Kant on the Philosophical Significance of the Telescope

Stephen Howard
FRIAS, Universität Freiburg, Germany
ORCID: https://orcid.org/0000-0002-7194-3853
DOI: 10.24310/nyl.19.2025.20551

Abstract: A footnote in the *Critique of Pure Reason* asserts, surprisingly, that astronomy teaches us two fundamental lessons of the critical philosophy: about the limits of theoretical cognition, and about the need to shift to practical philosophy and concern ourselves with the highest good. This article aims to explain this footnote, with reference to passages in Kant's published and unpublished writings. A first set of passages concern the Leibnizian distinction between clear and obscure representations. Making a very different point to the footnote in the *Critique*, Kant claims that the telescope can clarify our representations. A second set of passages, in the third *Critique*, *Reflexionen* and lecture transcripts, suggest that astronomers have a particular tendency towards metaphysical issues. By combining the two sets of passages, I argue, we can reconstruct what Kant could have had in mind in the footnote. Astronomy is significance for the critical philosophy because it so successfully extends our knowledge, and thus, paradoxical as it may sound, reveals the greater field of what we do *not* know.

Palabras clave: Kant; astronomy; telescope; critique; boundary determination; highest good.

Kant sobre el significado filosófico del telescopio

Resumen: Una nota a pie de página en la *Crítica de la razón pura* afirma, sorprendentemente, que la astronomía nos enseña dos lecciones fundamentales de la filosofía crítica: sobre los límites del conocimiento teórico y sobre la necesidad de pasar a la filosofía práctica y preocuparnos por el bien supremo. Este

artículo tiene como objetivo explicar esta nota a pie de página, haciendo referencia a pasajes de los escritos publicados e inéditos de Kant. Un primer conjunto de pasajes se refiere a la distinción leibniziana entre representaciones claras y oscuras. Haciendo una observación muy diferente a la nota a pie de página de la *Crítica*, Kant afirma que el telescopio puede aclarar nuestras representaciones. Un segundo conjunto de pasajes, en la tercera *Crítica*, *Reflexionen* y transcripciones de conferencias, sugiere que los astrónomos tienen una tendencia particular hacia las cuestiones metafísicas. Al combinar los dos conjuntos de pasajes, sostengo que es posible reconstruir lo que Kant podría haber tenido en mente en la nota a pie de página. La importancia de la astronomía para la filosofía crítica se debe a sus grandes logros en la ampliación de nuestro conocimiento, lo que, por paradójico que pueda parecer, revela la mayor parte de lo que no conocemos.

Palabras clave: Kant; astronomía; telescopio; crítica; determinación de límites; bien supremo.

Recibido: 25 de septiembre de 2024
Aceptado: 21 de noviembre de 2024

1. Introduction

In the chapter on the «Ideal of Pure Reason» in the first *Critique*, Kant adds an intriguing footnote to his discussion of the use of the 'principle of thoroughgoing determination' in natural theology. We will return to the context in which the note appears, but we can leave it aside at the outset, because the note seems to make a point that is much broader than the discussion to which it is appended. The note states,

> The observations and calculations of the astronomers have taught us much that is worthy of admiration, but the most important is surely that they have revealed for us the abyss of ignorance. Without these cognitions, human reason would never have been able to imagine this abyss as so large. Reflection on it must bring forth a great change in the determination of the final ends of the use of our reason. (A575/B603n)[1]

[1] My translation. I have broken up Kant's sentence into three, and I diverge in various ways from the Guyer and Wood translation in the Cambridge edition, including reading

Kant here links astronomy, and specifically its observations with the telescope and mathematical calculations, with two philosophical discoveries. The first is the discovery of the extent of our ignorance, here described as the possibility of knowing, through the cognitions (*Kenntnisse*) of the astronomers, our lack of knowledge (*Unwissenheit*). This is what Kant presents elsewhere as the central task of the *Critique*: that of determining the boundary of our reason (4:351, cf. A395, A761/B789). I have argued elsewhere that we should attend to the details of this task of boundary-determination, but the basic point is familiar to all readers of the *Critique* (Howard 2022). Kant seeks to determine the boundary between what we can know – objects of possible experience, given in space and time, subsumed under categories in judgements of the understanding, and subject to the synthetic *a priori* principles of the understanding – and what we can merely think – ideas of pure reason, which include the transcendental ideas about the soul, the world-whole, and God, and things in themselves.[2]

The second discovery concerns «the final ends of the use of our reason». It is not entirely clear what Kant means here, because elsewhere in the *Critique* he distinguishes reason's «essential ends» (*wesentliche Zwecke*) from its «highest» or «final end» (*höchster Zweck*, *Endzweck*), where the former are plural and the latter is singular (A840/B868). Kant emphasises that «there can be only a single» final end

«wohl» as «surely», not «probably». The German runs: «Die Beobachtungen und Berechnungen der Sternkundiger haben uns viel Bewundernswürdiges gelehrt, aber das Wichtigste ist wohl, daß sie uns den Abgrund der *Unwissenheit* aufgedeckt haben, den die menschliche Vernunft, ohne diese Kenntnisse, sich niemals so groß hätte vorstellen können, und worüber das Nachdenken eine große Veränderung in der Bestimmung der Endabsichten unseres Vernunftgebrauchs hervorbringen muß». In what follows, Kant's writings are cited according to the Academy Edition pagination (Kant, 1902-), except for the *Critique of Pure Reason*, cited according to the standard A/B pagination. For passages contained in the Cambridge edition, I generally follow these translations, modified where I consider helpful.

[2] Kant was not the first to suggest that astronomy has an sobering effect on our theoretical ambitions: Locke makes the same point in the *Essay Concerning Human Understanding* (Locke [1690] 1997: 492-3 (IV.iii.24)). Locke even uses the phrase «abyss of ignorance», which Kant seems to repeat verbatim. I will return to the historical context and the influences on Kant's views on astronomy on another occasion.

(A840/B868). It is odd, then, that the footnote mentions final ends (*End-absichte*) in the plural.[3] A further complexity stems from the fact that the precise referent of «final end» in the *Critiques* is a matter of debate. Gabriele Gava (2014) associates the final end with Kant's doctrine of the highest good, the proportioned maximum of virtue and happiness (cf. A797-819/B825-47, 5:110-41), while Thomas Sturm (2020) associates it with Kant's concept of wisdom. Sturm thus argues that the Kantian final end is not exclusively practical but also theoretical, and so it involves both our cognitive and volitional relations to the highest good.[4] For our purposes, the important point, common to both Gava's and Sturm's readings, is that reason's final end is at least partly practical and that it involves the highest good. In the footnote to the Ideal chapter, then, I take Kant to suggest that reflection on the abyss of ignorance as revealed by astronomy decisively shifts our orientation to encompass practical concerns and the highest good.

Now, a reader might object that we should not grant too much significance to what is, after all, a footnote. However, it makes such a remarkable claim that it seems worth our while to consider what Kant could have meant. This will require some detailed discussion, because Kant's views on astronomy have not received much attention in the literature to date. Commentators who have examined Kant's engagement with cosmology have tended to focus on Newtonian mechanics (Friedman 1992, 2013), the rational cosmology of German school-metaphysics (Watkins 2001), or Kant's attempt to synthesise these two approaches (Clavier 1997, Falkenburg 2000). These studies emphasise the a priori aspects of cosmology, whether in its Newtonian or Wolffian guises, instead of the empirical and mathematical work of astronomers like Tycho Brahe or Galileo, to which Kant seems to allude when he writes of the «observations and calculations of the astronomers» in the footnote.

[3] A feasible reading is that this is a slip of the pen and that Kant intends to refer to the final end (singular) of reason.

[4] Sturm (2020: 18) points to the following passage from the second *Critique*: «*wisdom* considered theoretically signifies *cognition of the highest good,* and practically *the fitness of the will for the highest good*» (5:130).

Waschkies (1987) provides a rare discussion of Kant's connections to observational astronomy. But he limits his claims to the fact that Kant's teacher Knutzen wrote a treatise on comets and seems to have observed the night sky with a telescope in winter 1743-44 with a group of students, among whom may have been Kant (Waschkies 1987: 90-116). Studies of Kant's *Universal Natural History* (1755) can hardly avoid noting that Kant draws heavily on astronomical works, as he refers to figures including Brahe, Cassini, Flamsteed, Halley, Huygens, and Kepler. However, even Adickes, who in *Kant als Naturforscher* is primarily interested in Kant's relationship to the empirical sciences, does not consider the astronomical context to be significant for an understanding of Kant's 1755 work (Adickes 1925: 206-315). The only commentator I know of who discusses the role of astronomy in Kant's mature thought is Heinz Heimsoeth, who wrote two interesting papers touching on the topic. In the first, which is concerned with Kant's views on hypothesis, analogy and induction, Heimsoeth discusses comments on Galileo, Kepler, Huygens and Newton that appear throughout Kant's writings (Heimsoeth 1970a, 10-41). The second paper focuses on theological issues, in particular the way that astronomy can support theodicy by extending our assessment of God's goodness and wisdom beyond the Earth (Heimsoeth 1970b).[5] I am not aware of any discussions of the claims about astronomy in the footnote to the chapter on the Ideal, which will be my topic here.

2. The telescope and obscure representations

Passing allusions to astronomy appear in many well-known passages in Kant's works. In the most famous sentence in the Kantian corpus, the

[5] This point about astronomy and theodicy is made by Leibniz: «our earth is as a point in comparison with the distance of some fixed stars … Thus, since the proportion of that part of the universe which we know is almost lost in nothingness compared with that which is unknown, and which we yet have cause to assume, and since all the evils that may be raised in objection before us are in this near nothingness, perhaps it may be that all evils are almost nothingness in comparison with the good things which are in the universe». Leibniz [1710] 1985: 138 (§19).

«starry heavens above me» and the moral law are described as the «two things [that] fill the mind with ever new and increasing admiration and reverence» (5:161). Almost as famous, and more controversial among specialists, is Kant's comparison between the achievement of the first *Critique* and «the first thoughts of Copernicus» (Bxvi; see for instance Schönecker, Schulting and Strobach 2011). In the Antinomy chapter, Kant uses astronomical controversies – over what should be taken to be at rest and what in movement when calculating the motions of the moon and planets – as analogies for controversies of reason in which both sides are correct from their own perspective (A461/B489, see 6:354). In the Appendix to the Transcendental Dialectic, Kant uses the discovery of the elliptical orbits of the planets to exemplify the use of the regulative principles of homogeneity, specification, and continuity (A662-3/B690-1, see Meer 2019: 245-60). Finally, in §38 of the *Prolegomena*, Kant uses the same example, with the addition of Newton's law of universal attraction that underpins planetary orbits, to elucidate his claim that the understanding prescribes the universal laws of nature (4:320-2, see Friedman 1992: 165-210). However, these passages, famous and interesting as they are, seem to use astronomy merely as an example to help the reader grasp otherwise abstract philosophical doctrines. They do not, in my view, explain why Kant claims in the footnote in the *Critique* that astronomy itself decisively spurs us towards the critical doctrines of the boundary of reason and our orientation towards the highest good.

If we instead turn to some lesser-known passages, we can find descriptions of specific philosophical benefits of astronomy that go in a very different direction to our footnote. The passages discuss the common early-modern distinction between clear, obscure, distinct and confused representations (and intuitions). In the *locus classicus* for this distinction, Leibniz's essay «Meditations on Knowledge, Truth, and Ideas», published in the *Acta eruditorum* in 1684, Leibniz distinguished between clear and obscure representations, and then further subdivided

clear representations into distinct and confused representations.[6] As Stefanie Grüne (2009: 71n75) has noted, Kant broadly adheres to Leibniz's taxonomy of these kinds of representation. Representations can be clear (*klar*) or obscure (*dunkel*), and clear representations can in turn be distinct (*deutlich*) or confused (*undeutlich*).[7] Something novel in Kant's account, at least compared to Leibniz's, is that if we are *conscious* of our representations then they are clear, whereas *unconscious* representations are obscure.[8]

Accordingly, the broadly Leibnizian classification of representations appears early in the *Anthropology* (1798) when Kant discusses unconscious representations. This field of these «obscure representations», Kant writes, is «immense». To flesh out his contrasting account of clear representations, he then introduces the telescope (and microscope):

> Clear representations, on the other hand, contain only infinitely few points of this field which lie open to consciousness; so that as it were only a few places on the vast map of our mind are illuminated. […] Everything the assisted eye discovers by means of the telescope (perhaps directed toward the moon) or microscope (directed toward infusoria) is seen by means of our naked eyes. For these optical aids do not bring more rays of light and thereby more created images into the eye than would have been reflected in the retina without such artificial tools, rather they only spread the images out more, so that we become conscious of them. (7:135-6)

[6] Brandon Look contends that in Kant's era this essay may have been principally known through Wolff's reworking of the claims in the German Logic, although he notes that it was republished in Dutens' edition of 1768 (Look 2021: 23n63). Leibniz's general point that the large part of our representations are obscure is accessibly presented in his doctrine of *petites perceptions* in the *New Essays*, first published in Dutens' edition, but it is also at the heart of his metaphysics, for example §§60-1 of the *Monadology* (Leibniz 1989: 220-1).

[7] Of course, Kant famously dismisses what he calls the Leibnizian-Wolffian philosophy's «merely logical» distinction between sensibility, allegedly understood as confused cognition, and the understanding, understood as distinct (2:394-5, A44/B61-2). But this does not mean that he rejects Leibniz's taxonomy of clear, obscure, distinct and confused representations, which was taken up by Wolff, Baumgarten and other school metaphysicians. Grüne (2009: 71-102) provides a comprehensive discussion of how Kant applies the taxonomy to kinds of representations in general, and to intuitions and concepts in particular.

[8] See the passages quoted by Grüne (2009: 72).

These optical aids, Kant asserts, can make some of our obscure representations clear. This is not a claim that I have found Kant's German predecessors making in these terms – although, more generally and outside of a Leibnizian context, it was common for early modern thinkers to praise the telescope and microscope for their capacity to extend our knowledge.[9] Kant suggests that these apparatuses do not themselves *add* any representations to what we already perceive. They simply spread out the images that are too compressed for us to process, meaning that our obscure and unconscious representations become clear and conscious.

A similar claim appears in the *Jäsche Logic* (1800), this time with regard to distinct intuitions. Here, the Milky Way serves as Kant's example:

> *First, sensible* [distinctness]. This consists in the consciousness of the manifold in intuition. I see the Milky Way as a whitish streak, for example; the light rays from the individual stars located in it must necessarily have entered my eye. But the representation of this was merely clear, and it becomes distinct only through the telescope, because then I glimpse the individual stars contained in the Milky Way. (9:35)[10]

With this astronomical example, Kant returns to a topic treated in the *Universal Natural History* (1755), where he wrote:

> Anyone who looks at the sky full of stars on a clear night will be aware of the bright band that, because of the large number of stars that are concentrated there more than elsewhere and because of the fact that in the enormous distances they can no longer be seen as individual stars, exhibits a uniform light, which has been given the name of the *Milky Way*. (1:248)

[9] For example, in the preface to his *Micrographia*, Hooke writes that «*artificial Organs*» provide «prodigious benefit to all sorts of useful knowledge, by the invention of Optical Glasses. By the means of *Telescopes*, there is nothing so *far distant* but may be represented to our view; and by the help of *Microscopes*, there is nothing so *small*, as to escape our inquiry; hence there is a new visible World discovered to the understanding (Hooke 1665: unpag.). See the discussion in Wilson 1995: 66.

[10] Kant makes similar points in various other places: 7:156; 24:119, 355, 410. For these references, I am indebted to Sturm and Wallner, forthcoming. Grüne (2009: 77, 81) points to a related passage in the Mrongovius metaphysics notes (29:879) and explains a discrepancy with the *Jäsche Logic* passage.

The Milky Way, something familiar to every amateur stargazer, is a mass of light that results from an aggregation of stars that we cannot differentiate. This idea recurs in Kant's claims about so-called nebulous stars, which are groups of stars on a smaller scale than the Milky Way (1:254-5). The band of bright stars that is the Milky Way is a key piece of evidence for Kant's argument, in his 1755 cosmology, that the systematic arrangement of our solar system is repeated at the higher level of the system of stars.

The point made in the *Jäsche Logic* differs slightly from the one made in the *Anthropology*. In the logic text, Kant states that we can have a clear representation of the Milky Way as an undifferentiated mass of light without having distinct representations of the many individual stars that constitute it.[11] Again, Kant adds that the telescope is an apparatus that allows us to move from confused (or, in the *Anthropology*, obscure) representations to distinct (or clear) representations. Kant here presents a broadly Leibnizian picture of perception, but with a striking empiricist bent. At stake is not how we can increase the adequacy of our ideas, but how a *lens* can improve the clarity of our perceptions.

These passages from the *Anthropology* and *Logic* sharply contrast with the footnote from the *Critique* with which we began. In the *Anthropology* and *Logic*, Kant suggests that astronomy enables us to make our confused perceptions more distinct, while in the footnote he proposes that astronomy has taught us the great extent of our ignorance. How can these opposed claims be reconciled? One might suggest that the passages from the *Anthropology* and *Logic*, which echo claims Kant made in 1755 and 1763, are merely remnants of his pre-critical Leibnizianism; the footnote could be said to contain a more properly 'critical' view of the philosophical value of astronomy. But this seems doubtful in light of the fact that Kant supervised or at least approved the publication of the

[11] This is in line with Leibniz, for whom knowledge can be clear («when I have the means for recognizing the thing represented») and yet not distinct (if I cannot «enumerate one by one marks sufficient for differentiating a thing from others») (Leibniz 1989: 24).

Anthropology and *Logic* in 1798 and 1800. More importantly, Kant's empiricist point about clarifying perceptions with a telescope is not particularly Leibnizian. Moreover, passages in other texts from the 1770s to the 1790s further complicate matters, as we shall now see.

3. Astronomy and metaphysics

When discussing the «mathematical sublime» in the *Critique of Judgement* (1790), Kant writes,

> *That is sublime in comparison with which everything else is small*. Here one readily sees that nothing can be given in nature, however great it may be judged to be by us, which could not, considered in another relation, be diminished down to the infinitely small; and conversely, there is nothing so small which could not, in comparison with even smaller standards, be amplified for our imagination up to the magnitude of a world. The telescope has given us rich material for making the former observation, the microscope rich material for the latter. Thus nothing that can be an object of the senses is, considered on this footing, to be called sublime. (5:250)

As in the *Anthropology*, Kant here links the telescope with the microscope. Observations through the telescope have taught us that nothing in nature is so large that it does not appear to be infinitely small when «considered in another relation». By «another relation», Kant seems to mean that the telescope allows us to see across huge distances, in relation to which anything that to the naked eye appears very large can be understood to be tiny. As a result, no object perceivable through the senses can properly be said to be sublime because the sublime is, on Kant's definition, that which is greater than anything else. For any object of the senses, the magnifying power of the telescope's lens allows us to shift our perspective and see it in the context of even larger expanses of space.

If no objects of the senses can be called mathematically sublime, how can things in nature be said to be so? Key to Kant's well-known claims here is that the experience of the sublime «indicates a faculty of the mind which surpasses every standard of sense» (5:254). The faculties involved when judging a thing as sublime are the power of judgement, im-

agination, and reason: the power of judgement refers (*bezieht*) imagination to the ideas of reason (5:256). Such judgements lead us from the concept of nature to the supersensible, «which surpasses every standard of sense». A judgement of the sublime indicates a supersensible faculty in us not because we represent something as an infinitely large magnitude, but because «as we progress we always arrive at ever greater units» (5:256). In traditional terms, the mathematical sublime results from the potential, not the actual infinite: we feel we have grasped part of a series without end. And the power of judgement proceeds by «representing to us all that is great in nature as in its turn small, but actually representing our imagination in all its boundlessness, and with it nature, as paling into insignificance beside the ideas of reason if it is supposed to provide a presentation adequate to them» (5:257). A judgement of the sublime thus reveals something not about nature in itself but about the relations between our cognitive faculties: namely, that the transcendent ideas of reason outstrip anything in nature and any products of our imagination.[12]

Having suggested that the telescope reveals that objects of the senses cannot be sublime, Kant gives an example of how we arrive at the mathematical sublime. This reveals, I will argue, a different connection between astronomy and the experience of the sublime:

> Examples of the mathematically sublime in nature in mere intuition are provided for us by all those cases where what is given to us is not so much a greater numerical concept as rather a great unity as measure (for shortening the numerical series) for the imagination. A tree that we estimate by the height of a man may serve as a standard for a mountain, and, if the latter were, say, a mile high, it could serve as the unit for the number that expresses the diameter of the earth, in order to make the latter intuitable; the diameter of the earth could serve as the unit for the planetary system

[12] This paragraph aims only to provide a straightforward summary of these well-known passages. For discussion of the mathematical sublime, see Clewis (2009: 64-6). Clewis (2009 and 2015) has done important work on the significance of the sublime for Kant's wider philosophical project: he emphasises the key role of the sublime in Kant's attempt to bridge nature and freedom in the third *Critique*. Without contradicting Clewis' interpretation, I here explore a different aspect of the wider philosophical significance of the Kantian sublime.

> so far as known to us, this for the Milky Way, and the immeasurable multitude of such Milky Way systems, called nebulae, which presumably constitute such a system among themselves in turn, does not allow us to expect any boundaries here. (5:256)[13]

Here we have an example of an indefinite series. The height of a human can serve as a unit of measure to estimate the height of a tree, which in turn provides a unit for the height of a mountain; we can continue this process to estimate the sizes of a mountain, the earth, the planetary system, the Milky Way, the yet higher systems of systems of stars, and beyond. Kant is here exemplifying the process that we have just seen described with regard to judgements of the sublime. The power of judgement connects the imagination with those transcendent totalities that are the ideas of reason, allowing us to imagine a series that progresses indefinitely (without «any boundaries») and which outstrips any determinate concepts of nature. The passage describes a movement of thought: we extend our measure from the human scale to the planetary, the solar system, the stellar system, and so on. This echoes the approach of the 1755 *Universal Natural History*, where Kant conceived of the system of stars as a higher-level version of the solar system.[14]

This passage is not about astronomy in the senses we have been considering so far: it is not about the enhanced perception provided by the telescope, nor about the salutary lessons such observations have for our theory of knowledge. It rather describes something like a thought experiment through which we can arrive at judgements about the mathematical sublime. Nevertheless, the passage suggests that astronomy is not simply an activity of mere perception with the aid of a telescope. Practising astronomers also interpret these observations and thereby reflect on the nature and extent of the universe, so observational astronomy has an *a priori* side.

Such an idea points us in the direction of an answer to the question raised above, namely, why Kant contends that astronomers, who use an

[13] I here amend the Cambridge translation of *Grenzen*. For discussion of Kant's distinction between limits (*Schranken*) and boundaries (*Grenzen*), see Howard 2022.
[14] For a discussion of the analogical method of the *Universal Natural History*, see Howard, 2023.

apparatus that clarifies obscure perceptions, can teach us about the boundary of reason and our reorientation towards our practical final end. The point I have here drawn out of the third *Critique* appears more explicitly elsewhere in the Kantian corpus. In the *Anthropologie Dohna-Wundlacken* (1791-2), again in the context of a discussion of clear and obscure representations, Kant states that our obscure representations can be clarified in astronomy, not only with the aid of the telescope but also «through logical inference [*durch Schlüsse*]». He continues: «In this way the ancients explained the glimmering of the Milky Way as the light of an uncountable number of stars, although, because they lacked a telescope, they could not see them» (Kant 2000: 194).[15] Kant here suggests that *a priori* reasoning can take the place of the magnifying lens, allowing us, through mere thought, to 'zoom in', so to speak, on what for our perception is only an undifferentiated mass of light. We thus infer that the Milky Way is constituted by separate stars that we are unable to distinguish from each other with the naked eye.

Astronomy therefore has a metaphysical side. Kant points to this in a *Reflexion* penned in his copy of Baumgarten's *Metaphysica* around 1776-78. He writes that even if mathematicians, aesthetes, or natural philosophers make «arrogant jokes about metaphysics», they all hear the «voice that always calls them to make an attempt in the field of metaphysics». This is because, «[a]s human beings who seek their final end not in the satisfaction of the aims of this life, they cannot do otherwise than ask: why am I here, why is everything here [*woher ist das Gantze*]» (R5112, 18:93). We are led to metaphysical questions because our final end – by which, we recall, Kant means the highest good, the maximum of happiness and virtue – pushes us beyond worldly aims. And Kant then adds: «The astronomer is even more spurred to these questions. He cannot withhold from searching for something that would satisfy him in this regard. With the first judgement that he makes about this he is in the

[15] This is a point regularly made by Leibniz: he claimed that Democritus surmised that the Milky Way was constituted of separate stars before the fact was observed. See Leibniz 1996: 265 and a passage quoted in Smith 2011: 151.

territory of metaphysics» (R5112, 18:93). More than anyone else, the astronomer tends to ask metaphysical questions about our existence and the entirety of the universe.

Why should astronomers have this particular tendency towards metaphysics? An answer can be found in the *Logik Phillipi*, notes of Kant's logic lectures from around 1772. The context for Kant's remarks is a discussion of non-being (*Das Nichtseyn*). Non-being is «no object»; conversely, «the cancellation of the positive is something objective». This is precisely the context of the footnote with which we began, in the Ideal chapter of the *Critique*. Kant's point is that negation cannot exist without something positive, which it negates and of which it is derivative. The logic lecture transcript presents two examples that reappear in the *Critique*: one needs to have known light in order to be able to recognise darkness; and the 'savage' (*der Wilde*) does not know what they lack because they have never known abundance.[16] Kant continues,

> Likewise, one cannot know the boundaries of cognition, except by knowing all knowledge. In this way, the astronomer knows his ignorance to a much greater extent than the average person. Among all the theoretical sciences, none can humble [us] more than astronomy. (24:283-4)[17]

This note sheds light on the relation between astronomy, the notion of negation, the boundaries of knowledge, and metaphysics. In order to know what we do not know, we must have something positive from which this negation can be derived. That is, one must know everything in order to precisely know the boundary beyond which we cannot know.

[16] Compare the examples from the *Logik Phillipi*: «Die Remotion des Lichts ist Finsterniß; da muß ich das Licht gekannt haben, wenn ich wissen will daß es removiret und dadurch Finsterniß da ist. Der Wilde kennt seinen Mangel nicht, denn er hat den Überfluß niemals gehabt» (24:283), and from the *Critique*: «Der Blindgeborne kann sich nicht die mindeste Vorstellung von Finsternis machen, weil er keine vom Lichte hat; der Wilde nicht von der Armut, weil er den Wohlstand nicht kennt» (A575/B603). It goes without saying that Kant's talk of «der Wilde» is unacceptable today.

[17] «Eben so kann man die Grenzen des Erkenntnisses nicht kennen, als daß man alles Wissen kennt. So wird der Astronom seine Unwissenheit weit mehr erkennen, als der gemeine Mann. Unter allen theoretischen Wissenschafften kann keine mehr demüthigen als die Astronomie».

The astronomer knows more than the average person, and so has more insight into the extent of our lack of knowledge.

The reasons for the astronomer's greater knowledge are just those given in the passages from the *Anthropology* and *Logic* that we examined in section 1: the telescope transforms obscure and unconscious representations into clear and conscious ones. But we can now more fully grasp Kant's conception of astronomy. This science shows that the more we see, the more we realise that there is more to see. As in the case of the mathematical sublime, this is an indefinite progression. Admittedly, astronomy is no different to other natural sciences in this respect. As Kant puts it in the *Prolegomena*, the expansion of our knowledge in mathematics and natural science «goes to infinity» (4:352). «In the explanation of the appearances of nature», we read in the *Critique*, «much must remain uncertain and many questions insoluble, because what we know about nature is in many cases far from sufficient for what we should explain» (A476-7/B504-5). In Kant's technical terms, mathematics and the natural sciences have limits, which can always be pushed further back through new discoveries. By contrast, metaphysics has a fixed boundary, which can at least in principle be precisely determined.[18] Metaphysics, or transcendental philosophy, is unique among the sciences in that it can be completed (Bxxiii-xxiv, A477/B505).

Astronomy is not unique, then, in progressing indefinitely. But it is the relatively advanced state of astronomical knowledge when compared to other sciences – a consequence of the technical sophistication of its apparatus, the telescope – that means it provides the most insight into what we do not know. Counter-intuitively, the more we know, the greater our awareness of our lack of knowledge. The point is nicely put by Richard Feynman (1964: 1) when he suggests that physics has «an expanding frontier of ignorance». Kant's claim thus seems ultimately to be that, as we discover more and more through empirical astronomy, we realise that there is one thing that we certainly cannot know, namely, everything: the totality of the physical universe. Because astronomy

[18] See Howard 2022: 68-71.

makes ever-increasing progress in line with the improvements of lenses in telescopes, we gain insight into our lack of capacity for knowledge of the entire universe. Here, the infinite progression of an empirical science meets the critical philosophy's finite task of boundary-determination. Astronomy, due to its advanced status, provides us with insight into the completable task of critique, that is, where to locate the fixed boundary of reason between the knowable and the merely thinkable. We can know more and more about the empirical world, but the *totality* of this knowledge of appearances can only be thought.

Here we can recall Kant's (controversial) claim that the problem of the antinomy of reason first spurred his work on a critique of pure reason.[19] The antinomy of reason concerns cosmological questions about the world (or universe). Astronomical observations are most obviously relevant to the spatial side of the first antinomy, that is, to the question of whether the universe has an outer boundary in space.[20] However, all four antinomies concern the world as an «absolute totality» of appearances (A407/B434, A416/B443). Kant defines the concept of world at stake in the antinomies as «the mathematical whole of all appearances and the totality of their synthesis in the great as well as in the small» (A418/B446). Arguably, then, insofar as observations through the telescope cause the astronomer to realise that our empirical knowledge of the universe will progress indefinitely without ever reaching the absolute totality, astronomy brings us to the antinomy problematic, which, Kant suggests, awoke him from his dogmatic slumber.

Moreover, as is well known, Kant's resolution of the third and fourth antinomies has the minimal result, from a theoretical perspective, of saving freedom and a necessary being from disproof (A558/B586, A560-1/B588-9). But this minimal theoretical result has major practical

[19] 12:257-8, 4:338, A757/B785. The controversy in the literature arises because Kant also credits the impetus for the *Critique* to «the remembrance of *David Hume*» (4:260); see Ertl 2002. On Kant's use of 'antinomy' in the singular, see Hinske 1966. For ease of reading, I also refer more loosely to the antinomies (plural), even if it would be technically better to speak of the four antinomial conflicts.

[20] I have begun to examine this topic in Howard 2022b.

consequences, because it allows Kant to take up the ideas of freedom and God in his practical philosophy. Transformed into pure practical postulates, these ideas are conditions of the highest good, that is, the proportioned maximisation of virtue and happiness.[21]

With this, we return to the footnote from the *Critique* with which we began. Kant states there that reflection on the «ignorance» revealed to us by astronomy «must bring forth a great change in the determination of the final ends of the use of our reason». This «great change» is a shift from theoretical ambitions to *practical* ones. When we acknowledge the boundary of our theoretical knowledge, we realise that only a practical perspective can satisfy the needs of reason for complete explanation. So we must shift to the highest end of our use of reason, namely, our striving towards the highest good. And this shift to a practical perspective, from the domain of nature to that of freedom, is the final element in Kant's claim that astronomy spurs us towards the critical philosophy.

4. Conclusion

Many of Kant's comments on the philosophical lessons taught by the telescope present what we might call an empiricist refashioning of Leibniz's doctrine of confused perceptions. On this account, the lens spreads out the field of perception, making clear (or distinct) what to the naked eye is obscure (or confused). But such arguments do not explain why, in the footnote to the Ideal chapter discussed in this paper, Kant suggests that the «observations and calculations of the astronomers» have revealed an «abyss of ignorance» that spurs a shift in how we conceive of reason's final end. Indeed, Kant's point seems to be the opposite: the telescope simply extends our knowledge, rather than exposing our cognitive limits.

In an attempt to show how these different claims can be reconciled, I turned to the discussion of the mathematical sublime in the third *Critique* as well as various *Reflexionen* and lecture notes. These passages

[21] See 5:132-3. Needless to say, much debate surrounds the Postulates, but my brief discussion here aims to be uncontroversial.

consider the metaphysical questions that accompany the practice of extending our astronomical knowledge with the telescope. It seems to be key to Kant's view that observational astronomy was a more advanced science than many others, providing the empirical basis for one of the great intellectual successes of early modernity, Newton's system of the world. The more one knows, the more one realises how much one does not know; because they possess more empirical knowledge than most people, astronomers have a greater insight into their lack of knowledge. Thus, to repeat the passage from the *Logik Phillipi*, «the astronomer knows his ignorance to a much greater extent than the average person. Among all the theoretical sciences, none can humble [us] more than astronomy». (24:283-4). And as the astronomers peer further and further into the indefinitely extended cosmos, Kant suggests, they should eventually shift their perspective from nature to freedom, concerning themselves not with exclusively theoretical issues but with the realisation of the highest good.[22]

5. Bibliography

Adickes, E. (1925): *Kant als Naturforscher*. Vol. 2. Berlin: de Gruyter.
Cassirer, E. (1981): *Kant's Life and Thought*. Trans. James Haden. New Haven: Yale.
Clavier, P. (1997): *Kant: Les idées cosmologiques*. Paris: PUF.
Clewis, R. R. (2009): *The Kantian Sublime and the Revelation of Freedom*. Cambridge: Cambridge University Press.
Clewis, R. R. (2015): «The Place of the Sublime in Kant's Project», *Studi Kantiani* 28: 149-68.
Ertl, W. 2002. «Hume's Antinomy and Kant's Critical Turn», *British Journal for the History of Philosophy* 10.4: 617-40.
Falkenburg, B. (2000): *Kants Kosmologie: Die wissenschaftliche Revolution der Naturphilosophie im 18. Jahrhundert*. Frankfurt am Main: Klostermann.
Feynman, R. (1964): *The Feynman Lectures on Physics.* Vol 1. New York: Addison Wesley.
Friedman, M. (1992): *Kant and the Exact Sciences*. Cambridge, MA: Harvard University Press.

[22] For helpful comments on earlier versions of this paper, I thank Karin de Boer and the members of the Leuven Research Group in Classical German Philosophy as well as a reviewer for this journal. This research was funded by the Research Foundation - Flanders (FWO) and FRIAS, Universität Freiburg.

Friedman, M. (2013): *Kant's Construction of Nature: A Reading of the Metaphysical Foundations of Natural Science*. Cambridge: Cambridge University Press.
Gava, G. (2014): «Kant's Definition of Science in the *Architectonic of Pure Reason* and the Essential Ends of Reason», *Kant-Studien* 105.3: 372-93.
Grüne, S. (2009): *Blinde Anschauung. Die Rolle von Begriffen in Kants Theorie sinnlicher Synthesis*. Frankfurt: Klostermann.
Heimsoeth, H. (1970a): «Kants Erfahrung mit den Erfahrungswissenschaften», in *Studien zur Philosophie Immanuel Kants II: Methodenbegriffe der Erfahrungswissenschaften und Gegensätzlichkeiten spekulativer Weltkonzeption*. Bonn: Bouvier, 1970, 1-85.
Heimsoeth, H. (1970b): «Astronomisches und Theologisches in Kants Weltverständnis», in *Studien zur Philosophie Immanuel Kants II*, 86-108.
Hinske, N. (1966): «Kants Begriff der Antinomie und die Etappen seiner Ausarbeitung», *Kant-Studien* 56.3: 485-96.
Hooke, R. (1665): *Micrographia: or Some Physiological Descriptions of Minute Bodies Made by Magnifying Glasses. With Observations and Inquiries Thereupon*. London: The Royal Society.
Howard, S. (2022a): «Kant on Limits, Boundaries, and the Positive Function of Ideas», *European Journal of Philosophy* 30: 64-78.
Howard, S. (2022b): «From the Boundary of the World to the Boundary of Reason: The First Antinomy and the Development of Kant's Critical Philosophy», *HOPOS: The Journal of the International Society for the History of Philosophy of Science* 12.1: 225-41.
Howard, S. (2023): «Kant's Universal Natural History and Analogical Reasoning in Cosmology» in *Between Leibniz, Newton, and Kant*: *Philosophy and Science in the Eighteenth Century*. Second Edition. Ed. Wolfgang Lefèvre. Cham: Springer, 247-70.
Kant, I. (1902–): *Kants gesammelte Schriften*. 29 vols. Ed. Preussischen Akademie der Wissenschaften and successors. Berlin: de Gruyter.
Kant, I. (2000): *Königsberger Kantiana*. Ed. Sabina Laetitia Kowalewski and Werner Stark. Hamburg: Meiner.
Leibniz, G. W. ([1710] 1985): *Theodicy*. Trans. E.M. Huggard. La Salle, Illinois: Open Court.
Leibniz, G. W. (1989): *Philosophical Essays*. Ed. and trans. Roger Ariew and Daniel Garber. Indianapolis: Hackett.
Leibniz, G. W. (1996): *New Essays on Human Understanding*. Trans. and ed. Peter Remnant and Jonathan Bennett. Cambridge: Cambridge University Press.
Locke, J. ([1690] 1997): *An Essay Concerning Human Understanding*. Ed. Peter Woolhouse. London: Penguin.
Look, B. ed. (2021): *Leibniz and Kant*. Oxford: Oxford University Press.
Meer, R. (2019): *Der transzendentale Grundsatz der Vernunft. Funktion und Struktur des Anhangs zur Transzendentalen Dialektik der Kritik der reinen Vernunft*. Berlin: de Gruyter.
Schönecker, D., D. Schulting and N. Strobach (2011): «Kants kopernikanisch-newtonische Analogie», *Deutsche Zeitschrift für Philosophie* 59.4: 497-518.

Smith, J. (2011): *Divine Machines: Leibniz and the Sciences of Life*. Princeton, NJ: Princeton University Press.
Sturm, T. (2020): «Kant on the Ends of the Sciences», *Kant-Studien* 111.1: 1-28.
Sturm, T. and Larissa Wallner (forthcoming): «Kant's Empirical Account of Science», ms.
Waschkies, H.-J. (1987): *Physik und Physikotheologie des Jungen Kant*. *Die Vorgeschichte seiner Allgemeinen Naturgeschichte und Theorie des Himmels*. Amsterdam: Grüner.
Watkins, E. (2019): «Kant on Rational Cosmology», in *Kant on Laws*. Cambridge: Cambridge University Press, 191-211.
Wilson, C. (1995): *The Invisible World: Early Modern Philosophy and the Invention of the Microscope*. Princeton, NJ: Princeton University Press.

Stephen Howard
stephen.howard@frias.uni-freiburg.de