

Research Article

Rudolf Meer*

Between *Old* and *New* Teleology. Kant on Maupertuis' *Principle of Least Action*

<https://doi.org/10.1515/opphil-2020-0196>

received October 5, 2021; accepted December 30, 2021

Abstract: In the *Appendix to the Transcendental Dialectic*, Kant formulates teleological principles, or rather ideas, and explicates them referring to concrete examples of natural science such as chemistry, astronomy, biology, empirical psychology, and physical geography. Despite the increasing interest in the systematic relevance of the *Appendix to the Transcendental Dialectic* and its importance for Kant's conception of natural science, the numerous historical sources for the regulative use of reason have not yet been investigated. One that is very central is Maupertuis' *principle of least action*. In 1781, Kant transformed teleology into heuristics and methodology, but in doing so, he partially develops a teleology which was disqualified by Maupertuis because its starting point lies in the *construction of animals or plants*, the *structure of the earth*, and the *immensity of the celestial bodies*. Based on Maupertuis' principle of action, it can be shown that the *Appendix* forms a systematic interface between *Universal Natural History and Theory of the Heavens* and *Critique of Judgement* which allows the reconstruction of Kant's regulative use of reason and its specific status in the context of natural science and his critical appraisal of Maupertuis.

Keywords: *Appendix to the Transcendental Dialectic*, regulative use of reason, Maupertuis, principle of least action, teleology, heuristics, philosophy of nature

1 Introduction

In the *Transcendental Analytic* of the *Critique of Pure Reason*¹ and subsequently in the *Metaphysical Foundations of Natural Science*, Immanuel Kant clearly distinguishes his critical project from teleological thinking² and the closely related physicotheology. At the same time, in the *Appendix to the Transcendental Dialectic*, he explicates the “systematic unity of a teleological connection,”³ referring to concrete examples from natural science such as chemistry, astronomy, biology, empirical psychology, and physical geography. In doing so, the decisive point of reference is Pierre Louis Moreau de Maupertuis, although he is not mentioned by name. With his *principle of least action*, introduced in the 1740s,⁴ Maupertuis significantly changed

¹ Kant's writings are cited according to the Cambridge Edition. The usual A/B pagination for the *Critique of Pure Reason* or the abbreviations of the Academy Edition are given in square brackets.

² On the concept of teleology in Kant's critical philosophy, see Ferrarin, *Power*, 25–42; Dörflinger, *Leben*, 7–26; Klingner, *Vernunft*, 226–9; Breitenbach, “Views,” 351–69; McLaughlin, “Presupposition,” 554–72; and McFarland, *Concept*.

³ Kant, *Critique of Pure Reason*, 616 [A691/B719].

⁴ The *Essai de cosmologie* from 1750 and the *Examen philosophique* from 1756 are the culmination of Maupertuis' critique of the concepts of forces and their replacement by a final cause. The principle itself, however, already goes back to the *Lois du repos*

* **Corresponding author: Rudolf Meer**, University of Graz, Centre for the History of Science, 8010 Graz, Austria/Kantian Rationality Lab & Academia Kantiana, Immanuel Kant Baltic Federal University (IKBFU), Kaliningrad, Russian Federation, e-mail: rudolf.meer@uni-graz.at

the debate about the status of final causes and the possibility of teleology in natural science. Fully aware of the central importance of his *principle*, he defended his conception as a *new teleology* against the *old* forms.⁵

In terms of the *principle of least action* and its specific status in Maupertuis' theory, both continuities and breaks in Kant's concept of teleology can be reconstructed. Starting with the *Universal Natural History and Theory of the Heavens*, Kant develops an *old teleology* which was disqualified by Maupertuis and defends it based on the solar system. In the *Appendix to the Transcendental Dialectic*, Kant transforms teleology into a heuristic and a methodology, but develops systematically incompatible approaches: on the one hand, Kant reduces the regulative principles to mere *auxiliary means* of the principles of understanding, thus taking away their transcendental dignity; on the other hand, he mixes two concepts of final causes which were strictly differentiated by Maupertuis as *old* and *new teleology*. Not until the *Critique of the Power of Judgment* will these contradictions be resolved, but without dropping the claim made against Maupertuis.

Despite the increasing interest in the systematic relevance of the *Appendix to the Transcendental Dialectic*⁶ and its importance for Kant's conception of natural science,⁷ the numerous historical sources for the regulative use of reason have not yet been investigated. One of these sources will be examined in the following sections on the basis of the *principle of least action*, in order to discuss a systematic problem which lies in the possibility or the status of teleology within the framework of the first critique. Research has already drawn attention to the mixture of various teleological approaches in the *Appendix to the Transcendental Dialectic*.⁸ On that basis, the status of the regulative principles or ideas is controversial and discussed as *categorical*, *system*, and recently also as an *ideational* interpretation.⁹ The references to Maupertuis make it possible to develop an historically based criterion by which it becomes clear that all three positions in the question of the status of teleological principles have not only text-immanent proofs but also a systematic explanation deficit. For this reason, it can be shown with reference to the *principle of least action* where Kant's so-called *unsolved problem*¹⁰ of the *Appendix to the Transcendental Dialectic* lies and why, in the 1780s, it "still remains a problem worthy of investigation"¹¹ for him.¹²

2 Teleology and *Critique of Pure Reason*

In the *Critique of Pure Reason*, Kant explicates the principles of understanding to develop transcendental conditions of experience of an *object in general*. Accordingly, the *Transcendental Analytic* formulates

des corps (1740) and the paper *Accord de différentes loix de la nature qui avaient jusqu'ici paru incompatibles*, which was presented at the Paris Academy in 1744. For the history of the development of the principle, see Terrall, *Man*, 270; and Storni, "Principle," 1–23. For a formal description of the principle and the relationship to L. Euler, see Pulte, *Prinzip*, 75; Radelet De Grave, "Moindre," 439–84; Hecht, *Pierre*; Leduc, "Métaphysique," 11–30; and Lyssy, "L'économie," 31–50.

5 Maupertuis, *Versuch*, 20.

6 For an overview of the current controversies concerning the *Appendix to the Transcendental Dialectic*, see Willaschek, *Kant*, 17–98; Ypi, "Deduction," 163–5; Thöle, "Einheit," 113–48; Meer, *Grundsatz*, 3–8; Grier, *Doctrine*, 261–70; and Klimmek, *System*, 17–51.

7 See in particular Kitcher, "Order," 201–35; Marcucci, "Aspetti," 43–69; Watkins, *Kant*, 70–89; McNulty, "Use," 1–10; and Massimi, "Thing," 63–84.

8 See in particular, Thöle, "Einheit," 113–34; Horstmann, "Idee," 109–30; Horstmann, "Anhang," 525–46; McFarland, *Concept*, 14–6; Ginsborg, *Role*, 180–2; and Kitcher, "Order," 213–6. However, the theoretical scientific background of this confusion has not been taken into account.

9 This outline of the state of research is proposed by McNulty, "Use," 1–15.

10 Kant, *Theoretical Philosophy after 1781*, 153 [4:364].

11 *Ibid.*, 151 [4:362].

12 In the *Prolegomena*, Kant refers explicitly to the first part of the *Appendix to the Transcendental Dialectic*. In the second part, the references to natural science are less concrete. At the core are the concept of God and an examination of its *deistic* and *theistic* interpretations. However, questions concerning natural science are also developed, especially when Kant explicitly refers to the *history of the earth* or *physical geography* and *physiology of physicians* (Kant, *Critique of Pure Reason*, 614 [A687/B715]). Remarkably, teleology and physicotheology remain connected, even in Kant's critical period (see also Kant, *Critique of the Power of Judgment*, 303–8 [5:436–2]).

general laws of nature that are *prescribed* by understanding.¹³ In the *Metaphysical Foundations of Natural Science*, the principles of understanding are schematized based on the concept of *motion*,¹⁴ through which Kant deduces the “universal laws of material nature.”¹⁵ In addition to these laws, in the *Transcendental Dialectic*, in particular the *Appendix*, Kant develops regulative principles of the “systematic unity of nature.”¹⁶ Through these, a “purposeful unity of things”¹⁷ is created which “opens up for our reason, as applied to the field of experience, entirely new perspectives for connecting up things in the world in accordance with teleological laws.”¹⁸ In order to establish science as a “whole of cognition ordered according to principles”¹⁹ and not merely as an *aggregate*, Kant refers in the *Transcendental Methodology*, and, in particular, in the *Metaphysical Foundations of Natural Science*, to the concepts of reason by which natural science is determined as “*rational*”²⁰ and, with this, is set apart from a mere “*historical doctrine of nature*.”²¹ In addition to the “*nexus effectivus*,”²² according to which the connections between causes and consequences are clarified *a priori* by the principles of understanding, a “*nexus finalis*,”²³ through which the relationship to a unity is reflected, also plays a crucial role in Kant's theoretical philosophy.

In contrast to the *antinomy* and its *resolution* in the *Critique of the Power of Judgment*, in the *Critique of Pure Reason*, there is no explicit clarification given to the function of the concepts of reason and their importance with respect to the principles of understanding or the relationship between teleology and mechanics:²⁴ in the *Transcendental Analytic* as well as in the subsequent examinations of the *Prolegomena*, Kant formulates the principles of understanding as forming *necessary and sufficient conditions* of experience²⁵ and does not develop the regulative use of reason in the *Metaphysical Foundations of Natural Science* as an immanent principle. At the same time, however, the regulative use of reason is introduced as “indispensably necessary,”²⁶ and “lacking that, no sufficient mark of empirical truth”²⁷ would be possible.²⁸ Consequently, the principles of understanding are necessary but not solely *sufficient conditions* for experience and depend on the regulative use of reason.

Based on this indeterminacy of the necessity of teleological connections in the context of the first *Critique*, the respective research positions are also controversial. Sketched out in schematic form, it is possible to distinguish three interpretations, i.e., a *categorical*, a *system*, and an *ideational* interpretation. Following the *categorical reading*, all laws that are presented in the form of necessity are indirectly related to the principles of understanding. Systematicity is therefore only an additional auxiliary means for laws of experience, which however does not have an independently founded status.²⁹ Following the *system*

¹³ Kant, *Critique of Pure Reason*, 283 [A158/B197]; and Kant, *Theoretical Philosophy after 1781*, 112 [4:320].

¹⁴ Ibid., 191 [4:476].

¹⁵ Kant, *Critique of the Power of Judgment*, 258 [5:386].

¹⁶ Kant, *Critique of Pure Reason*, 618 [A695/B723], 616 [A691/B719], 649 [A651/B679].

¹⁷ Ibid., 614 [A686/B714].

¹⁸ Ibid., 614 [A686–7/B714–5].

¹⁹ Kant, *Theoretical Philosophy after 1781*, 183 [4:467]; Kant, *Critique of Pure Reason*, 592–3 [A647/B675], 696–7 [A842–3/B870–1].

²⁰ Kant, *Theoretical Philosophy after 1781*, 183 [4:468].

²¹ Ibid., 183 [4:468]. On the relationship between the Kantian classification of science in the *Metaphysical Foundations of Natural Science* and the *Critique of Pure Reason*; see in particular, Van den Berg, “Conception,” 11–6, but also Plaaß, *Theorie*, 38; Pollok, *Anfangsgründe*, 58–9; Watkins, “Structure,” 568; and Sturm, “Kant on the Ends,” 1–3.

²² Kant, *Critique of Pure Reason*, 615 [A687/B715].

²³ Ibid., 615 [A687/B715].

²⁴ The term *mechanics* is used in a broader sense and not in the technical one of the *Metaphysical Foundations of Natural Science*; see McLaughlin, *Kritik*, 138–41; Allison, “Antinomy,” 25–42; Ginsborg, “Kant,” 231–58; and Breitenbach, *Analogie*, 115.

²⁵ Kant, *Critique of Pure Reason*, 213 [A81/B106–7], 377–82 [A280–9/B336–46]; and Kant, *Theoretical Philosophy after 1781*, 89–90, 96, 110–1 [4:294–5, 302, 318].

²⁶ Kant, *Critique of Pure Reason*, 591 [A644/B672].

²⁷ Ibid., 595 [A651/B679].

²⁸ Following Kant, “all human cognition begins with intuitions, goes from there to concepts, and ends with ideas” (ibid., 622 [A702/B730]), and has in “regard to all three elements sources of cognition *a priori*” (ibid., 622 [A702/B730]).

²⁹ See Friedman, “Laws,” 161–99; Friedman, *Kant*, 165–201; Friedman, “Regulative,” 73–102; and Pollok, *Theory*, 109.

reading, the connection of concepts, in a hierarchy of scientific judgments and their approximation to an ideal, forms its own source for necessary laws.³⁰ Thus, it is to be explained independently of the principles of understanding. Following the *ideational reading*, the ideas gained via the transcendental principles of reason are apodictically applied in the sense of an *as-if* and form their own source of *a priori* laws.³¹

The *categorical*, the *system*, and the *ideational readings* thus form three different interpretations of the status of regulative principles and their relationship to constitutive ones – a problem that remains *unresolved* in the *Critique of Pure Reason*. This ambiguity has its origin in the fact that Kant does not strictly separate various historically established teleological concepts, but rather mixes them in his own elaboration in the *Appendix to the Transcendental Dialectic*.

3 Historical sources for Kant's concept of teleology

3.1 The principles of the philosophers

More so than in other passages of the *Critique of Pure Reason*, in the development of the *systematic unity of nature* in the *Appendix to the Transcendental Dialectic*, Kant refers to concrete results of natural science: “For even though it is not actually expressed this way, it is still very easy to discover the influence of reason on the classifications of students of nature.”³² And even more concretely, Kant writes: “We also find this transcendental presupposition [of the “systematic unity of nature”] hidden in an admirable way in the principles of the philosophers, although they have not always recognized it [in nature] or admitted it to themselves.”³³ Accordingly, this precondition forms a

scholastic rule or logical principle, without which there could be no use of reason, because we can infer from the universal to the particular only on the ground of the universal properties of things under which the particular properties stand. But that such unanimity is to be encountered even in nature is something the philosophers presuppose in the familiar scholastic rule that one should not multiply beginnings (principles) without necessity (*entia praeter necessitate non esse multiplicanda*). It is thereby said that the nature of things themselves offers material for the unity of reason.³⁴

In this passage, Kant explicitly refers to the principle that became known in early modern times as *Occam's razor*.³⁵ The actual point of reference, however, is Maupertuis, although he is not mentioned by name.³⁶ Kant studied Maupertuis' *Essai de cosmologie* from 1751, which was translated into German as *Versuch einer Cosmologie* (1751), even before he published the *Universal Natural History and Theory of the Heavens*.³⁷ With the *principle of least action* presented in the *Essai*, Maupertuis developed a mathematical reformulation of the scholastic principle of parsimony.

³⁰ Buchdahl, “Relation,” 209–26; Buchdahl, “Conception,” 24–46; Buchdahl, “Verhältnis,” 97–142; Kitcher, “Order,” 215; Rush, “Reason,” 847; and Guyer, “Kant,” 287 develop this position based on different priorities.

³¹ See especially McNulty, “Use,” 4–7; Massimi, “Laws,” 491–508; Henschen, “Kant,” 20–9; and Watkins, “What,” 471–90.

³² Kant, *Critique of Pure Reason*, 592 [A646/B674].

³³ *Ibid.*, 595 [A651/B679].

³⁴ *Ibid.*, 595 [A652/B680].

³⁵ For the historical background of this principle in early modern philosophy, see Wood, “Repudiation,” 350–74; and Sober, *Razors*, 4–58.

³⁶ Another possible point of reference could be Ch. Wolff, *Philosophia*, 38, who in 1728 introduces the concept of teleology for a *Science of Purpose* (*Wissenschaft der Zwecke*) in the *Philosophia rationalis sive logica*.

³⁷ Kant is acquainted with the *principle of least action* merely in the interpretation of Maupertuis, and not in that of Euler, Pulte, “Teleologie,” 81.

3.2 Maupertuis and the implementation of a new teleology

In the eighteenth century, the debate on Descartes', Leibniz', and Newton's natural philosophy led to an increasing skepticism toward teleological explanations.³⁸ At the same time, a multitude of teleological approaches can be found that differ in their argumentation and objectives.³⁹ This results in intensive debate about the status and function of the concept of purpose in physics and leads to the question of the position of final causes in relation to efficient ones.

Maupertuis' *principle of least action* represents a decisive turning point in the development of eighteenth-century teleological thought. According to the *highest principle*, when bodies collide with each other, the "movement is distributed such that the quantity of action, required for the change that has taken place, is as small as possible."⁴⁰ This describes the physical quantity of the action which is necessary during the transition from one point to another – the actual transition is realized on that path which assumes the least action.

According to Maupertuis' conviction, the *principle* overcomes the assumption of primary forces by contrasting the concept of efficiency with a final approach. The goal is to reduce physics to the collision of bodies, which can be derived from the *principle of least action*.

In order to distinguish his idea of a final cause from other teleological approaches, Maupertuis starts his *Essai de cosmologie* with a critique of teleology and physicotheology. "We find so many proofs of an omnipotent and omniscient being that it is somewhat more expedient to reduce them in number rather than to seek to increase them" and "to make a choice among these proofs."⁴¹ Maupertuis makes such a choice by schematically distinguishing two forms of teleological thinking and their structure of evidence. An explicit distinction is made between a *new* and an *old teleology* (or physicotheology), as the former is introduced on the basis of the *principle of least action*.⁴²

From Maupertuis' point of view, the argumentative structure of an *old teleology* refers in its proofs to "the sparks of wisdom and ability we see scattered in finite beings."⁴³ These are proofs of God's existence "which the old ones derived from the beauty, order, and connection of the world"⁴⁴ by taking their starting point in the *construction of animals or plants*, the *structure of the earth*, and the *immensity of the celestial bodies*.⁴⁵ Therefore, Maupertuis opposes a notion of purpose that takes its starting point in concrete cases or properties unique in time and space.

³⁸ Thiele, "Euler," 375–9; Ben-Menahem, *Causation*, 134; Pulte, *Prinzip*, 83–9; and Putle, "Teleologie," 77–8.

³⁹ Terrall, *Man*, 270–2; Schramm, *Natur*, 38–55; Speiser, "Pierre," 341–61; and Sala, *Kant*, 28–33.

⁴⁰ "Dans le choc des corps, le mouvement se distribue de maniere maniere, que la quantité d'action que suppose le changement arrivé, est la plus petite qu'il soit possible." (Maupertuis, *Essai*, 106) "Bey dem Stoß der Körper wird die Bewegung also vertheilet, daß die Größe der Wirkung, welche die vorgegangene Veränderung voraus setze, so klein, als möglich, ist." (Maupertuis, *Versuch*, 57, 89)

⁴¹ "Soit que nous demeurions renfermés en nous mêmes, soit que nous en sortions pour parcourir les merveilles de l'Univers, nous trouvons tant de preuves de l'existence d'un Etre tout puissant & tout sage, qu'il est en quelque sorte plus nécessaire d'en diminuer le nombre que de chercher à l'augmenter." (Maupertuis, *Essai*, 1–2) "[S]o finden wir so viel Beweise eines allmächtigen und allweisen Wesens, daß es einigermaßen nöthiger ist, die Anzahl derselben zu vermindern, als sie zu vermehren zu suchen [und] eine Wahl unter diesen Beweisen anzustellen" (Maupertuis, *Versuch*, 19–20).

⁴² In research, studies have also discussed Maupertuis' distinction between an *old* and *new teleology* (Schramm, *Natur*, 25–31; Schramm, "Creation," 100–1) is also discussed as *naïve vs. formal teleology* (Thiele, "Euler," 376; Stöltzner, "Ordnungen," 199–239). With reference to Windelband's, *Geschichte*, 145 differentiation of humanities and natural sciences, Pulte, "Physikotheologie," 308; Putle, "Teleologie," 80 also uses the distinction *idiographic* and *nomothetic teleology*. Löw, *Philosophie*, 217 introduces a similar distinction by separating a *vertical* and *horizontal argumentation* structure in teleology.

⁴³ "de ces étincelles de sagesse & de puissance que nous voyons répandues dans les Etres finis" (Maupertuis, *Essai*, 5–6) "aus den Funken der Weisheit und des Vermögens, welche wir in den endlichen Wesen zerstreut sehen" (Maupertuis, *Versuch*, 21).

⁴⁴ "que les Anciens ont tirée de la beauté, de l'ordre, & de l'arrangement de l'Univers" (Maupertuis, *Essai*, 9) "welche die Alten aus der Schönheit, Ordnung und Verbindung der Welt hergeleitet" (Maupertuis, *Versuch*, 22).

⁴⁵ Ibid., 41.

The bodies of animals and plants are too intricate machines, their last parts escape our sensations too much, and whose application and intention we know too little to be able to judge the wisdom and power which was necessary for their construction.⁴⁶

As Maupertuis indicates, this criticism is directed explicitly against the cosmogony of Descartes and the physicotheology of Newton. With regard to Descartes, Maupertuis writes:

Some philosophers have been daring enough to explain all the mechanism of the world and even its first formation from these single laws. They have said, give us matter and motion, and we shall make the world such as it is. An enterprise truly extravagant!⁴⁷

Maupertuis alludes in this quote to Voltaire's characterization of Descartes' cosmogony, according to which he hypothetically tries to develop the world starting from chaos and based on natural laws.⁴⁸ In addition to this *excessive* Cartesian attempt, Newton is also guilty of a teleology based on individual cases, when he "seems to have been more moved by the proofs found in the contemplation of the world than by all the others he could have taken from the deep insight of his mind" and thereby mistakenly concludes that these are "nothing else but the effect of the will of a supreme being."⁴⁹

Following Maupertuis' criticism of these varieties of an *old teleology*, a justified version of teleology cannot be based on individual phenomena but rather must be based on general laws of nature. "A true philosopher must neither be blinded by those parts of the world from which order and agreement shine forth, nor swayed by those which he does not discover."⁵⁰ The *supreme being* is therefore "not to be sought in the separate and small parts of the world, whose relations to one another we know too little."⁵¹ It is found in the "first laws" and "general rules," and "not in phenomena which are nothing but too complicated consequences of these laws."⁵² Thus, in his *new teleology*, Maupertuis proceeds from general laws of nature

46 "Les corps des Animaux et des Plantes sont des machines trop compliquées, dont les dernières parties échappent trop à nos sens, & dont nous ignorons trop l'usage & la fin, pour que nous puissions juger de la sagesse & de la puissance qu'il a fallu pour les construire" (Maupertuis, *Essai*, 32–3)/"Die Körper der Thiere und Pflanzen sind allzu verwickelte Maschinen, deren letzte Theile unsern Empfindungen allzu sehr entziehen, und deren Gebrauch und Absicht wir allzu wenig wissen, als daß wir von der Weisheit und Macht, welche zu ihrem Bau nöthig gewesen ist, sollten urtheilen können." (Maupertuis, *Versuch*, 31).

47 "Quelques Philosophes ont été assez téméraires pour entreprendre d'en expliquer par ces feules lois toute la Mécanique, & même la première formation: donnez nous, ont-ils dit, de la matière & du mouvement, & nous allons former un monde tel que celui-ci. Entreprise véritablement extravagante!" (Maupertuis, *Essai*, 112–3)/"Einige Philosophen sind wegen genug gewesen, aus diesen einzigen Gesetzen die ganze Mechanik der Welt und sogar ihre erste Bildung erklären zu wollen. Man gebe uns, haben sie gesagt, Materie und Bewegung, so wollen wir eine Welt machen, wie diese ist. Eine in der That ausschweifende Unternehmung!" (Maupertuis *Versuch*, 59).

48 Voltaire, *Eléments*, 34; Sala, *Kant*, 22; and Waschkies, *Physik*, 571.

49 "Newton paroît avoir été plus touché des preuves qu'on trouve dans la contemplation de l'Univers, que de toutes les autres qu'il auroit pû tirer de la profondeur de son esprit. Ce grand homme a cru, que les mouvemens des corps célestes demontroient assez l'existence de celui qui les gouverne." (Maupertuis, *Essai*, 10–1)/"Newton scheint durch die Beweise, welche man in der Betrachtung der Welt findet, mehr gerührt gewesen zu seyn, als durch alle andere, welche er aus der tiefen Einsicht seines Geistes hernehmen können. [...] Newton hat geglaubt, eine solche Einförmigkeit könne nichts anders, als die Wirkung des Willens eines höchstens Wesens seyn." (Maupertuis, *Versuch*, 23).

50 "Le vrai Philosophe ne doit, ni se laisser éblouir par les parties de l'Univers où brillent l'ordre & la convenance, ni se laisser ébranler par celles où il ne les découvre pas." (Maupertuis, *Essai*, 46–7)/"Ein wahrer Philosoph muß sich weder durch die Theile der Welt, aus welchen Ordnung und Übereinstimmung hervorleuchten, blenden, noch durch diejenigen, wo er dieselben nicht entdeckt, wankend machen lassen." (Maupertuis, *Versuch*, 36).

51 "Ce n'est donc point dans les petits détails, dans ces parties de l'Univers dont nous connoissons trop peu les rapports, qu'il faut chercher l'Etre suprême" (Maupertuis, *Essai*, 54–5)/"Man muß also das höchste Wesen nicht in den voneinander getrennten und kleinen Theilen der Welt, deren Verhältnisse gegen einander wir allzu wenig kennen, suchen" (Maupertuis, *Versuch*, 39).

52 "[C]herchons le dans les premières lois qu'il a imposées à la Nature; dans ces règles universelles, selon lesquelles le mouvement se conserve, se distribue, ou se détruit; & non pas dans des Phénomènes qui ne sont que des suites trop compliquées de ces lois." (Maupertuis, *Essai*, 61–2) "Laßt es uns in den ersten Gesetzen suchen, welche es der Natur gegeben hat, in den allgemeinen Regeln, nach welchen die Bewegung erhalten, vertheilt oder zernichtet wird, und nicht in Erscheinungen, welche nichts, als allzu verwickelte Folgen dieser Gesetze sind." (Maupertuis, *Versuch*, 41).

and formulates an *instrumentalist standpoint*. The *principle of least action* builds a *second-order law* that allows him to derive other specific laws which are known and confirmed by experience.⁵³

4 Kant's examination of Maupertuis' *principle of least action*

4.1 *Universal Natural History and Theory of the Heavens*

In the *Universal Natural History and Theory of the Heavens*, Kant agrees on the one hand with Maupertuis' criticism of the *old teleology*. In this sense, he shares Maupertuis' doubts about developing a teleology in the field of biology: in the question of the creation of a *single plant*, a *caterpillar*,⁵⁴ or even a *single snow-crystal*,⁵⁵ there is far too little concrete evidence for a well-founded teleology. On the other hand, the book from 1755 represents a large-scale attempt to rehabilitate the *old teleology* criticized by Maupertuis in the case of the solar system. Among all "things in nature whose first cause we can investigate, the origin of the world system and the generation of the heavenly bodies together with the causes of their motions is the one which we might first hope to understand thoroughly and reliably."⁵⁶ Accordingly, the *Universal Natural History and Theory of the Heavens* can also be read as an alternative to the *principle of least action*, as becomes clear when Kant claims, with regard to Maupertuis' criticism of the *old teleology*, "I shall destroy this difficulty,"⁵⁷ and outlines his own project as follows:

It seems to me that in a certain sense one could say here without being presumptuous: *Give me matter and I will build a world out of it*, that is, give me matter and I will show you how a world is to come into being out of it.⁵⁸

Kant implicitly quotes here Maupertuis' reference to Voltaire's parody of Cartesian cosmogony. Thus, he positions his natural history in the context of a thinker who is directly attacked by Maupertuis. Furthermore, with his writing from 1755, Kant addresses a case in relation to which Maupertuis believes that he has demonstrated in Newton the limitations of *old teleological* thoughts. Although Kant proposes a different solution than that of Newton,⁵⁹ he positions his concept again in the context of a thinker attacked directly by Maupertuis. In this sense, Kant not only conceives the *Universal Natural History and Theory of the Heavens* as an *old teleology*, but also defends it explicitly before the president of the Berlin Academy.⁶⁰

4.2 *The Appendix to the Transcendental Dialectic*

The *Universal Natural History and Theory of the Heavens* represents, if not a counterexample, at least an alternative to Maupertuis' *new teleology*. The book also forms the starting point of a defense of a teleological

⁵³ Pulte, *Prinzip*, 36; Pulte, "Mannigfaltigkeit," 241; Ben-Menahem, *Causation*, 147; and Storni, "Principle," 1–22.

⁵⁴ Kant, *Natural Science*, 201 [1:230].

⁵⁵ Kant, *Theoretical Philosophy*, 179 [1:138].

⁵⁶ Kant, *Natural Science*, 200 [1:229].

⁵⁷ *Ibid.*, 200 [1:229].

⁵⁸ *Ibid.*, 200 [1:229–30].

⁵⁹ According to Kant, the laws of action (attraction and repulsion) are inherent to matter. The natural order necessarily unfolds in accordance with these laws. They are sufficient for the production and preservation of the orderly and functional constitution of the world (*ibid.*, 199 [1:228]; see Janiak, *Newton*, 102–12).

⁶⁰ In contrast, Tonelli, *Elementi*, 51–61; Tonelli, "Conditions," 126–44; Waschkies, *Physik*, 573–6 finds in the *Universal Natural History and Theory of the Heavens* a defense of Maupertuis' *principle*. However, this is an interpretation that is strongly influenced by *The Only Possible Argument in Support of a Demonstration of the Existence of God* and goes back to basic considerations of Cassirer, *Erkenntnisproblem*, 586–600. See also the remarks of Sala, *Kant*, 27–8, who also argues with reference to the book from 1763. Buchdahl, *Metaphysics*, 493; and Pulte, "Teleologie," 82–3 argue in a similar way. For the relationship between the book from 1755 and 1763, see Kreimendahl and Oberhausen, "Einleitung."

concept based on individual cases that can be traced throughout Kant's entire writings, although it is in a state of constant transformation.

Despite the increasing discrediting of teleology in the context of physics toward the end of the eighteenth century, the question of its function and structure remains an unresolved problem for Kant. The difficulties that arise from the status of final causes are made clear by a very complex formulation in the *Appendix to the Transcendental Dialectic*, compressed into one sentence:

What is strange about these principles, and what alone concerns us, is this: that they seem to be transcendental, and even though they contain mere ideas to be followed in the empirical use of reason, which reason can only follow asymptotically, as it were, i.e., merely by approximation, without ever reaching them, yet these principles, as synthetic propositions *a priori*, nevertheless have objective but indeterminate validity, and serve as a rule of possible experience.⁶¹

Using the word *concern* in the introductory formulation of this quotation suggests that Kant does not necessarily intend to present certain results of his considerations apodictically, but rather sketches a problem that is found in the following juxtaposition: the principles of reason form “synthetic propositions *a priori*,”⁶² serve “as a rule of possible experience,”⁶³ and thus seem to be “transcendental.”⁶⁴ At the same time, however, they represent “heuristic principles”⁶⁵ in the treatment of possible experience, by which the *empirical use of reason* is guided, but follows “only asymptotically.”⁶⁶ Based on this juxtaposition and the fact that a transcendental justification of concepts is merely feasible with reference to the manifold in time and space,⁶⁷ Kant comes to the conclusion that a “transcendental deduction is always impossible in regard to ideas.”⁶⁸ Nevertheless, he claims that the principles of reason have “objective but indeterminate validity”⁶⁹ or, as Kant formulates it in the following paragraph, “some objective validity.”⁷⁰

The *strangeness* mentioned by Kant results from an ambiguity in the task and function of teleological explanation in nature. Kant's approach oscillates between a reduction of systematicity to a mere auxiliary means of the principles of understanding, and a purposeful explanation of individual natural phenomena and nature as the lawful connection of our ideas, i.e., between an abolition of final causes and the *old* and *new teleology* characterized by Maupertuis.

4.2.1 Final causes of specific phenomena

The ideas or principles of reason are developed in the sense of an old teleology when they become “a rule of possible experience.”⁷¹ Kant writes: “It is thereby said that the nature of things themselves offers material for the unity of reason.”⁷² Based on this consideration, “systematic unity, as pertaining to the objects itself, is assumed *a priori* as necessary.”⁷³ Thus, purposiveness is not a *second-order principle* of the cognition of understanding but is developed based on individual cases and likewise applied to them. Thus, in Kant's argumentation so far, it “cannot even be seen how there could be a logical principle of rational unity among rules unless a transcendental principle is presupposed.”⁷⁴

⁶¹ Kant, *Critique of Pure Reason*, 601–2 [A664/B691].

⁶² Ibid., 602 [A663/B691].

⁶³ Ibid., 602 [A663/B691].

⁶⁴ Ibid., 601 [A663/B691].

⁶⁵ Ibid., 602 [A663/B691].

⁶⁶ Ibid., 601 [A663/B691].

⁶⁷ Ibid., 220 [A85/B117].

⁶⁸ Ibid., 602 [A663–4/B691–2].

⁶⁹ Ibid., 602 [A663/B691].

⁷⁰ Ibid., 602 [A664/B692].

⁷¹ Ibid., 602 [A663/B691].

⁷² Ibid., 595 [A652/B680].

⁷³ Ibid., 594 [A650–1/B678–9].

⁷⁴ Ibid., 594 [A650/B678], 596–7 [A654/B682].

In the first part of the *Appendix to the Transcendental Dialectic*, Kant contrasts the *apodictic use of reason* with a *hypothetical* one: in the latter, the particular is the certain and the universal is “assumed only problematically.”⁷⁵ In the course of the hypothetical use of reason, “several particular cases”⁷⁶ are tested by a general rule “to see if they flow from it.”⁷⁷ Thus, the intention is “bringing unity into particular cognitions.”⁷⁸ If all particular cases can be explained by this rule, “then the universality of the rule is inferred, including all subsequent cases, even those that are not given in themselves.”⁷⁹

A similarly formulated mental figure can also be found in the second part of the *Appendix to the Transcendental Dialectic* which refers to the ideas of God, world, and soul. Starting from the *field of possible experience*, an “object in the idea”⁸⁰ is concluded by means of a process of abstraction. This *object in the idea* “serves only to represent other objects to us, in accordance with their systematic unity.”⁸¹ Thus, it is possible to *derive* “the object of experience, as it were, from the imagined object of this idea as its ground or cause”⁸² in the form of an “as if.”⁸³ With the *object in the idea*, “we think a relation to the sum total of appearances, which is analogous to the relation that appearances have to one another.”⁸⁴ For this reason, Kant concludes that there is “not the least thing to hinder us from assuming these ideas as objective and hypostatic.”⁸⁵

In both parts of the *Appendix*, Kant formulates a reciprocal inference, in which he combines the *inference of induction*, *subsumption*, and *analogy*.⁸⁶ With induction the first, Kant explicates an inference from the manifold (the particular) to a unity (the universal) based on the principle of “universalization,”⁸⁷ with the second one, how specific cases are subsumed under general rules, and with the third one, an inference “from many determinations and properties, in which things of one kind agree, to the remaining ones, insofar as they belong to the same principle.”⁸⁸

4.2.2 Final causes of general laws

In contrast to all forms of *old teleology*, Kant points out in the same passages that it is not “merely a few parts of nature, e.g., the distribution of dry land, its structure and the construction and situation of mountains, or even only the organization of the vegetable and animal kingdoms”⁸⁹ that can be seen as purposive. Such argumentation is disqualified as “lazy reason (*ignava ratio*).”⁹⁰ On the contrary, “we make a purposiveness in accordance with universal laws the ground.”⁹¹ In this context, Kant always speaks in analogy of understanding and reason. In accordance with the “analogy of a causal determination,”⁹² the different laws should be systematically connected through reason. As understanding “unites the manifold into an object through concepts, so reason on its side unites the manifold of concepts through ideas.”⁹³

⁷⁵ Ibid., 592 [A646/B674].

⁷⁶ Ibid., 592 [A646/B674].

⁷⁷ Ibid., 592 [A646/B674].

⁷⁸ Ibid., 592 [A647/B675].

⁷⁹ Ibid., 592 [A647/B675].

⁸⁰ Ibid., 605 [A670/B698].

⁸¹ Ibid., 605 [A670/B698].

⁸² Ibid., 606 [A670/B698].

⁸³ Ibid., 606 [A671/B699].

⁸⁴ Ibid., 607 [A674/B702].

⁸⁵ Ibid., 607 [A673/B701].

⁸⁶ Kant, *Lectures on Logic*, 626 [9:133].

⁸⁷ Ibid., 626 [9:133].

⁸⁸ Ibid., 626 [9:132].

⁸⁹ Kant, *Critique of Pure Reason*, 616 [A691/B719].

⁹⁰ Ibid., 615 [A689/B717].

⁹¹ Ibid., 616 [A691/B719].

⁹² Ibid., 621 [A700/B728].

⁹³ Ibid., 591 [A644/B672].

In this sense, purposiveness becomes a kind of *second-order principle* and differs from that of the *Transcendental Analytic* because it is regulative and not constitutive. This approach becomes most clear, when Kant writes:

Reason never relates directly to an object, but solely to the understanding and by means of it to reason's own empirical use, hence it does not create any concepts (of objects) but only orders them and gives them that unity which they can have in their greatest possible extension, i.e., in relation to the totality of series.⁹⁴

Thus, the concepts of reason become “maxims”⁹⁵ based solely on the “speculative interest”⁹⁶ of reason, “even though it may seem as if they were objective principles.”⁹⁷ In this sense, the regulative use of reason reflects the laws which are determined by the principles of understanding.

4.3 Critique of the Power of Judgment

What Kant lacks in 1781 is an explicit choice between the various functions and forms of teleological thinking and, associated with this, a clarification of the relationship between final and efficient causes. In the *Critique of the Power of Judgment*,⁹⁸ however, he has already clarified this ambiguity in the form and structure of final causes in natural science. Thereby, the reflective power of judgment forms a capacity that is not directed to a certain cognition but to *cognition in general*. It reflects the conditions under which specific cases can be the object of human cognition, although they elude the objective cognition of the principles of understanding. “As for what occasions it, this principle [of purposiveness] is of course to be derived from experience,”⁹⁹ but “cannot rest merely on grounds in experience.”¹⁰⁰ It must have “as its ground some sort of *a priori* principle, even if it is merely regulative and even if that end lies only in the idea of the one who judges and never in any efficient cause.”¹⁰¹ Thus, the need to recognize the manifoldness of specific phenomena becomes the occasion for the power of judgment to reflect the relation and possible purposiveness of the capacities. In this sense, the reflecting power of judgment “attributes nothing at all to the object (of nature), but rather only represents the unique way in which we must proceed in reflection on the objects of nature with the aim of a thoroughly interconnected experience.”¹⁰² Individual phenomena are therefore the starting point for teleological reflections and do not assist an understanding of nature in the sense of the old teleology.

Moreover, in the *Antinomy* and its *resolution* of the *Critique of the Power of Judgment*,¹⁰³ Kant explicitly clarifies the *primacy of mechanics* over teleology, according to which the natural scientist is instructed to follow its mechanics as far as possible. This primacy, however, does not make teleology superfluous but installs it as an independent view of nature. However, physics is developed – in regard to the *Metaphysical*

⁹⁴ Ibid., 590–1 [A643/B671].

⁹⁵ Ibid., 603 [A666/B694].

⁹⁶ Ibid., 603 [A666/B694].

⁹⁷ Ibid., 603 [A666/B694].

⁹⁸ On the historical developmental between the *Appendix to the Transcendental Dialectic* and the teleological judgment of the *Critique of the Power of Judgment*, see inter alia Ginsborg, *Role*, 174–92; Ferrarin, *Power*, 25–42; and Dörflinger, *Leben*, 7–26.

⁹⁹ Kant, *Critique of the Power of Judgment*, 248 [5:376].

¹⁰⁰ Ibid., 248 [5:376].

¹⁰¹ Ibid., 376 [5:376].

¹⁰² Ibid., 71, 233–4 [5:184, 360]. For a critical evaluation of the subjective and objective moments in the concept of purposiveness in teleological judgment, see Klingner, *Vernunft*, 78–81.

¹⁰³ Kant, *Critique of the Power of Judgment*, 258–9 [5:387]. Kant develops two different *antinomies* whose relationship is disputed. Interpreters such as Löw, *Philosophie*, 204–6; Butts, “Teleology,” 4–6; and Gfeller, “Wie,” 218–20 have interpreted only the second antinomy as an actual contradiction. See the criticism of McLaughlin, *Kritik*, 135–7; and Breitenbach, “Views,” 113. For an overview of the state of research, see Klingner, *Vernunft*, 226–29; Quarfood, “Kant,” 735–47; Breitenbach, “Views,” 351–69; and Goy, *Theorie*, 93–103.

Foundations of Natural Science – as a discipline in which teleology does not play an immanent role, as § 68 makes clear:

Arithmetical and geometrical analogies as well as universal mechanical laws, no matter how strange and astonishing the unification of different and apparently entirely independent rules in a single principle in them may seem, can make no claim on that account to be teleological grounds of explanation within physics.¹⁰⁴

When Kant speaks of the unification of “entirely independent rules in a single principle,”¹⁰⁵ he is again indirectly alluding to Maupertuis' *principle of least action*. At this stage of Kant's development, the *principle* no longer plays a role for the foundation of mechanics, and physics gets along without teleological explanations.¹⁰⁶

5 Unsolved problems of the *Critique of Pure Reason*

Maupertuis' differentiation between an *old* and *new teleology* allows the analytical separation of various incompatible elements in Kant's conceptions of teleology. However, it is important to note that this distinction is not an unrestricted standard for Kant: as he constantly undermines it. At the same time, it becomes evident that in 1781 Kant lacks a critical examination between the various forms of teleology and the “choice among these proofs”¹⁰⁷ which was explicitly demanded by Maupertuis. Regardless of the methodological transformation of teleology in the *Appendix to the Transcendental Dialectic*, Kant's approach oscillates between three extremes: firstly, Kant reduces the regulative principles or ideas to mere auxiliary means of the principles of understanding and thus deprives them of their independent dignity within the framework of natural philosophy. Secondly, the regulative principles or ideas are developed for a systematic unity and therefore as a second-order condition, whereby the specific laws of understanding are subject to the more general laws of reason. Thirdly, Kant develops the regulative principles or ideas as a systematic unity of nature in the empirical use of reason, whereby these can be understood in a specific way as belonging to the objects.

It is remarkable, on the one hand, that the latter two interpretations renew and reproduce Maupertuis' *old* and *new teleology* as shown above. On the other hand, the ambiguities in Kant's teleological concept are reflected in the current research question concerning the necessity of regulative principles and ideas, i.e., the *categorical*, the *system*, and the *ideational reading*. It becomes clear that all three positions in the question of the status of teleological principles have not only text-immanent proofs but also a systematic explanation deficit.

The *categorical interpretation* is based entirely on the core function of the *Transcendental Analytic*. In this passage, Kant characterizes the principles of understanding as *necessary* and *sufficient* conditions for experience. This interpretation takes into account the fundamental role of the principles of understanding within the framework of the *Metaphysical Foundations of Natural Science*, according to which the “concept of matter had therefore to be carried through all four of the indicated functions of the concepts of the understanding.”¹⁰⁸ In addition, in the *Appendix to the Transcendental Dialectic*, Kant disparages the function of regulative concepts by formulating that they “cannot do us any harm.”¹⁰⁹

¹⁰⁴ Kant, *Critique of the Power of Judgment*, 253 [5:382].

¹⁰⁵ Ibid., 253 [5:382].

¹⁰⁶ For the function of teleology also in the context of mechanics, see Breitenbach, *Analogie*, 124–8; and McLaughlin, *Kritik*, 135–7.

¹⁰⁷ Maupertuis, *Versuch*, 20.

¹⁰⁸ Kant, *Theoretical Philosophy after 1781*, 191 [5:476].

¹⁰⁹ Kant, *Critique of Pure Reason*, 614 [A687/B715].

For then nothing more can follow from it in any case than that where we expected a teleological connection (*nexus finalis*), a merely mechanical or physical one (*nexus effectivus*) is to be found; in such a case we only miss one more unity, but we do not ruin the unity of reason in its empirical use.¹¹⁰

In this way, the natural scientist is instructed to follow the mechanical connections as far as possible and to regard teleological connections only as temporary auxiliary means. However, if the independent necessity of the regulative use of reason is disputed in relation to the constitutive principles of understanding, the central claim of the *Critique of Pure Reason* in regard to the *Universal Natural History and Theory of the Heavens* would become invalid, i.e., the differentiation between the principles of understanding and the principles of reason.¹¹¹ In the framework of the *Metaphysical Foundations of Natural Science*, the reduction of all necessary laws to the principles of understanding leads to the problem that Kant's differentiation between *proper* and *improper science* cannot be maintained.¹¹² In this sense, for example, the lawfulness of chemistry would also have to be indirectly attributed to the principles of understanding. Moreover, the hierarchically organized distinction between *rational science*, which is legitimized by the systematic unity of the ideas of reason, and *proper science*, which in turn is legitimized by the principles of understanding, becomes questionable.¹¹³

The *system interpretation*, in turn, corresponds to the concept of the *principle of least action* as introduced by Maupertuis. Accordingly, the “law of reason”¹¹⁴ permits a “coherent use of understanding”;¹¹⁵ the principles of understanding, however, make experience possible in the first place. The systematic unity forms, in this sense, a *second-order condition* to the principles of understanding and has, in analogy to the validity of the constitutive principles, “objective but indeterminate validity.”¹¹⁶ In contrast to Maupertuis, however, in the *Appendix to the Transcendental Dialectic*, Kant renounces a uniform principle of all-natural research, whereby the systematic unity becomes variable. Accordingly, there is a separate *supreme touchstone* in chemistry, biology, astronomy, and empirical psychology. However, what remains unexplained in the system reading is – in contrast to the *categorical* and *ideational readings* (and also the teleological judgment) – how the insights through the regulative use of reason have an effect on the constitutive one.¹¹⁷ Consequently, it remains open how the ideas of reason that have been developed regulatively or hypothetically as the *supreme touchstone of truth* can be applied concretely.

The *ideational interpretation* already points clearly toward the solution of the teleological judgment. Kant introduces final causes starting from special cases, moving from these to a general rule or object in the idea, in order to explain cases which are not given. Based on the actual scientific handling of empirical material and its classification, the *Appendix to the Transcendental Dialectic* pursues the claim to argue in a pragmatic manner and in a practically well-founded way. In the development of systematic unity, Kant refers to chemistry, physiological anthropology, astronomy, and empirical psychology¹¹⁸ to make the possibilities of teleology plausible, even if not purely argumentative. In doing so, the circular, elliptical, parabolic, and hyperbolic movements of the planets,¹¹⁹ the elements of pure earth, pure water, pure air,

¹¹⁰ Ibid., 614–5 [A687–8/B715–6].

¹¹¹ Kant develops this differentiation in the 1770s ([18:222]; [18:357, 380, 389]). It is still important in the *Critique of the Power of Judgment*: “Our reason does not comprehend the possibility of a unification of two entirely different kinds of causality, that of nature in its universal lawfulness and that of an idea that limits the latter to a particular form for which nature does not contain any ground at all” (Kant, *Critique of the Power of Judgment*, 290 [5:422]; see: McFarland, *Concept*, 129–31; Allison, “Antinomy,” 38–9; Breitenbach, *Analogie*, 129).

¹¹² Kitcher, “Unity,” 258.

¹¹³ Many interpreters have disputed the general relevance of a transcendental principle of reason and the *Appendix to the Transcendental Dialectic* in the context of the first critique, but have not sufficiently considered its function for Kant's philosophy of (natural) sciences (among others Serck-Hanssen, “Nutzen,” 67; Baum, “Systemform,” 34; and Henrich, *Identität*, 39).

¹¹⁴ Kant, *Critique of Pure Reason*, 595 [A651/B679], 617 [A694/B722].

¹¹⁵ Ibid., 595 [A651/B679], 618 [A694/B722].

¹¹⁶ Ibid., 602 [A663/B691], 610–1 [A680/B708].

¹¹⁷ McNulty, “Use,” 3.

¹¹⁸ For details of the historical background as well as a systematic connection between these scientific examples, see Meer, *Grundsatz*, 215–3.

¹¹⁹ Kant, *Critique of Pure Reason*, 601 [A662–/B690–1].

etc.,¹²⁰ the ladder of continuity among creatures,¹²¹ a single radical or absolutely fundamental power,¹²² as well as “wise intentions of a world-author” in “regard to the shape of the earth, the mountains, the seas, etc.”¹²³ are concluded, determined, and apodictically applied in the sense of an as-if. However, within the framework of the *Critique of Pure Reason* such an argumentation stands in contradiction to Kant's claim of a *sufficient* and necessary validity of the principles of understanding.

6 Conclusion

Maupertuis' philosophy of nature, and in particular his foundation of mechanics via the *principle of least action*, forms a central reference point for Kant's thinking, which can be traced from the 1750s through the *Critique of Pure Reason* to the *Critique of the Power of Judgment*. In all three stages of development, Kant attempts to establish his own philosophy of nature with reference to, but also in critical dissociation from, Maupertuis. Remarkably, Kant's entire philosophical writing thus pursues a teleology that starts out from distinct phenomena but reconciles it in a specific way with the question of the connection between human cognition and capacities.

In the *Appendix to the Transcendental Dialectic*, this leads to a blending of systematically incompatible concepts: on the one hand, Kant reduces the regulative principles to mere auxiliary means of the principles of understanding, so that consequently, they do not have a transcendental status; while on the other hand, he also mixes two concepts of final causes differentiated by Maupertuis as *old* and *new teleology*. Based on this ambiguity, a final clarification of the relationship between *nexus effectivus* and *nexus finalis* is not possible in the context of the first *Critique*. At the same time, this offers an explanation for the different interpretative approaches in to the status of regulative principles, i.e., the *categorical*, *system*, and *ideational* interpretations as discussed in the research on the *Appendix to the Transcendental Dialectic*. Kant's analysis lacks a critical examination between the different forms of teleological thinking. He has not yet decided which form of teleology the critical project is compatible with. Probably, he had exactly this difficulty in mind when he wrote in the *Prolegomena* that there is an *unsolved problem* in the *Appendix to the Transcendental Dialectic*.

Funding information: This research was supported by the Ministry of Science and Higher Education of the Russian Federation grant no. 075-15-2019-1929, project “Kantian Rationality and Its Impact in Contemporary Science, Technology, and Social Institutions,” provided at the Immanuel Kant Baltic Federal University (IKBFU), Kaliningrad.

Conflict of interest: Author states no conflict of interest.

References

- Allison, Henry E. “Kant's Antinomy of Teleological Judgment.” *The Southern Journal of Philosophy* 30 (1991), 25–42.
- Baum, Manfred. “Systemform und Selbsterkenntnis der Vernunft bei Kant.” In *Architektur und System in der Philosophie Kants*, edited by Hans Friedrich Fulda and Jürgen Stolzenberg, 25–41. Hamburg: Meiner, 2001.
- Ben-Menahem, Yemima. *Causation in Science. The Principle of Least Action: From Teleology to Causality*. Princeton: UP, 2018.
- Breitenbach, Angela. “Two Views on Nature. A Solution to Kant's Antinomy of Mechanism and Teleology.” *British Journal for the History of Philosophy* 16 (2008), 351–69.

¹²⁰ Ibid., 592 [A646/B674].

¹²¹ Ibid., 604 [A668/B696].

¹²² Ibid., 593 [A649/B677].

¹²³ Ibid., 614 [A687/B715].

- Breitenbach, Angela. *Die Analogie von Vernunft und Natur. Eine Umweltphilosophie nach Kant*. Berlin/Boston: De Gruyter, 2009.
- Buchdahl, Gerd. "The Relation Between Understanding and Reason in the Architectonic of Kant's Philosophy." *Proceedings of the Aristotelian Society* 67 (1966), 209–26.
- Buchdahl, Gerd. *Metaphysics and Philosophy of Science. The Classical Origins: Descartes to Kant*. Oxford: Blackwell, 1969.
- Buchdahl, Gerd. "The Conception of Lawlikeness in Kant's Philosophy of Science." *Synthese* 23 (1971), 24–46.
- Buchdahl, Gerd. "Zum Verhältnis von allgemeiner Metaphysik der Natur und besonderer metaphysischer Naturwissenschaft bei Kant." In *Probleme der "Kritik der Reinen Vernunft"*. Kant-Tagung Marburg 1981, edited by Burkhard Tuschling, 97–142. Berlin: De Gruyter, 1984.
- Butts, Robert E. "Teleology and Scientific Methods in Kant's Critique of Judgment." *Noûs* 24 (1990), 1–16.
- Cassirer, Ernst. *Das Erkenntnisproblem in der Philosophie und Wissenschaft der Neueren Zeit*. Bd. 2. Berlin: Cassirer, 1922.
- Descartes, René. "Traité de la Lumière." In *Oeuvres*, edited by Charles Adam, and Paul Tannery. Bd. 11, 1–118. Paris: Vrin, 1909.
- Dörflinger, Bernd. *Das Leben Theoretischer Vernunft. Teleologische und Praktische Aspekte der Erfahrungstheorie Kants*. Berlin/New York: de Gruyter, 2000.
- Euler, Leonhard. *Methodus Inveniendi Lineas Curvas Maximi Minimive Proprietate Gaudentes Sive Solution Problematis Isoperimetrici Latissimo Sens Accepti*. Lausanne/Genf: Bousquet, 1744.
- Ferrarin, Alfredo. *The Power of Pure Reason. Kant and the Idea of Cosmic Philosophy*. Chicago: UP, 2015.
- Friedman, Michael. "Causal Laws and the Foundations of Natural Science." In *The Cambridge Companion to Kant*, edited by P. Guyer, 161–99. Cambridge: UP, 1992a.
- Friedman, Michael. *Kant and the Exact Sciences*. Cambridge: UP, 1992b.
- Friedman, Michael. "Regulative and Constitutive." *Southern Journal of Philosophy* 30 (1992c), 73–102.
- Gfeller, Thomas. "Wie Tragfähig ist der Teleologische Brückenschlag? Zu Kants Kritik der teleologischen Urteilskraft." *Zeitschrift für philosophische Forschung* 52 (1998), 215–36.
- Ginsborg, Hannah. *The Role of Taste in Kant's Theory of Cognition*. New York, London: Garland, 1990.
- Ginsborg, Hannah. "Kant on Understanding Organisms as Natural Purposes." In *Kant and the Sciences*, edited by Eric Watkins, 231–58. Oxford: UP, 2001.
- Goy, Ina. *Kants Theorie der Biologie. Ein Kommentar. Eine Lesart. Eine Historische Einordnung*. Berlin/Boston: De Gruyter, 2017.
- Grier, Michelle. *Kant's Doctrine of Transcendental Illusion*. Cambridge: UP, 2001.
- Guyer, Paul. "Kant on the Systematicity of Nature: Two Puzzles." *History of Philosophy Quarterly* 20 (2003), 277–95.
- Henrich, Dieter. *Identität und Objektivität. Eine Untersuchung über Kants Transzendente Deduktion*. Heidelberg: Winter, 1976.
- Henschen, Tobias. "Kant on Causal Laws and Powers." *Studies in History and Philosophy of Science* 48 (2014), 20–9.
- Horstmann, Rolf-Peter. "Die Idee der Systematischen Einheit. Der Anhang zur Transzendentalen Dialektik in Kants Kritik der Reinen Vernunft." In *Bausteine kritischer Philosophie. Arbeiten zu Kant*, edited by Rolf-Peter Horstmann, 109–30. Bodenheim: Philo, 1997.
- Horstmann, Rolf-Peter. "Der Anhang zur Transzendentalen Dialektik (A 642/B 670–A 704–B 732). Die Idee der Systematischen Einheit." In *Immanuel Kant. Kritik der Reinen Vernunft*, edited by Marcus Willaschek and Georg Mohr, 525–46. Berlin: de Gruyter, 1998.
- Janiak, Andrew. *Newton as Philosopher*. Cambridge/New York: UP, 2008.
- Kant, Immanuel. *Gesammelte Schriften*, edited by Königl. Preussische Akademie der Wissenschaften. Berlin: Reimer, 1900.
- Kant, Immanuel. *Universal Natural History and Theory of the Heavens*, translated with Introduction and notes by S. L. Jaki. Edinburgh: Scottish Academic Press, 1981.
- Kant, Immanuel. *Theoretical Philosophy, 1755–1770*, translated and edited by David Walford. Cambridge: UP, 1992a.
- Kant, Immanuel. *Lectures on Logic*, translated and edited by J. Michael Young. Cambridge: UP, 1992b.
- Kant, Immanuel. *Critique of Pure Reason*, translated and edited by Paul Guyer and Allen Wood. Cambridge: UP, 1999.
- Kant, Immanuel. *Critique of the Power of Judgment*, translated and edited by Paul Guyer, Eric Matthews. Cambridge: UP, 2000.
- Kant, Immanuel. *Theoretical Philosophy after 1781*, translated by Gary Hatfield and Michael Friedman. Cambridge: UP, 2002.
- Kant, Immanuel. *Natural Science*, edited by Eric Watkins. Cambridge: UP, 2012.
- Kitcher, Philip. "Projecting the Order of Nature." In *Kant's Philosophy of Physical Science*, edited by Robert E. Butts, 201–35. Boston: Dordrecht, 1986.
- Kitcher, Philip. "The Unity of Science and the Unity of Nature." In *Kant and Contemporary Epistemology*, edited by Paolo Parrini, 253–72. Boston: Dordrecht, 1994.
- Klimmek, Nikolai. *F. Kants System der transzendentalen Ideen*. Berlin/New York: De Gruyter, 2005.
- Klingner, Stefan. *Technische Vernunft. Kants Zweckbegriff und das Problem einer Philosophie der Technischen Kultur*. Berlin/Boston: De Gruyter, 2013.
- Kreimendahl, Lothar and Oberhausen, Michael. "Einleitung." In *Immanuel Kant. Der Einzig Mögliche Beweisgrund zu Einer Demonstration des Daseins Gottes*. Hamburg: Meiner, 2011.
- Leduc, Christian. "La Métaphysique de la Nature à L'academie de Berlin." *Philosophiques* 42 (2015), 11–30.
- Löw, Reinhard. *Philosophie des Lebendigen. Der Begriff des Organischen bei Kant, Sein Grund und Seine Aktualität*. Frankfurt am Main: Suhrkamp, 1980.

- Lyssy, Ansgar. "L'économie de la Nature – Maupertuis et Euler sur le Principe de Moindre Action." *Philosophiques* 42 (2015), 31–50.
- Marcucci, Silvestro. "Aspetti Epistemologici e Teoretici Della Deduzione Transcendentale Delle Idee in Kant." *Studie Kantiani* 1 (1988), 43–69.
- Massimi, Michela. "Prescribing Laws to Nature. Part I. Newton, the Pre-Critical Kant, and three Problems about the Lawfulness of Nature." *Kant-Studien* 105 (2014), 491–508.
- Massimi, Michela. "What is this Thing Called *Scientific Knowledge*? – Kant on Imaginary Standpoints and the Regulative Role of Reason." *Kant Yearbook* 9 (2017), 63–84.
- Maupertuis, Pierre Louis Moreau de. "Lois du Repos des Corps." *Mémoires de l'Académie Royale des Sciences* (1740), 170–6.
- Maupertuis, Pierre Louis Moreau de. "Accord de Différentes Loix de la Nature Qui Avoient Jusqu'ici Paru Incompatibles." *Mémoires de l'Académie Royale des Sciences* (1744), 417–26.
- Maupertuis, Pierre Louis Moreau de. *Essai de Cosmologie*. Berlin, 1751a.
- Maupertuis, Pierre Louis Moreau de. *Versuch Einer Cosmologie*. Berlin: Nicolai, 1751b.
- Maupertuis, Pierre Louis Moreau de. "Examen Philosophique de la Preuve de L'existence de Dieu Employée Dans L'essay de Cosmologie." *Histoire de l'Académie Poyale des Sciences et Belles-lettres de Berlin* 12 (1756), 389–424.
- McFarland, John David. *Kant's Concept of Teleology*. Edinburgh: UP, 1970.
- McLaughlin, Peter. *Kants Kritik der Teleologischen Urteilstkraft*. Bonn: Bouvier, 1989.
- McLaughlin, Peter. "Transcendental Presupposition and Ideas of Reason." *Kant-Studien* 105 (2014), 554–72.
- McNulty, Michael Bennett. "Rehabilitating the Regulative Use of Reason: Kant on Empirical and Chemical Laws." *Studies in History and Philosophy of Science* 54 (2015), 1–10.
- Meer, Rudolf. *Der Transzendente Grundsatz der Vernunft. Funktion und Struktur des Anhangs zur Transzendentalen Dialektik der Kritik der Reinen Vernunft*. Berlin/New York: De Gruyter, 2019.
- Newton, Isaac. *Opticks: Or a Treatise of the Reflections, Refractions, Inflections and Colours of Light*. London: Smith, Walford, 1730.
- Newton, Isaac. *Die Mathematischen Prinzipien der Physik*, edited by Volkmar Schüller. Berlin/Boston: De Gruyter, 1999.
- Plaaß, Peter. *Kants Theorie der Naturwissenschaft: Eine Untersuchung zur Vorrede von Kants Metaphysischen Anfangsgründen der Naturwissenschaft*. Göttingen: Vandenhoeck und Ruprecht, 1965.
- Pollok, Konstantin. *Kants Metaphysische Anfangsgründe der Naturwissenschaft. Ein Kritischer Kommentar*. Hamburg: Meiner, 2001.
- Pollok, Konstantin. *Kant's Theory of Normativity. Exploring the Space of Reason*. Cambridge: UP, 2017.
- Proops, Ian. "Kant's First Paralogism." *Philosophical Review* 119 (2010), 449–95.
- Pulte, Helmut. *Das Prinzip der Kleinsten Wirkung und Die Kraftkonzeptionen der Rationalen Mechanik. Eine Untersuchung zur Grundlegungsproblematik bei Leonhard Euler, Pierre Louis Moreau de Maupertuis und Joseph Louis Lagrange*. Stuttgart: Steiner, 1989.
- Pulte, Helmut. "Von der Physikotheologie zur Methodologie. Zur Transformation von Nomothetischer Teleologie und Systemdenken bei Kant und Fries." In *Jakob Friedrich Fries- Philosoph, Naturwissenschaftler und Mathematiker*, edited by Wolfram Högbe and Kay Herrmann, 299–349. Frankfurt am Main: Lang, 1998.
- Pulte, Helmut. "Mannigfaltigkeit der Regeln und Einheit der Prinzipien: Zur Entmetaphysierung Teleologischen Denkens im Anschluß an P. L. M. de Maupertuis." In *P. L. M. de Maupertuis. Eine Bilanz Nach 300 Jahren*, edited by Hartmut Hecht, 235–59. Berlin: Spitz, 1999.
- Pulte, Helmut. "Formale Teleologie und Theoretische Vereinheitlichung Wissenschaftstheoretische und-historische Überlegungen zu Ihrer Beziehung bei Kant und Fries, Kitcher und Friedman." In *Formale Teleologie und Kausalität in der Physik/Formal Teleology and Causality in Physics*, 77–96. Paderborn: Mentis, 2005.
- Quarfood, Marcel. "Kant on Biological Teleology. Towards a Two-Level Interpretation." *Studies in History and Philosophy of Biological and Biomedical Sciences* 37 (2006), 735–47.
- Radelet De Grave, Patricia. "La Moindre Action Comme Lien Entre la Philosophie Naturelle et la Mécanique Analytique: Continuités D'unquestionnement." *Revista de la Sociedad Espanola de Historia de la Ciencias y las Tecnicas* 21 (1998), 439–84.
- Rush, Fred L. "Reason and Regulation in Kant." *Review of Metaphysics* 53 (2000), 837–62.
- Sala, Giovanni B. *Kant und Die Frage Nach Gott. Gottesbeweise und Gottesbeweiskritik in den Schriften Kants*. Berlin: De Gruyter, 1990.
- Schramm, Matthias. *Natur Ohne Sinn*. Graz: Styria, 1985.
- Schramm, Matthias. "The Creation of the Principle of Least Action." In *Formale Teleologie und Kausalität in der Physik/Formal Teleology and Causality in Physics*, 99–114. Paderborn: Mentis, 2005.
- Serck-Hanssen, Camilla. "Der Nutzen von Illusionen. Ist Die Idee der Seele unentbehrlich?" In *Über den Nutzen von Illusionen. Die Regulativen Ideen in Kants Theoretischer Philosophie*, edited by Bernd Dörfliinger and Gunter Kruck, 59–70. Zürich/ New York: Olms, 2011.
- Sober, Elliott. *Ockham's Razors. A User's Manual*. Cambridge: UP, 2015.
- Speiser, David. "Pierre Moreau de Maupertuis (1698–1759)." In *Pierre Moreau de Maupertuis: Eine Bilanz Nach 300 Jahren*, edited by Hartmut Hecht, 341–61. Baden-Baden: Spitz, 1999.

- Stöltzner, Michael. "Drei Ordnungen formaler Teleologie. Ansichten des Prinzips der kleinsten Wirkung." In *Formale Teleologie und Kausalität in der Physik/Formal Teleology and Causality in Physics*, 199–239. Paderborn: Mentis, 2005.
- Storni, Marco. "Maupertuis's Principle of Least Action: Epistemology and Metaphysics." *Montesquieu* (2019), 1–22.
- Sturm, Thomas. "Kant on the Ends of the Sciences." *Kant-Studien* 101 (2020), 1–28.
- Terrall, Mary. *The Man who Flattened the Earth. Maupertuis and the Sciences in the Enlightenment*. Chicago: UP, 2002.
- Thiele, Rüdiger. "Euler und Maupertuis vor dem Horizont des Teleologischen Denkens." In *Schweizer im Berlin des 18. Jahrhunderts*, edited by Martin Fontius and Helmut Holzhey. Berlin: De Gruyter, 1996.
- Thöle, Bernhard. "Die Einheit der Erfahrung. Zur Funktion der Regulativen Prinzipien bei Kant." In *Erfahrung und Urteilskraft*, edited by Rainer Enskat, 113–48. Würzburg: Königshausen und Neumann, 2000.
- Tonelli, Giorgio. *Elementi Metodologici e Metafisici in Kant dal 1745 al 1768: Saggio di Sociologia Della Conoscenza*. Bd. 1. Turin: Edizioni di Filosofia, 1959.
- Tonelli, Giorgio. "Conditions in Königsberg and the Making of Kant's Philosophy." In *Bewußt Sein. Gerhard Funke zu Eigen*, edited by Alexius J. Bucher, Hermann Drüe and Thomas M. Seebohm, 126–44. Bonn: Bouvier, 1975.
- Van den Berg, Hein. "Kant's Conception of Proper Science." *Synthese* 183 (2011), 7–26.
- Voltaire. *Eléments de Philosophie de Newton. In Oeuvre Complètes*. Bd. I. Paris: Vrin, 1792.
- Waschkies, Hans-Joachim. *Physik und Physikotheologie des Jungen Kant. Vorgeschichte Seiner Allgemeinen Naturgeschichte und Theorie des Himmels*. Amsterdam: Grüner, 1987.
- Watkins, Eric. "The Argumentative Structure of Kant's Metaphysical Foundations of Natural Science." *Journal of the History of Philosophy* 36 (1998), 567–93.
- Watkins, Eric. *Kant and the Sciences*. Oxford: UP, 2000.
- Watkins, Eric. "What is, for Kant, a Law of Nature?" *Kant-Studien* 105 (2014), 471–90.
- Willaschek, Marcus. *Kant on the Sources of Metaphysics. The Dialectic of Pure Reason*. Cambridge: UP, 2018.
- Windelband, Wilhelm. *Geschichte und Naturwissenschaft*. Straßburg: Heitz, 1904.
- Wolff, Christian. *Philosophia Rationalis Sive Logica, Methodo Scientifica Pertractata et Ad Usum Scientiarum Atque Vitae*. Frankfurt: Renger, 1740.
- Wood, Rega. "Ockham's Repudiation of Pelagianism." In *The Cambridge Companion to Ockham*, edited by Paul Vincent Spade, 350–74. Cambridge: UP, 1999.
- Ypi, Lea. "The Transcendental Deduction of Ideas in Kant's Critique of Pure Reason." *Proceedings of the Aristotelian Society* 117 (2017), 163–85.