphasis added).

From 1605,[10] Bacon envisioned a more comprehensive natural history, no longer merely and solely descriptive and observational, to achieve truer insight concerning causes and axioms, aiming especially to understand the changing states and diversity of nature. Bacon's comprehensive use of natural history did not merely provide experimental and theoretical natural philosophy with descriptions of events or a storehouse of facts simply to provide a sufficient stock of observations to ground hypotheses and theories or to devise experiments, as his followers held.[11] Anstey remarks that it is a common misconception about Bacon's theory of natural history that the natural-philosophical stage, the interpretation of nature, follows from the natural-historical stage once the latter is complete: "However, a careful analysis of the respective classifications of natural history and natural philosophy, of Bacon's view on intermediate axioms, and of his own exemplar natural histories, shows that there is a mutual interplay between the construction of natural history and the development of natural philosophy for Bacon" (Anstey 2018, 209–10). Indeed, natural history's mechanical account of natural processes "illuminates" the causal explanations of natural philosophy. Likewise, regarding scrupulous collection, examination, and description of "the heteroclites or the irregulars of nature," the history of nature varying or erring would help "to correct the partiality of axioms and opinions which are commonly framed only upon common and familiar examples" (Bacon 1605/1876, 87). Some interpreters have replaced the metaphor of the "storehouse of facts" for natural history with an increasingly refined "scaffold" on which Bacon constructs natural philosophy.[12]

Recent scholarship has found "compelling evidence" that Buffon, clearly an advocate of experimental philosophy, conceived his undertaking in the *Histoire naturelle* as a natural history à la Bacon, or "at least as a project continuous with the method and practice of the Baconians of the latter decades of the seventeenth century" (Anstey 2018, 222). Bacon's interplay between the historical-descriptive and theoretical-philosophical aspects of our knowledge of nature is echoed in Buffon's 1749 "Initial Discourse: On the Manner of Studying and Expounding Natural History," when Buffon (1749/1981, 121) writes that the ancient naturalists had no idea "de ce que nous appelons Physique particulière

10. Anstey (2018, 208) recalls that, even in Bacon's mature scheme of the later 1623 *De Dignitate et de Augmentis Scientiarium*, with the distinction between *experientia liberata* and *interpretatio naturae*, "natural history is identified with core constituents of both operative and speculative natural philosophy."

11. I refer to Boyle's preface to the 1662 *Defence of the Doctrine Touching the Spring and Weight of the Air* (quoted in Anstey and Vanzo [2016, 91]).

12. I refer to Schwartz (2014) and Anstey (2018).

& expérimentale" and charges them with having missed the connection that an accurate and thorough descriptive process might have with "l'*explication* des phénomènes de la Nature" (emphasis added).[13]

Below I examine how Descartes disputed any merely descriptive aim of our historical knowledge of natural phenomena, advocating instead a fictitious explanatory model of the origin and formation of those phenomena, to make them more intelligible to us. My examination integrates Cooper's account of the contextualized meaning of Kant's natural history, and it affords a nuanced account of Kant's approach. For in his explanation of the current configuration of the universe through the stages of its mechanical formation, Kant explicitly reassesses this Cartesian genetic and explanatory theory of matter, rejected by Newton.

Newton never offered a cosmogony. Nevertheless, according to the *General Scholium* added to the second edition of the *Principia*, we may understand how our solar system works, how planets and comets constantly pursue their revolutions in orbits of specific kinds and positions, by means of the mere laws of mechanics. Newton writes that he finds no sufficient, competent collection of works of nature that shows digression from the law of gravity. However, he also writes that we cannot understand the constitution and first origin of the cosmos through mechanism alone, for the perfect systematic arrangement of the heavenly bodies cannot follow from mere mechanism but only from divine wisdom and power: "Yet they could by no means have at first derived the regular position of the orbits from those laws. . . . It is not to be conceived that mere mechanical causes could give birth to so many regular motions. . . . This most beautiful system of the sun, planets, and comets, could only proceed from the counsel and dominion of an intelligent and powerful Being" (Newton 1729/1962, 692.13–17, 28–30). Newton's combination of the two distinct features of divine "counsel" and "dominion" as concurring in giving birth to the beautiful order and disposition of the solar system recasts Bacon's account of the twofold mode of God's diachronic expression of power and wisdom in the creation:

> In the work of creation we see a double emanation of virtue from God; the one referring more properly to power, the other to wisdom; the one expressed in making the subsistence of the matter, and the other in disposing the beauty of the form. This being supposed, it is to be observed that for anything which appeareth in the history of the creation, the confused

13. In the first quotation, the English translation renders Buffon's *Physique* as "natural science," which risks missing the old sense of *physis*, i.e., the nature of the specific individuals under study.

> mass and matter of heaven was made in a moment; and the order and disposition of that chaos or mass was the work of six days; such a note of difference it pleased God to put upon the work of power, and the works of wisdom; wherewith concurreth, that in the former it is not set down that God said, *Let there be heaven and earth*, as it is set down of the works following; but actually, that God made heaven and earth: the one carrying the style of a manufacture, and the other of a law, decree, or counsel. (Bacon 1605/1876, 44)

Announcing an essay (*Versuch*) on the constitution and mechanical first origin of the whole world edifice treated according to Newton's fundamental principles (*Grundsätzen*), Kant meant to go beyond Newton's account of the heavens, without radically departing from Newton, by converting his descriptive model requiring the external intervention of God into an explanatory and inherently developmental law-governed approach.[14] Kant lacked access to Newton's unpublished drafts of the 1713 *General Scholium* and manuscript material composed around the same time (1713–15), but Steffen Ducheyne has shown how in this manuscript material Newton included several further points of criticism of Leibniz's Cartesianism (and of Cartesian philosophy in general), beyond those commonly documented and based on empiricist rejection of innate ideas. Ducheyne (2006, 245–46) underlines that "Newton's concerns were not only epistemological, he had severe theological, metaphysical and physical reasons for rejecting Cartesianism," and he quotes a passage from an unpublished manuscript that takes issue with §47 of Descartes's *Principia*, Part III, in which Newton charges Descartes with mere hypothetical reasoning and cautions that a self-propelling matter would not guarantee God's substantial omnipresence. In his *Opticks* Newton considered it "unphilosophical" to pretend that "the world might arise out of chaos by the mere Laws of Nature" (Shea 1986, 104 n. 13).[15]

Kant could find Descartes's explanatory and genetic mechanical approach to the formation and order of the heavenly bodies in §45 of *Principia*, Part III,[16]

14. Kant owned the 1713 edition of Newton's *Principia* printed in Amsterdam in 1714 (Warda 1922, 35). Falkenburg examines the systematic aspects of Kant's precritical cosmological project, focusing on his multilevel "unification methodology" in respect to Wolffian-Leibnizian metaphysics and Newton's physics. The main divergences between them are as follows: relative vs. absolute concept of space and time, internal vs. external force, continuum theory of matter vs. atomism, preestablished harmony vs. direct divine intervention (see Falkenburg 2020, 3–31).

15. Samuel Clarke's Latin translation of the second edition of Newton's 1719 *Opticks* was among Kant's books (Warda 1922, 35). On Newton's criticism of the Cartesian idea that sheer mechanical causes could originate motions, see Massimi (2014, 494–96).

16. Kant owned Descartes's *Principia* printed in 1650 in Amsterdam (Warda 1922, 47).

in which Descartes (1644/1905, 100) advocates the cognitive value of pursuing comprehension of the nature of things by examining the developmental stages of their formation (animal and vegetable nature included, through the study of embryos and seeds). Descartes advocates this much better (*longe melius*) way of explaining, regardless of the falsity (modulo the Genesis account) of assuming an original developmental formation of the natural world in time. He supports this claim of intelligibility despite the "doubtless" acceptance of the Christian truth of creation and the assent of natural reason to God's omnipotence, according to which, for example, God created the Earth, the solar system, and the fixed stars in all their present perfection at the origin of the world (99–100). In §47 Descartes, referring to his principle of inertia, his seven laws of motion, and his assumption that originally all parts of matter were of equal magnitude and quantity of motion, writes that these suppositions suffice as causes and principles from which to deduce all the effects that appear in nature. These laws of nature are such that, even supposing chaos in every part of the universe, one can still derive the order that presently exists in the world through the action (*efficacia*) of these laws. In short, it may be possible to start from chaos and deduce from it, through laws of nature, the order now to be found in things.[17]

In his own *Principia*, Descartes did not intend merely to 'recount' the world's development over time, because the evolutive mechanical model of formation was adopted as exemplar, on the basis of its genuine explanatory power; in a parallel passage of *Le monde* Descartes (1664/1905, 48) contrasts his cosmogonic fable, painted in 'chiaroscuro', to the "exact demonstrations" of what he says next, clarifying that his chief aim is to indicate how to obtain autonomous findings, once one undertakes the required research. Descartes's lawful deductive way of explaining present astronomical harmony is clearly echoed in the first part of Kant's subtitle: to inquire into the constitution and mechanical origin of the whole universe, claiming that even if we suppose an original chaotic confusion of every part of the universe, nature will produce the present order through the sole action of its own laws. As Kant writes at the outset of the *Theory of the Heavens*, one aim of his work is to derive the formation of the heavenly bodies themselves and the origin of their movements from the initial state of nature from mechanical laws (1755/2012, 194). Kant himself acknowledges this Cartesian legacy: "I will not be deprived of the right that Descartes

17. "Esti enim forte etiam ex Chao per leges naturae idem ille ordo qui jam est in rebus deduci posset" (Descartes 1644/1905, 102). In the parallel passage of *Le monde*, composed in 1632–33 but published in 1664, Descartes (1664/1905, 34–35) writes that God has established the laws of nature in such a marvelous way that even if he does not endow created matter with order or proportion, but composes the most confused and muddled chaos that poets may describe, ordinary natural laws suffice to cause the parts of that chaos to resolve and arrange themselves into their present good order.

always enjoyed from fair judges when he dared to explain the formation of the heavenly bodies from purely mechanical laws" (199).

Note that in Keill's *Examination of Dr. Burnet's "Theory of the Earth,"* Descartes is indicated as "the first who introduced the fancy of making a World, and deducing the origination of the Universe from mechanical principles" (Keill 1734, 16). As Jacques Roger remarks, confirming Cooper's general claim about the previous prevalent attitudes concerning natural history, contemporary scientists rejected Descartes's explanatory model of intelligibility for two main reasons:

> First, they did not believe that laws of nature are able to predominate chance if there is . . . no preexisting order: so that laws of nature may explain how the machine is running, but not how the machine was formed. Laws could not explain order. This is particularly clear in Boyle's essay *The Origin of Forms*. Second, they were generally sensitive to the argument from design and to the existence of final causes, which Descartes had clearly rejected. Hence they were disposed to discover in every existing structure direct evidence of God's wisdom, which supposed the structure to have been immediately created by God. Not before Maupertuis, in the 1750s was the argument from design transferred from purposeful structure to purposeful laws. (Roger 1982, 99)

In the next section, I focus on how Kant's precritical natural philosophy drew on, yet departs from, Newton's natural philosophy in the *Principia*, accounting for Haller's and Maupertuis's achievements and innovations in taking issue with certain features of Buffon's model of natural history. I highlight specific ways in which Kant's cosmogony attempted to settle contemporaneous controversies, avoiding any arbitrary or eclectic combination of elements of opposing theories. Instead, Kant attempts to establish a unified physical theory of efficient causes, from the originary state of matter to the present arrangement, in terms of a universal natural history.

4. Haller, Maupertuis, and Wright: Going beyond Newton's *Principia* according to Newton's Principles

As remarked earlier, the subtitle of Kant's 1755 essay presents his ambitious aim to publish an original work worthy of consideration by leading scientists of the time for its distinctive attempt to explain the constitution and the (vortex) mechanism at the origin of the whole universe "according to Newton's principles." Recent literature examining the origins of Kant's dynamical theory of matter has disclosed relevant respects in which his *Universal Natural History* does not endorse Newton's *Principia*. Referring to the two mechanical and materialistic traditions of Stephen Hales's chymio-statical experiment on elastic air and of Hermann Boerhaave's theory of fire, Michela Massimi (2011, 527) points to Newton's pre-*Principia* and *Opticks* that "offered air first, and ether then as the *repository of repulsive force*." Hales, building on Newton, is identified as the "main source of inspiration for Kant's repulsive force manifesting itself in the dissolution of matter in vapours" (527).[18] Cooper (2020) notes that this picture is complemented by how Kant's plan diverged from Newton's agenda in the *General Scholium* to the *Principia*, extending it by analogy to the cosmos as unified by the general rule of universal gravitation.[19]

Such analogical generalization in natural history was a relative novelty. As mentioned above, Kästner's 1750 German translation of Buffon's *Historie* was the only German edition until the 1760s. In his preface, Haller commented on a passage in Buffon's "Initial Discourse: On the Manner of Studying and Expounding Natural History," in which Buffon (1749/1981, 121) claimed that one should not confine oneself solely to making exact descriptions and ascertaining particular facts: "We must try to raise ourselves to something greater and still more worthy of our efforts, namely: the combination of observations, the generalization of facts, linking them together by the power of analogies and the effort to arrive at this high degree of knowledge. From this level we can judge that particular effects depend upon more general ones; we can compare nature with herself in her vast operation; and, finally, we are able to open new routes for the further perfection of the various branches of natural philosophy."

Haller underscores the scientific value of hypothetical thinking, remarking that the true utility of unproven but probable explanatory hypotheses is that, although they are not yet the truth, they are the best route invented to lead to it. Distinctive singular empirical appearances cannot be composed into a unique picture without aid from a hypothetical leading thread (a *Leitfaden*) bringing order to observed peculiarities and filling in blanks in truth. According to Haller, after Newton's destruction of arbitrary conjectures or hypotheses not inferred by general induction from phenomena (Rule IV) and his support of the hypothesis of the ether, "no one will be ashamed to propose something which is not completely demonstrable" (1750/1981, 301). Kant clearly endorses this view in his 1755 appeal to analogy, rejecting charges of fantasy and defending

18. Among the signs of divergence are Kant's appeal to a fine matter originally diffused in space, an original material cause/vortex mechanism underpinning the counterbalance of attractive and repulsive forces, and the varying density of each planet at the surface and in its interior (unaffected by the sun's heat).

19. Cooper (2020, 80–81) devotes one section of his essay to "Haller and hypotheses."

the probability of his unprovable (yet irrefutable) conjecture of the successive expansion of creation through the infinite spaces that contain the material for this within themselves.[20] Indeed, analogy "must always guide us in such cases where understanding lacks the thread (*Faden*) of infallible proofs" (1755/2012, 268). Moreover, when analogy is in perfect agreement with empirical observation, the synergy of their mutual correspondence has the scientific value of a "formal proof," thus raising a "presumption" (*Muthmaßungen*) to the certainty (convincing clarity and evidence) of a justified belief (221).[21] We can augment Cooper's reconstruction by remarking that Haller's legacy for Kant is not confined to the analogical extension of Newton's gravitation beyond the solar system and the scientific status of hypothesis and analogies determined from phenomena, for it points to the need for a goal-oriented force to explain the right order of parts in certain natural organized products.

The charges of "pernicious work" against Buffon's *Historie* by the Nouvelle Ecclésiastiques led to the Sorbonne Condemnation and to Buffon's disavowal in 1751 of everything in his book that concerned the formation of the Earth and that could be said to be contrary to the narration of Moses.[22] In his 1752 preface to the second volume of the *Historie der Natur*, Haller criticizes Buffon's theory of an organic active (nutritive, generative) 'homeomeric' and nonteleological matter, universally diffused within all animal and vegetable substances, equally suitable to become a man, animal, or plant, by widening the gap between inorganic organized natural products (from salts to crystalline structures) and organic, living bodies. At first, Haller (1751/1981, 315) acknowledges that Buffon's opinion

> derives its greatest probability from the universal conformity of Nature as a whole. The laws of gravity, attraction and elasticity, whose dominion extends to infinite distance, seem to demonstrate a great inclination in nature to govern several bodies by the same forces, and accomplish several

20. Kant assumes that creation continues to happen; as Schönfeld (2000, 117) remarks, Kant's cosmogony "applies to the past, present and future, because the evolution of the universe is an ongoing process." De Bianchi describes the model of Kant's hypothesis of a universe with matter disseminated throughout in different degrees of density as an elastic sphere that expands and tends to collapse. Like a phoenix, expansion can begin anew following collapse, owing to the repulsive force of ether (see De Bianchi 2013, 28–30). For readings in light of current science, see Scrimieri (1996–99, 1999–2000), De Franco (2004), and Schönfeld (2010).

21. On the scientific value of the case in which analogy and observation match and mutually support each other in full, to formally prove the certainty of a cosmological conjecture, see also Kant (1755/2012, 221, 238, 290–91).

22. Lyon and Sloan (1981, 213–93) translate into English the first reviews (dated 1749–51) of the *Histoire naturelle*, the 1751 Letters of the Deputies and Syndic of the Faculty of Theology of Paris to Buffon, and his reply.

> effects by the same laws. One easily discovers the traces of a creating spirit (*esprit créateur*) in this artistry (*art*) of producing such different, contradictory and complicated effects by the same causes. . . . From salts to snowflakes, to the trees of Diana, to the feathery plumes of ice, there extends an uninterrupted chain of organisations, which without any other artistry (*art*), are produced by the force of attraction alone.

Nevertheless, on the basis of anatomy, Haller remarks that Buffon cannot explain the 'right' order followed by organized particles in animal generation that correctly join separated parts of a body according to an invariable plan, stressing that Buffon needs a force that has foresight, can make a choice, and has a goal and that, against the laws of blind combination (for Haller, valid also for crystals), always and unfailingly brings about the same end (320). Haller highlights that Buffon is unable to explain on mechanical grounds the invariable production of the right anatomic order of parts in a living organism (so that an eye is never attached to a knee). By contrast, it seems that the force of attraction alone suffices to explain the physical formation of inorganic organizations on the ground of the ordinary presence of divine artistry within the universal conformity of nature.

Kant could find in Maupertuis an extension of the same need for a goal-oriented force to explain the formation of any organized natural product, such as the harmonic arrangement of the heavenly systems.[23] Kant acknowledged his debt to Maupertuis's notion of the specific elliptical figuration of an apparently disaggregated plurality of stars as expressing their internal mutual relationship, grouped according to a common plane. In the *Theory of the Heavens*, Kant explicitly quotes (in the original French) the second, augmented 1742 edition of Maupertuis's *Discourse sur les différentes figures des astres*, from an excerpt published in the 1745 *Acta Eruditorum*.[24] Maupertuis used our solar system to model any stellar nebula, regarding its stars as rotating about a common axis, so that the nebula would likely have a flattened form of an elliptical figure (Maupertuis 1742, 76–77). Prima facie, Kant's extensive quotation appears merely to endorse Maupertuis's insight, but we have evidence of how Kant was originally engaging with it, because he enhanced and highlighted its speculative significance

23. See Maupertuis's (1750, 19) comparative examination of Newton's arguments from intelligence and design for the uniformity of inorganic nature and the suitability of organs and functions in the construction of an animal's parts with Descartes's elimination of final causes. Tonelli (1959) was the first scholar (rediscovered by Waschkies [1987]) to point out that Maupertuis was, with Crusius, one of the two essential "intellectual mentors" of the young Kant.

24. Kant owned a copy of the 1761 German translation (from a Latin edition) of Maupertuis's *Essai sur la formation des corps organisés*, which was published in Berlin in 1754 (Warda 1922, 29).

once he incorporated it into his unified theory of developmental natural history from God's design. Kant's speculative appropriation of Maupertuis's point is made in a letter to Johann Erich Biester (June 8, 1781); Kant expresses his concern about an announcement in Goldbeck's *Literary News from Prussia* about the late, controversial acknowledgment of his 1755 work in light of an alleged priority ascribed to Lambert's nebular hypothesis in his 1761 *Kosmologische Briefe*. The attribution of the priority to Lambert was made by the astronomer Johann E. Bode. In a note attached to the letter, Kant vindicates the exclusive originality of his analogy between the elliptical nebulosae and a system of galaxies contra Lambert's division of our galaxy into galaxies arranged at different levels. Kant writes that the elliptical conformation of the nebulae (i.e., Maupertuis's legacy) constituted the essential ground of his conjecture, according to which the Milky Way is a simple member (*Glied*) of an even larger system of similar world orders (Kant 1968/1999, 184).

Kant's position largely accords with Maupertuis's concept of a purposive regularity of nature in the formation of its organized products (with which Maupertuis mainly intends human, animal, and vegetal bodies, although also heavenly systems). Unlike Kant, however, Maupertuis does not rely on any community of the origin of the nature of things in the wise plan of God's Supreme Intelligence; rather, he "believes to see the necessity" that God granted some degree of 'intelligence', by "analogy" with what we call longing, repulsion, or memory (Maupertuis 1754, 14), to matter itself, because "jamais on n'expliquera la formation d'aucun corps organisé, par les seules propriété physiques de la matiere" (29). Moreover, since for Maupertuis granting intelligence to matter is required for the self-formation of organized bodies, he underlines how his theory of the properties God gave ab initio to matter is more respectful of God's greateness and dignity than is recourse to the "immediate products of His power" (65). Indeed, Maupertuis's work opens with a declaration of dissatisfaction with the explanatory power of modern philosophy, that the move from Descartes's simple extension to Newton's attraction has only added properties upon properties to matter (impenetrability, mobility, inertia) in the attempt to explain a greater variety of natural phenomena, but yet is baffled by the simplest chemical operation.[25] In particular, Maupertuis emphasizes the explanatory limits of Newton's blind mechanical attraction.[26]

25. "Les opérations le plus simples de la Chymie ne sauroient s'*expliquer* par cette attraction, qui rend si bien raison des mouvemens des spheres célestes: *il faut dès-là suposer des attractions qui suivent d'autres loix*" (Maupertuis 1754, 3–4; emphases added).

26. "Une attraction uniforme & aveugle répandue dans toutes les parties de la matiere, ne sauroit servir à expliquer comment ces parties s'arangent pour former le corps dont l'organisation est la plus

By contrast, to assume that God endowed matter with some degree of a property similar to the basic features of our intelligence (i.e., "desir, aversion, mémoire" [Maupertuis 1754, 32]) could explain both the formation of bodies from minimal material parts (elements) and the self-maintenance of organized structures (33). Maupertuis summarizes the competing systems of the formation of organized bodies as follows: (1) blind and fortuitous chance, (2) the view of the Supreme Being (omnipresent in nature but distinct from it, according to Newton), mastering elements as the architect uses stones to build designed edifices, and (3) "les élémens eux-même doués d'intelligence s'arangent & s'unissent pour remplir les vûes du Créateur" (66–67). Option 3 conjoins the self-sustainability of a dynamical system with internal finality, dispensing with any argument from design at the price of endowing mere matter with a sort of intelligent principle. In 1755 Kant does not quote this work by Maupertuis, but we have evidence that in 1763, presenting again his cosmogony as an argument for God's design, Kant cites Maupertuis's molecules as a dangerous example of hylozoism (Zammito 2006, 343).[27]

We know from Kant himself that the starting point for his first theory about the origin and evolution of the cosmos was a secondhand, abridged version of Thomas Wright's *An Original Theory or New Hypotheses of the Universe* (1750).[28] This legacy is significant in that it prompted Kant to change his *Gestalt*. Kant himself acknowledges he felt constrained to move from regarding the fixed stars merely as an immeasurable multitude of elements without visible order to considering them as a system, "which has the greatest resemblance with that of the planets" (1755/2021, 201). In the same passage, Kant admits to having regarded the bright points that we see filling the space above us as a mere swarm scattered without visible order, that is, as a confused and dispersed cluster, à la Newton, before changing his view under the influence of Wright. Wright (1750, 48, 50) explained the appearance of the Milky Way as an optical effect arising from the eccentric view of the observer's situation, contending that "the Stars are not infinitely dispersed and distributed in a promiscuous Manner throughout all the mundane Space, without Order or Design," because "no such Phaenomenon [i.e., the Milky Way] could possibly be produced by Chance, or

simple. Si toutes ont la même tendance, la même force pour s'unir les unes aux autres. . . . Pourquoi ce merveilleux arangement?" (Maupertuis 1754, 13–14).

27. On Maupertuis's endowed molecules, see Wolfe (2010). On Kant's 1763 reflections on governing laws of nature, see Massimi (2014, 497–507). For a recent study of Kant's precritical view of hylozoism and of his preference for Stahl's nonmechanist account (via immaterial forces) for the explanation of organisms in the 1766 *Dreams of a Spirit-Seer*, see Pecere (2021).

28. The excerpt from Wright's book known to Kant was published in the journal *Freye Urtheile* (January 1, 1751).

exhibited without a designed Disposition of its constituent Bodies" (48). Kant drew on Wright's approach, both when he notes the irresponsible carelessness of ascribing to "blind chance and irrational necessity" (Kant 1755/2012, 292) an analogy (in time) related to the mechanical generation and development of the world structure, which ultimately is grounded in the highest wisdom,[29] and when he develops the ring or disk model to include the nebulae in analogy with our planetary system (202–3, 218, 261–62). Wright too regards Saturn's rings as a model in cosmology, for he mentions "the notion of a flat disk of stars, revolving around a common center, like the rings of Saturn" (van Helden 1984, 18).[30]

Kant's pre-Wright vision owed a debt to Newton's *Opticks* and to the second edition of the *Principia*. Research on Newton's unpublished scientific papers documents how "Newton explicitly recognizes that nebulae (which he identifies with star clusters) and the Milky Way are visible proof of how far the real universe departs from his perfectly regular model" (Hoskin 1977, 91), for in a manuscript that may belong to the early 1690s, headed "Cosmography. Ch. 1 Of the Sun & fixt Stars" (Hall and Hall 1962, 374–77), Newton writes that, observed through a good telescope, the Milky Way is simply the confused light of fixed clouds and cloudy stars, which are simply "heaps of stars" (376), which appear blended together. As regards the published papers known to Kant, the relevant loci are a Query (Quaestio XXVIII) added to the Latin edition (1706) of the *Opticks*, an addition in the 1713 second edition of the *Principia* to Corollary 2 of Proposition XIV, Theorem XIV, and few lines in the 1726 third edition of the *General Scholium* (Newton 1726, 387–93). In the first text, Newton (1706, bk. III, 298) asks, "What hinders the fix'd stars from falling upon one another?" In the second, he maintains that the fixed stars "are everywhere promiscuously dispersed in the heavens" (1713, 176) and that their contrary attractions destroy their mutual action. In 1726 the arrangement of the systems of the fixed stars is due only to the providential counsel and dominion of the intelligent and powerful Supreme Being that placed those systems at an immense distance from one another; otherwise they would have collapsed by their gravity (Newton 1726, 389; Hoskin 1977, 93).

As remarked earlier, it was on the analogical elliptical basis with our star system that Kant proposed extending Newton's attraction beyond the solar system:

29. The analogy in question is Buffon's equality between the density of the sun's body and the matter of the entire planetary structure taken as being united in one lump (see Kant 1755/2012, 290–91).

30. "Hence we may imagine some Creations of Stars may move in the Direction of perfect Spheres, all variously inclined, direct and retrograde: . . . more properly in the Manner of *Saturn*'s Rings, nay, perhaps Ring within Ring, to a third or fourth Order . . . nothing being more evident, than that if all the Stars we see moved in one vast Ring, like those of *Saturn*, round any central Body, or Point, the general Phaenomena of our Stars would be solved by it" (Wright 1750, 65). On the reiterative and hierarchical structure of Kant's universe, see Schönfeld (2000, 117).

in this way he superseded Wright's separate galactic gravities with "the more general explanation of the singular operation of gravity throughout the universe" (Calinger 1979, 353), viewing the position of the fixed stars as related to a common plane.

Now how did Kant originally appropriate Maupertuis's view of the explanatory limits of Newton's attraction for the formation of bodies from minimal material parts? Kant defines the natural (external) processes of matter in terms of the blind mechanism of its own forces. These are said to have created order out of disorder, to have brought all the heterogeneous components of matter together necessarily (i.e., by laws) from a chaotic state of general dispersion of very subtle particles diffused across the heavens into beautiful harmony and arrangement, without the direct intervention of God. Anticipating religious objections, for an advocate of religion may well regard this approach as taking divine government to be unnecessary because nature would appear as sufficient for itself, Kant claims that this thoroughly mechanical explanation of phenomena offers a proof of God's existence: there is a God, precisely because nature even in chaos cannot proceed otherwise than regularly and in an orderly fashion (Kant 1755/2012, 199). Kant does not confine himself to stressing the deceptive ease with which natural causes can be given an anthropomorphic significance relying on the special arrangements of Providence; he also notes that accepting entirely naturalistic accounts, regardless of any conformity to mankind's purposes and of any divine intervention to prevent celestial collapse, does not necessarily exclude government by a Supremely Wise Power.

Kant's 'supreme wise-power' argument-strategy develops also against the backdrop of an issue debated by Henry More and Descartes: how could an unextended God impart motion to the matter of the universe without any contact?[31] In the 1756 *Monadologia Physica*, Kant reacts against the view that a simple substance present in space would be substantially divided by the division of its extensive quantity as its sphere of activity; Kant claims this tenet is as absurd as holding that dividing the mass of created things is to divide God rather than the ambitus of God's presence. In 1755, retrospectively in light of the issue of a divine notion of contact in the *Monadologia*, God's perfect plan and supremely wise purpose as a first cause ruling over matter makes God immediately and directly but internally present to all things, and divine omnipresence is an external sphere of activity; otherwise, God would have to be regarded as touching things. Kant aims to show that the genuine notion of contact is

31. Through the mediation of Isaac Barrow, More's anti-Cartesian theories of space and time as definite, existing entities independent of matter because they are attributes of God ("emanative effects"; see Friedman [2009, 35–36]) were transmitted to Newton.

constituted instead by the action and reaction of different elements upon each other.[32]

This reference helps to clarify one of the core ideas of the *Theory of the Heavens*, that there is no necessity of an immediate divine 'touch' to ensure the continuing harmony of the system by periodic readjustments, for the blind mechanism of nature is responsible for the formation and spin of heavenly bodies from chaotic matter according to providential wisdom, via the interaction of attraction and repulsion. Recall that in the *General Scholium* Newton rejected representing God as the world soul, as a master ruling his own body, stressing that what makes God a true God is his "true dominion" (1729/1962, 692.37–693.11). This "true" dominion, true because it is over (necessarily obedient) servants (relative, dependent on, and distinct from God), points to God's action through subordinated causes.[33] To counter objections by the defender of religion, Kant uses an argument from design, echoing the excellent contrivances of things and final causes in the ideas and will of the Lord, as in Newton's *General Scholium*: Kant speaks of the community of the origin of the nature of things in the plan of a universal Supreme Intelligence, in which they were devised for common purposes. Kant uses this argument also to dismiss recourse to providential arrangements of natural conditions in conformity to human needs, as in the case of the (external) finalistic account of the beneficial effect of the winds of Jamaica, which make a torrid area suitable to be inhabited. According to Kant the process is based only on the sheer interplay between attraction and repulsion. Kant explains the origin of heavenly bodies by assuming that their matter was at one time separated into its elements of varying sizes and densities and scattered through infinite space. He then claims that matter organizes itself into a revolutionary state by attraction and repulsion. At first Kant defines both attractive and repulsive forces as being equally certain, equally simple, and equally original and general. These two forces are said to be borrowed from the Newtonian *Weltweisheit*. Massimi (2011, 528) noted that Kant "did not expressly speak of ether," speaking of *feinen Grundstoffe*, but Kant ascribes to Newton the hypothesis of such a subtle and infinitely less resisting matter filling the cosmos, building on a Leibniz-Newton controversy.

Soon after, however, we have an interesting admission of the unsatisfactory status of Newton's repulsive force (pertaining to nebulous particles of comets

32. See Kant (1756/1992, 60–61). Contra Henry More and the Newtonians, contra the Newtonian absolute space as *sensorium Dei* and God himself as incorporeal ether (Massimi 2011, 542), Kant appears indebted to Descartes for this idea of a simple substance's external presence (in divisible space) in virtue of its (variable) power to act on bodies or its sphere of activity, which does not affect its unextended nature or essence: see Ferrini (2018).

33. See on this point Henry (2011).

and the fluid of the solar atmosphere) and Kant's use of repulsive force regarding the infinite dispersion of rarified matter up to the gaseous state. Kant remarks that Newtonian attraction alone is not sufficient to explain the beginning of the formation of planets in a primordial cosmic space, for in the case of fundamental particles of such exceptional fineness, this force would be far too slow and feeble. Kant (1755/2012, 231) speaks of the concourse of "certain elements which unite themselves by the common laws of combination."[34] Kant does not specify these typical laws further, but the similarity of context seems to suggest reference to chemical laws of combination to bring together disaggregated elementary particles, as pointed out by Maupertuis. Kant seems to refer to the original difference in kind and active properties of the elements before they form masses subject to gravity, a point he will continue to deepen.

Inheriting both Haller's caveat to Buffon and Maupertuis's criticism of the uniformity and blindness of Newton's attraction, Kant may well have had in mind the elective attractions of chemistry, regarding masses as a general result of combinations of elements. This reading would explain why Kant (1755/2012, 200) makes clear that the universal Supreme Intelligence has put "a secret artistry" into the forces of nature,[35] binding matter to certain internal laws, so that, when it is freely abandoned to these laws, it must necessarily bring forth "beautiful" combinations (Maupertuis's *merveilleux arangement*). Note that in his letter to Gensichen dated April 19, 1791, Kant shall state that the elementary particles dispersed in vapor through the universe (which contains all stuffs of innumerable variety in elastic state) form (*bildet*) the celestial bodies only through the encounter of matters displaying chemical affinity during their gravitational fall. In meeting together according to the law of gravitation, matters mutually annihilate their elasticity, thus producing dense masses and heat inside them, which in the greater bodies (the stars) is joined with exterior luminescence and in the smaller ones (the planets) with interior warmth (Ferrini 2004, 308).

In this way Kant may explain emerging organization in lifeless matter, while avoiding any risk of hylozoism, within the frame of a hypothetical natural history that traces back in time, as far as the analogy permits, the relation between present conditions of things in nature and their chains of efficient causes according to mechanical laws. In the precritical period, this meant also devising a universal natural history as presenting a temporal development of efficient causes (from a chaotic origin to the present order of heavenly matter), into the inner purposiveness of a speculative natural philosophy that constitutes

34. On this point, see Ferrini (2004, 302 n. 55).
35. In Kant (1755/2012, 200), *Kunst* is rendered as "ability."

the only possible argument for God's existence, "outlining a physical cosmology that makes the bridge to rational theology" (Falkenburg 2020, 12).[36] In this way Kant avoids materialism by presenting the possibility of an evolving universe only through natural powers by according 'theoretical or conjectural' natural history with teleological natural philosophy.[37]

This provides a more nuanced view of Kant's physical and explanatory project regarding the generation of heavenly bodies, for his strategy appears to appropriate and unify coherently, inter alia, Bacon's project for a history of nature that accounts for changing states and diversity of natural phenomena, in mutual interplay with natural philosophy as knowledge of the causes and effects of nature; Descartes's explanation of the constitution and order of the universe as developing from initial disorder by the interplay of merely mechanical laws of nature; the Baconian and Newtonian argument from divine will and the divine power's design, which reintroduced final causes; and the mediation of Haller's and Maupertuis's criticism of Buffon's model for natural history and arguments regarding purposiveness in organized bodies. Kant improved upon Wright's view and took distance from Newton's theological stance on the direct role of God's intervention in the arrangement of the heavens as well as from any form of hylozoism, which endowed fine particles of matter with powers of intelligence and self-organization. By contrast, Kant maintained that God's plan and activity endowed lifeless matter with properties so that its smallest parts could arrange and join themselves into (beautiful) systems through the artistry concealed within their own (blind) mechanical lawfulness.[38] Investigating this rich context of Kant's 1755 approach to universal natural history has shown not only his break with any merely descriptive task and his shift to derivative inferential inquiries but also his proposed development of a genetic and lawful possible history of nature into a provisional and developmental natural philosophy.

36. In his 1763 essay Kant sets forth some of his 1755 cosmogonic ideas as an illustration of the argument from design. His negative and positive aims are always the same: (1) to avoid the "mistake" of subsuming the arrangement of the cosmos immediately and directly under God's intentions (Kant 1763/1992, 183) and (2) to show how it is possible to explain that order and regularity emerge from dispersion and chaos by means of the universal laws of nature, remaining consistent with our cognition of a wise God (177); see on this point Ferrini (2000).

37. According to Dugald Stewart (1811, 48), in his biography of Adam Smith, "Theoretical or Conjectural History" was a distinctive and widespread commitmment of eighteenth-century Scots.

38. Here I can only mention that, in 1790, Kant's aesthetic judgment of the nebulae seems to exemplify the mathematical sublime in nature by retaining an important feature of the precritical assessment, because "as we progress we always arrive at ever greater units (*Einheiten*)" (Kant 1790/2000, 140).

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