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Kant's Ideal of Systematicity in Historical Context

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Abstract
This article explains Kant's claim that sciences must take, at least as their ideal, the form of a 'system'. I argue that Kant's notion of systematicity can be understood against the background of de Jong and Betti's Classical Model of Science (2010) and the writings of Georg Friedrich Meier and Johann Heinrich Lambert. According to my interpretation, Meier, Lambert and Kant accepted an axiomatic idea of science, articulated by the Classical Model, which elucidates their conceptions of systematicity. I show that Kant's critique of the mathematical method is compatible with his adherence to this axiomatic conception of science. I further show that systematicity advances traditionally accepted logical ideals of scientific knowledge, which explains why Meier and Kant think that sciences must be 'systematic'.

Keywords: systematicity, logical perfections, Kant, Meier, Lambert

1. Introduction

Kant claims that sciences must take the form of systems (*MFNS*, 4: 467) and his views on systematicity have received considerable attention (Falkenburg 2000: 376–85; Sturm 2009: 129–82; Hoyningen-Huene 2013: 155–8; van den Berg 2014: 17–24; Gava 2014; Blomme 2015; Gava 2018).[1] However, it is not yet fully clear why Kant claims that sciences must be systematic. In this paper, I provide a historical analysis that elucidates the concept of systematicity and explains why systematicity is an ideal for science.

An overview of Kant's remarks on systematicity is contained in the *Kant-Lexikon* (Willascheck et al. 2015: 2238–42). Much of the literature concerned with systematicity focuses on how it can explain the necessity of empirical laws in Kant (McNulty 2015: 2–3). Friedman has argued that necessary laws of nature result from the subsumption of empirical regularities under *a priori* principles (Friedman 1992). By contrast, system interpretations (Buchdahl, 1971: 29, 32–3); Kitcher 1986: 206, 209–10; Guyer 2003: 280–9) argue that the necessity of empirical laws involves the embedding of empirical regularities in systems of judgements (McNulty 2015: 3; Breitenbach 2018: 111). In this article, I will not be concerned with the necessity of empirical laws. Rather, I explain the historical context of Kant's notion of systematicity and elucidate how the ideal of systematicity is to be understood.

Following Hinske (1990), Blomme (2015) and Sturm (2009: 129–46), who discuss systematicity in Wolff, Lambert, Meier and Kant, I argue that Kant's notion of systematicity can be understood against the background of the writings of Georg Friedrich Meier and Johann Heinrich Lambert. (I also briefly discuss Wolff: on Wolff and Lambert, see Waibel 2007; on Wolff and Kant, see Gava 2018.) However, in contrast to these authors, I do not think that this is because Meier or Lambert (or Wolff) provides the origins of Kant's notion of systematicity. Rather, I argue that all three authors endorse a classical idea of *axiomatic science* that explains their accounts of systematicity.[2] This classical idea of axiomatic science has been articulated by de Jong and Betti (2010) through the so-called *Classical Model of Science* (hereafter: Classical Model). My contention is that the Classical Model illuminates the concept of systematicity adopted by Meier, Lambert and Kant.

Like de Jong and Betti (2010: 186), I use the term 'axiomatic science' in a broad sense. Axiomatic science in this sense denotes a science that has (i) fundamental judgements and non-fundamental judgements that follow from these fundamental judgements, and (ii) fundamental concepts and non-fundamental concepts that are defined in terms of these fundamental concepts. If we adopt this idea of axiomatic science, we can describe Meier, Lambert and Kant as endorsing such an idea of science. I am aware that Kant applies the word *axiom* only to the principles of mathematics and argues that philosophy does not have axioms in this specific sense of the word (section 3.2). However, Kant does accept that a science should satisfy conditions (i) and (ii), and hence can be taken to accept an axiomatic idea of science if one adopts my broad use of the term 'axiomatic science'.

We can distinguish my position from Hinske's, since Hinske connects the idea of systematicity to Wolff's idea of an axiomatic ideal for science (henceforth, 'axiomatic idea of science') (Hinske 1990: 158–62; see also Gava 2018: 286). Hinske argues that Wolff's concept of a system was influenced by his mathematical method, which he construes as embodying such an axiomatic ideal. However, he argues that Kant rejected the mathematical method and did not endorse an axiomatic idea of science, which led Kant to adopt a novel concept of systematicity. I agree that Wolff's axiomatic idea of science influenced his idea of systematicity. However, in contrast to Hinske, I argue that Meier, Lambert and Kant all accepted an axiomatic idea of science as articulated by the Classical Model, and that this explains their concepts of systematicity. To achieve this aim I show that Kant's critique of Wolff's mathematical method is consistent with his adherence to the Classical Model.

I further argue that Meier's writings provide an additional reason for Meier and Kant to think that sciences should be systematic. In his *Vernunftlehre* (1752), Meier discusses logical perfections of scientific knowledge. Systematicity, as described above, furthers many of these perfections. Kant also embraced several of these perfections. Thus it is probable that systematicity was accepted as an ideal by Meier and Kant because it furthers these perfections. Meier's discussion of the logical perfections of science has not received much attention. However, Brigitte Falkenburg has analysed Kant's logical perfections of scientific knowledge, which build on Meier (2000: 355–66). Falkenburg links these perfections of proper science to the ideal of systematicity by arguing that the perfections prescribe the construction of sciences that are maximally general and maximally specific (2000: 383; 2001: 311). I extend Falkenburg's analysis by (a) providing a novel analysis of Meier's perfections of cognition, and (b) by specifying the relation between almost all of Meier's perfections and the ideal of systematicity. This will illustrate that we can take the ideal of systematicity to be an ideal for science because it furthers logical perfections.[3]

I have one final aim. Sturm (2009) argues that Kant articulated a novel conception of systematicity by articulating the idea that a system is constructed by positing an *idea of the whole* (Sturm 2009: 143; see also Blomme 2015: 109–10; Hinske 1990: 172–3). I will argue that this idea is anticipated by Lambert's idea that systematic sciences should be *complete*. According to Lambert, a systematic science is complete if we can specify all of its parts and specify rules in accordance with which we can treat these parts. I show that Kant's idea that systematic sciences are constructed on the basis of an idea of the whole expresses the same point.

In section 2 I introduce the Classical Model. In section 3, I discuss Kant's views on definitions and the difference between the mathematical and philosophical method, and show that, although Kant rejects Wolff's mathematical method, he adheres to the Classical Model. Section 4 discusses Meier and Kant in relation to the Classical Model and the logical perfections of cognition. I show that Kant's account of systematicity can be fruitfully interpreted against the background of the Classical Model and Meier's logical perfections. In section 5, I discuss Lambert's philosophy, the Classical Model and the relation of Lambert's philosophy to Kant's views on systematicity. I argue that Kant's views that systematic sciences are complete and that systematicity is a regulative ideal can be traced back to Lambert's views on the completeness of sciences.

2. The Classical Model of Science

The axiomatic idea of science adopted by Meier, Lambert and Kant has been articulated by de Jong and Betti's Classical Model of Science (2010). According to this model, a proper science is a system *S* of propositions and concepts (or terms) which satisfies the following conditions:

(1) All propositions and all concepts (or terms) of *S* concern a *specific set of objects* or are about a *certain domain of being*(*s*).
(2a) There are in *S* a number of so-called *fundamental concepts* (or terms).
(2b) All other concepts (or terms) occurring in *S* are *composed of* (or are *definable from*) these fundamental concepts (or terms).
(3a) There are in *S* a number of so-called *fundamental propositions*.
(3b) All other propositions of *S follow from* or *are grounded in* (or *are provable* or *demonstrable from*) these fundamental propositions.
(4) All propositions of *S* are *true*.
(5) All propositions of *S* are *universal* and *necessary* in some sense or another.
(6) All propositions of *S* are *known to be true*. A non-fundamental proposition is known to be true through its *proof* in *S*.
(7) All concepts or terms of *S* are *adequately known*. A non-fundamental concept is adequately known through its composition (or definition). (de Jong and Betti 2010: 186)

The Classical Model is an interpretative tool that reconstructs how several thinkers have traditionally understood a proper science. De Jong and Betti partly constructed the Classical Model on the basis of an analysis of the theory of science of Aristotle, the *Port-Royal Logic* of Arnauld and Nicole (1662), and the *Wissenschaftslehre* (1837) of Bolzano (de Jong and Betti 2010: 187). The Classical Model is so named because it can be traced to Aristotle and remained influential for more than two millennia, being largely abandoned only after Frege due to various factors, including the improved rigour of logic after Frege's and Hilbert's formalistic turn in mathematics (de Jong and Betti 2010: 197). The Classical Model is fruitfully applied to Kant in de Jong (1995, 1997, 2010) and van den Berg (2011, 2014: ch. 2).[4] In the following, I use the Classical Model as an interpretative tool to elucidate the concept of systematicity.[5]

Some remarks on some conditions of the Classical Model are in order, because they play a role in my analysis of Meier, Lambert and Kant. Conditions (2) and (3) capture the core of the axiomatic idea of science that I attribute to Meier, Lambert and Kant. These conditions, I argue, also capture the core of Kant's conception of systematicity. The fundamental propositions of an axiomatic science must be independent of one another. For example, in his Prize Essay of 1764 (as a referee has pointed out to me), Kant states as a second rule for the proper method of metaphysics that the fundamental (indemonstrable) judgements of metaphysics should not 'be contained in another' (NTM, 2: 285). Conditions (4)–(6) are typical of the Classical Model.[6] These conditions are not required by a modern account of an axiomatic system, in which a requirement of (syntactic or semantic) consistency is postulated. However, conditions (4)–(6) were endorsed by early modern followers of the Classical Model.

Condition (4) states that a proper science must have true propositions. For De Jong and Betti the postulate does not presuppose any particular conception of truth, but it excludes rhetorical talk of truth, such as 'some conventionalist approaches in which truth has no role in the choice between rival theories' (de Jong and Betti 2010: 191). Condition (5) states that the propositions of a proper science must be universal, which often means that these propositions are maximally general and necessary in some sense. The necessity ascribed to propositions of a science may be weaker than what we understand by necessity today (ibid. 192). For example, Wolff argues that the non-fundamental propositions of empirical sciences *follow deductively, a priori, or necessarily* from certain fundamental propositions, and are in this sense necessary, while denying that these empirical propositions are true in all possible worlds (Wolff [1751] 2003: vol. 2, 352-4). Finally, condition (6) makes clear that the Classical Model involves a theory of justification of scientific knowledge, which, as de Jong and Betti note (2010: 192), often involves a form of foundationalism. According to Kant, for example, knowledge in the strict sense involves apodictic certainty, which means that we are justified in asserting the necessary truth of a judgement (*MFNS*, 4: 468). This condition is also satisfied in the case of empirical judgements, if judgements are (partly) proven on the basis of *a priori* principles (van den Berg 2014: 35–7; 2011: 16–18). For example, according to Kant we have knowledge of the law of gravity, which is an empirical law, based on empirical *phenomena*, proven partly on the basis of mathematical and metaphysical (*a priori*) principles (Friedman 1992).

3. Kant on Real Definitions and the Mathematical Method

According to condition (2) of the Classical Model, non-fundamental concepts are defined in terms of fundamental concepts. In this section, I consider Kant's views on definitions. Section 3.1 gives an account of Kant's views on definitions, the distinction between nominal and real definitions, and his views on possibility and objective reality. In section 3.2, I discuss Kant's views on the distinction between the mathematical and the philosophical method and its implications for his views on definitions. I argue that Kant's acceptance of the Classical Model is compatible with his critique of Wolff's mathematical method

3.1 Kant on Nominal and Real Definitions

According to the Logic lectures, a definition is a distinct, complete and precise concept (Log-W, 24: 912–14; Vanzo 2010: 151; *KrV*, A727/B755). A concept is distinct if we clearly cognize its marks, i.e. the partial concepts contained in it (Log-W, 24: 847; Vanzo 2010: 153). A concept is complete or exhaustive if we have cognition of *all* the marks or partial concepts contained in it (Log-W, 24: 847, 912; Vanzo 2010: 154). A concept is precise if it is not superfluous, i.e. no mark is contained in another (Log-W, 24: 912–13; Vanzo 2010: 154). Finally, definitions are *original* expositions of concepts (A727/B755). As Vanzo explains Kant, if <<human being>> is used to define <<philosopher>>, and <<rational>> is a mark of <<human being>>, an *original* exposition of <<philosopher>> will mention <<human being>> but not <<rational>>, the latter being a *derived* (not original) mark from <<human being>> (Vanzo 2010: 154).

For Kant, definitions are either nominal or real. Nominal definitions are definitions of names or words (Vanzo 2010: 156). They signify the *logical essence* of concepts, i.e. the partial concepts analytically contained in a concept (*JL*, 9: 143). In contrast, real definitions explicate the (real) essence of *objects*, explicating the (real) inner ground of that which belongs to the possibility of a thing (Vanzo 2010: 153, 159; Log-W, 24: 919). Real definitions also enumerate all the essential features of an *object*, the complete essence of a thing, and thus allow us to strictly distinguish objects falling under the *definiendum* from other objects, something nominal definitions cannot do (Log-W, 24: 919; Vanzo 2010: 160–1).

As Nunez has shown (2014: 635), Kant thinks that real definitions consist of two parts: (i) a nominal definition (a definition in terms of genus and differentia, explicating the logical essence of a concept), and (ii) a proof of the possibility of the concept defined. In the *Critique*, for example, Kant notes that real definitions make concepts (a) *distinct*, i.e. we know a collection of marks contained in the defined concept (these marks are given by the nominal definition), and (b) contain a mark that secures the *objective reality* of the defined concept, i.e. the application of the concept to objects of experience (*KrV*, A241–2, n.).

As we have seen, real definitions prove the (real) possibility of concepts. To conclude this section, we must therefore analyse Kant's views on possibility. In the pre-critical Prize Essay of 1764, Kant argued that definitions should not constitute the beginning of metaphysical treatises but rather the end point of inquiry. Metaphysics, according to Kant, is based on certain indemonstrable judgements, which provide *data* about what is immediately certain about one's object of inquiry, from which further conclusions are then inferred (NTM, 2: 285). These indemonstrable propositions also provide the data from which definitions in the philosophical sciences can ultimately be drawn (281–2). Hence, the indemonstrable propositions provide the data from which the (real) possibility of concepts can be established (ibid.). In metaphysics, Kant argues, we follow the method of Newton, who derived rules governing motion analytically from experience and geometry. Likewise, in metaphysics we proceed from certain inner experiences which provide us with indemonstrable judgements on the basis of which a science of metaphysics can be erected (286).

While Kant relied on Newtonian verification criteria to establish the real possibility of concepts in his Prize Essay, he introduces a novel concept of (real) possibility in the first *Critique*. There Kant argues that logical possibility (consistency) is not sufficient to establish the real possibility of a concept (*KrV*, A220/B268). Rather, empirical concepts are really possible, i.e. applicable to objects of experience, because they are borrowed from our experience of objects, whereas *a priori* concepts are really possible because they express a condition 'on which experience in general (its form) rests' (ibid.). For example, the real possibility of the *a priori* concept of a triangle is not cognized from concepts, but from the fact that 'this very same formative synthesis by means of which we construct a figure in imagination is entirely identical with that which we exercise in the apprehension of an appearance in order to make a concept of experience of it' (A224/B271). It is the fact that the *a priori* concept of a triangle expresses a condition of experience that secures the objective reality of the concept of a triangle: it shows that this concept is applicable to objects of experience and is thus really possible. Insofar as real definitions secure the real possibility of concepts, they show that the concepts are objectively real or applicable to objects of experience.

3.2 Kant on Mathematical and Philosophical Method

I will argue that Kant adhered to the Classical Model and that this explains his views on systematicity. But first I will explain how his acceptance of the Classical Model is compatible with his critique of Wolff's mathematical method in the first *Critique*. For it may be thought that Kant's critique of the mathematical method implies a rejection of an axiomatic idea of science. Kant's critique of Wolff's mathematical method is often taken to imply that in philosophy, in contrast to mathematics, it is difficult or impossible to obtain real definitions (Vanzo 2010: 160, n. 61; Beck 1956: 183). If this is the case, how can Kant accept condition (2) of the Classical Model, which holds that non-fundamental concepts in proper sciences are defined in terms of fundamental concepts? In this section, I argue that Kant's rejection of Wolff's mathematical method, which should not be identified with the Classical Model, is consistent with adopting the Classical Model, which captures a conception of science shared by both Wolff and Kant (see for similarities between Wolff and Kant on method Gava 2018; on Kant's critique of the mathematical method, see de Jong 1995). With respect to definitions I argue, following Nunez (2014), that Kant leaves room for the possibility of giving real definitions of philosophical concepts.

In the Doctrine of Method of the first *Critique*, Kant criticizes Wolff's mathematical method by arguing that philosophy should not imitate mathematics by beginning with definitions (B758–9). According to Kant, as we have seen, a characteristic of a definition is that it provides a *complete* or *exhaustive* description of all the marks of a defined concept (A727/B755). Since the marks that we think in empirical concepts change in the course of empirical investigation, we cannot, if we adopt an analytic method, be certain that we have a complete specification of all the marks of an empirical concept, i.e. a definition. Similarly, if we adopt an analytic method we cannot be certain that we have a complete specification of all the marks of *a priori* given concepts in philosophy, and hence cannot be certain that we have attained a definition (A727–9/B755–7). Hence, in the philosophical sciences, if we adopt the analytic method, we often only have what Kant calls *expositions*, i.e. a possibly incomplete set of marks contained in a concept (A729/B757; *JL*, 9: 143). Note that such expositions follow the model of concepts as specified by the Classical Model: we describe non-fundamental concepts (species) in terms of more fundamental concepts or marks (genera), even though we cannot be certain that our list of marks is complete. In this sense, Kant's ideas are consistent with the Classical Model. Kant's point is that in the philosophical sciences we often cannot be sure whether we have obtained a definition. Nevertheless, definitions are an ideal of science. The *Jäsche Logik* states that definitions are *logical perfections* 'that we must seek to attain' (9: 143). Hence, Kant sees the model of definitions as represented in the Classical Model as an ideal for science, and accepts the model, even if this ideal is difficult to attain. As Kant puts it: attaining definitions in philosophy 'is fine, but often very difficult' (*KrV*, A731/B759 n.).

If definitions are an ideal for science, it should be possible to obtain them. It has been argued that Kant does not think real definitions can be obtained in philosophy (see e.g. Beck 1956: 183). However, Tyke Nunez has argued that Kant does think that philosophical concepts allow of real definitions (Nunez 2014; see also de Jong 1995: 265–6). He interprets Kant's negative remarks concerning the possibility of real definitions in philosophy as referring to philosophy as it was practised before Kant's Copernican turn (Nunez 2014: 637). According to Nunez, Kant thinks that, although the traditional method of analysis cannot yield definitions of philosophical concepts, Kant adopts a synthetic method in the first *Critique*, exemplified by the derivation of the categories, that allows for definitions of philosophical concepts (638–44). Remember that Kant took real definitions to consist of (i) a nominal definition and (ii) a mark through which we can secure the objective reality of the defined concept (*KrV*, A241–2 n.). Nunez argues that Kant provides such definitions of the categories in the *Critique*. In the chapter on phenomena and noumena, Kant notes that we cannot define the categories without specifying conditions of sensibility that show the objective reality of the categories (A240–1/B300). As Nunez argues (644–8), Kant goes on to give real definitions of some categories (a) by supplying a nominal definition of the category in terms of genus and specific difference, and (b) by specifying the sensible condition or schema that secures the objective reality of the category. For example, Kant nominally defines the category of *magnitude* as 'the determination of a thing through which it can be thought how many units are posited in it' (A242/B300). The schema that secures the objective reality of this category is described as follows: 'Only this how-many-times is grounded on successive repetition, thus on time and the synthesis (of the homogeneous) in it' (ibid.). Nunez's interpretation supports our reading of the model of definitions described in the Classical Model as an ideal for science.

Kant's other critical remarks on the mathematical method are also consistent with the Classical Model. In his critique of Wolff's mathematical method, he says that mathematics has axioms while philosophy does not (*KrV*, B760–1). However, Kant uses a specific interpretation of the term *axiom*. Axioms are immediately certain synthetic principles that are *intuitive*, i.e. that can be constructed in pure intuition (ibid.) Since philosophical principles do not allow of construction, philosophy lacks axioms. However, philosophy does have fundamental principles, as stated by the Classical Model, which are called discursive principles through concepts or *acroamata* (*JL*, 9: 110–11; de Jong 1995: 267). These fundamental principles ground the philosophical sciences.

Finally, Kant says that philosophy does not have demonstrations. However, by demonstration he means a *constructive proof*, as employed in mathematics, which he contrasts with acroamatic (discursive) proofs (*KrV*, B762). Although philosophy does not make use of constructive proofs, Kant does say that philosophy makes use of discursive proofs. In addition, in line with the Classical Model, he says that cognition must be logically grounded, which means that judgements must be logically derived from higher principles (van den Berg 2014: 30–4; *JL*, 9: 51–2; Falkenburg 2000: 368–70). Hence, Kant's critique of the mathematical method in the Doctrine of Method is consistent with adopting the Classical Model.

4. Meier and Kant on Systematicity, the Classical Model and the Logical Perfections of Knowledge

In this section I discuss Meier and Kant in relation to the Classical Model, their views on systematicity, and their views on the logical perfections of knowledge. I argue that both Meier and Kant accepted the Classical Model and that this model elucidates their ideas of systematicity. In addition, I discuss Meier's and Kant's views on logical perfections and their relation to the idea of systematicity. Meier devotes various chapters of his *Vernunftlehre* to discussing different *perfections* or ideals of scientific knowledge. I argue that systematicity furthers the perfections of (i) extensiveness, (ii) fruitfulness, (iii) truth, (iv) clarity, distinctness and completeness, and (v) certainty. This suggests that Meier embraced systematicity as an ideal partly because it furthers these perfections. As I shall argue Kant embraced systematicity as an ideal for science for the same reasons.

4.1 Meier and the Classical Model

That Meier endorses the Classical Model becomes clear from his *Vernunftlehre* (1752). There he notes that concepts are obtained through: experience, abstraction and combination (Meier 1752: 416). His account of abstraction states that we obtain more from less fundamental concepts analytically through abstraction until we arrive at fundamental concepts (430–1). We obtain concepts through combination by proceeding synthetically from more simple and more fundamental concepts to more complex and less fundamental concepts (439). Hence, Meier's account of concepts captures conditions (2a) and (2b) of the Classical Model.

According to Meier, constructing a system of concepts occurs through definitions and logical division. We define lower concepts (species) in terms of their proximate genus and specific difference (Meier 1752: 451). Hence, through definitions we systematically relate lower to higher concepts. Constructing a system of concepts also requires that we logically divide higher concepts (genera) into lower concepts (species). This division is guided by the rule that the species must constitute *all* the concepts contained under the higher concept, i.e. the species must constitute the total extension of the divided concept (437–74; see also Kant at *JL*, 9: 146–7, discussed in section 4.8).

Meier also distinguishes between indemonstrable judgements, which do not require any demonstration, and demonstrable judgements, which require a demonstration (Meier 1752: 514). The indemonstrable judgements are the fundamental judgements on the basis of which we demonstrate non-fundamental judgements in science. Hence, Meier accepted conditions (3a) and (3b) of the Classical Model.

The Classical Model illuminates how, according to Meier, systems of concepts and judgements are constructed. Systems of concepts are constructed by defining non-fundamental concepts on the basis of fundamental concepts, and systems of judgements are constructed by deducing non-fundamental judgements from fundamental judgements. In the next section, we will further explore the connection between axiomatics and systematicity in Meier.

4.2 Wolff and Meier on Mathematical Method: How to Construct Systematic Sciences

In the chapter on method, Meier discusses how we can construct systematic sciences. He stresses the importance of the mathematical method, which Wolff equated with the scientific method (Meier 1752: 634). The mathematical method is a variety of the Classical Model, though not identical with it. It states that non-fundamental scientific concepts must be defined in terms of fundamental concepts, and that non-fundamental scientific propositions must be deduced from fundamental propositions (van den Berg and Demarest 2020: 383).

The nature of the mathematical method was explained by Wolff in *Die Anfangsgründe aller Mathematischen Wissenschaften* (1750 [1999]).[7] Wolff claims that the mathematical method proceeds from definitions to axioms, and from axioms to theorems and problems (5). Definitions, which are either nominal or real, ground axioms. For example, if we define a circle by giving the procedure of moving a straight line around a fixed point, we can infer that all the straight lines that are drawn from the centre to the perimeter are equal to each other (16). This truth is an axiom (*Grundsatz*). Axioms either show that something is the case, as in the example of equal radii, or that something can be done or constructed, for example that between any two points we can draw a straight line (17). The first type is called *axiomata* and the second *postulata*. Since the truth of *axiomata* and *postulata* immediately follows from definitions, they do not require proof (ibid.). We derive theorems through strict demonstrations from definitions, *axiomata* and *postulata* (21, 25, 27–8; Wolff 1716 [1965]: 501).

Wolff's mathematical method presents us with an axiomatic method that derives theorems from definitions and axioms through logical proofs. Wolff and Meier take this axiomatic method to be the paradigmatic way of constructing systematic sciences (Hinske 1990: 159). Having described how Meier's adherence to an axiomatic ideal for science explains his idea of systematicity, we may now turn to Meier's discussion of the logical perfections of scientific knowledge. I will show that systematicity can be taken as an ideal for science because it furthers these perfections of knowledge.

4.3 Systematicity and Extensiveness in Meier

According to the perfection of extensiveness, cognition must be applicable to as many objects as possible (Meier 1752: 41). The term cognition (*Erkenntniß*) refers to both concepts and judgements. Hence, the concepts and judgements of a science must be applicable to as many objects as possible.

Systematicity furthers the ideal of extensiveness. According to Meier, systems of concepts are constructed by means of definitions and the logical division of concepts (see section 4.1). The logical division of higher concepts into lower concepts must, as we have seen, satisfy the following rule: (i) the species must constitute the total extension of the divided concept. Condition (i) ensures that a division is complete and that the constructed system of concepts has the widest possible extension. Constructing a system of concepts in accordance with condition (i) thus furthers extensiveness.

4.4 Systematicity and Fruitfulness in Meier

The perfection of fruitfulness concerns the number of consequences that follow from a cognition: if a cognition has *many* consequences, Meier calls it *fruitful* (Meier 1752: 101). Fruitfulness is a maxim of maximality. It tells us that scientific principles should allow for the derivation of the maximum number of consequences. It is related to the maxim of parsimony, which tells us that sciences should be based on a minimal set of principles. These two maxims combined give rise to the following maxim: in science, we should choose the smallest set of principles (parsimony) that allow us to derive the maximum number of consequences (fruitfulness). This maxim expresses an axiomatic ideal (de Jong and Betti 2010), which directs us to derive as many consequences as possible from a minimal number of principles. Insofar as systematic sciences can be viewed as axiomatic sciences, systematic sciences can be taken to further the perfection of fruitfulness.[8]

4.5 Systematicity and Truth in Meier

Meier's account of truth corresponds to condition (4) of the Classical Model. Meier specifies two criteria for truth (Meier 1752: 130). The first mark of truth is internal *possibility*: a true judgement must not be contradictory (131–2). The second mark of truth can be called grounding: a judgement is true if (i) it is a consequence of true grounds and (ii) it is a ground of consequences all of which are true (133). Condition (i) is plausible because we take something to be true on the basis of proofs, which show that something follows from true grounds. Condition (ii) is plausible because of scientific practice, in which we prove the truth of hypotheses by showing that all their consequences are true (134–5).

That systematicity is necessary for knowledge of truths follows from the marks of truth. We can say that a judgement is true if (i) it follows from true grounds and (ii) all its consequences are true. Hence, knowledge of true judgements requires that we systematically order judgements as a deductive interconnection of grounds and consequences.

4.6 Systematicity, Clarity, Distinctness and Completeness in Meier

Other perfections of cognition are the *clarity*, *distinctness* and *completeness* of cognition. These notions can be traced to Wolff, and before Wolff to the views of Descartes and Leibniz. According to Wolff a concept is *clear* if we can identify the things to which it applies (Wolff 1754 [1978]: 126; van den Berg 2014: 19). A concept is *distinct* if we know its marks, i.e. the partial concepts contained within the concept (128; van den Berg 2014: 19). Finally, a concept is complete if we know all its marks and if the marks we know are sufficient for knowing the things represented by the concept and distinguishing them from other things (129; van den Berg 2014: 19). Meier adopts similar concepts of clarity, distinctness and completeness (Meier 1752: 184, 214, 235).

Distinctness and completeness are perfections of cognition that are improved through establishing systems of cognition. If we construct systems of genera and species, we make the species distinct by explicating the genera that are contained in these species. In turn, we further the completeness of an analysed concept by explicating as many of the marks or more fundamental concepts that are contained in a concept. By constructing systems of concepts we thus improve the distinctness and completeness of cognition.

4.7 Systematicity and Certainty in Meier

Meier's account of the perfection of certainty corresponds to condition (6) of the Classical Model. Certainty is that which secures that we know a true judgement (Meier 1752: 251). In science, according to Meier, we aspire to *logical certainty*, which is knowledge of a truth through knowledge of its grounds. He distinguishes between exhaustive and inexhaustive certainty (255–6). If we know all of the grounds of a true judgement, as in mathematical demonstrations, we have obtained exhaustive certainty. Establishing a systematic and deductive interconnection of grounds and consequences is necessary for obtaining logical and exhaustive certainty.

4.8 Kant on Systematicity as a Logical Perfection

Having described Meier's views on systematicity, the Classical Model and the logical perfections, we may now turn to Kant. Kant describes systematicity as a *logical perfection* (*JL*, 9: 139–40).[9] The ideal of systematicity is related to the procedure of constructing systems of concepts.

Kant states that a system of concepts depends on the 'distinctness of concepts both in regard to what is contained in them and in respect of what is contained under them' (ibid.). As was the case for Meier (section 4.1), this means that a system of concepts is constructed by specifying both the *intension* of concepts through *definitions* and the *extension* of concepts through *logical division* (Longuenesse 1998: 150–1; *JL*, 9: 140). In the following, I describe how definitions and logical division give rise to a system of concepts.

Kant distinguishes between synthetic and analytic definitions and between nominal and real definitions (*JL*, 9: 141–4). Synthetic nominal definitions are made through the arbitrary combination of concepts. We can, for example, give a nominal synthetic definition of the concept 'square' by combining the concepts 'four-sided', 'equilateral' and 'rectangle' (Log-D, 24: 757). In this way, we define less fundamental concepts (species) in terms of more fundamental concepts (genera and differentia), proceeding synthetically from the simpler, more fundamental to the complex, less fundamental concepts.

Synthetic real definitions are, as we have seen (section 3.1), based on synthetic nominal definitions. They consist of (i) a nominal definition and (ii) a proof of the real possibility of the defined concept. In mathematics, we prove the possibility of the defined concept through a constructive procedure that shows how an object is possible (*JL*, 9: 141). For example, we can define a circle by showing that it can be constructed by letting a straight line move around a fixed point. This construction is based on a synthetic nominal definition proceeding from genus and differentia to species, e.g. the nominal definition of a circle as a (curved) line (genus) whose points are all equidistant from a centre point (differentia) (see Nunez 2014: 633). The same is true for definitions of the categories. They consist of (a) a nominal definition of the category in terms of genus and specific difference, and (b) a specification of the schema that secures the objective reality of the category (Nunez 2014: 644–8).

To conclude: all synthetic real definitions are based on synthetic nominal definitions. This means that when giving synthetic real definitions we define complex, less fundamental concepts in terms of simpler and more fundamental ones and we proceed synthetically from simple, fundamental to complex, less fundamental concepts. Kant's views on synthetic definitions thus capture conditions (2a) and (2b) of the Classical Model. Through defining concepts in terms of more fundamental ones, we construct a system of concepts.

Analytic definitions are constructed by analysing given concepts and making these concepts distinct and complete (*JL*, 9: 142). Using this method we proceed analytically from the more complex, less fundamental to more simple and fundamental concepts, and define less fundamental in terms of more fundamental concepts by means of genus and specific difference. Kant's views on analytic definitions thus likewise capture conditions (2a) and (2b) of the Classical Model. As we have seen, however, Kant is sceptical about obtaining analytic definitions of empirical and *a priori* philosophical concepts.

Definitions bring about a system of concepts by specifying their intension. According to Kant, as was the case for Meier (section 4.1), the construction of a system of concepts also requires the determination of the *extension* of concepts through logical division (*JL*, 9: 146–7). Through logical division we obtain lower concepts (species) from higher concepts (genera). In the *Jäsche Logik*, Kant notes that the logical division of concepts must satisfy the following rules: the species (a) exclude each other; (b) belong under one higher concept; and, again like Meier, (c) constitute the total extension of the concept that is divided (van den Berg 2014: 22; Anderson 2005: 29; *JL*, 9: 146–7). By following these rules, we systematically determine the extension of a concept.

Kant's views on the systematicity of judgements are articulated in the doctrine of proof of the *Jäsche Logik*. A proof consists of three parts: (i) conclusion, (ii) ground of proof, (iii) the way in which (i) follows from (ii) (Log-D, 24: 748; Zinkstok 2013: 96–7). Through proofs we systematically relate grounds to their consequences. Proofs must terminate in fundamental principles (*JL*, 9: 71). Hence, Kant's doctrine of proof captures conditions (3a) and (3b) of the Classical Model. Through providing proofs from fundamental principles we construct systems of judgements. In the next section, we discuss the similarities between Meier's and Kant's accounts of the logical perfections of knowledge.

4.9 Kant on Systematicity and the Perfections of Fruitfulness, Extensiveness and Truth

Kant discusses Meier's account of the perfections in his logic lectures and accepts most of them (Falkenburg 2000: 355–66). However, in his lectures he does not explicitly relate these perfections to systematicity. Kant does relate the idea of systematicity to the perfections in the first *Critique*, where, as Falkenburg notes (2001: 312), Kant states that the goal of the systematic unity of knowledge amounts to the goal of satisfying *logical perfections* of knowledge (A838/B866). If we consider Kant's remarks on systematicity in the first *Critique*, we find connections between the ideal of systematicity and the ideals of fruitfulness and, by implication, extensiveness and truth. Kant argues that through the systematic ordering of cognition, we achieve unity alongside the greatest possible *extension* (A644/B673). How a system furthers unity alongside maximal extension becomes clear if we discuss Kant's remarks on systematicity in relation to the perfection of fruitfulness.

In our discussion of fruitfulness, we have introduced the following maxim: science should be based on the smallest set of principles (parsimony) that allow us to derive the maximum number of consequences (fruitfulness). Kant articulates this maxim in the section 'On the regulative use of the ideas of pure reason', where he discusses the maxims of genera and specification (see Guyer 1990: 21–34; 2003: 282; Falkenburg 2000: 382–5 discusses these maxims and also the logical perfections in this context). There he notes that systematic sciences are brought about by following what he calls the maxim of genera, according to which we subsume species under genera, then subsume these under higher genera, and so forth until we reach a highest genus (*KrV*, A651–2/B679–80). Applied to systems of judgements, this maxim expresses the idea that sciences should be based on a minimum number of principles. However, Kant notes that in science we should also follow the maxim of species, which directs us to maximally specify each species into subspecies, these subspecies into further subspecies, and so forth (A654–5/B682–3). Applied to systems of judgements, this maxim tells us that in science we need to choose principles that allow for the derivation of the most consequences. It is by following these two maxims that we establish systematic sciences (A658/B686). Hence, systematic sciences follow the maxim that we should choose the smallest set of principles (parsimony) that allow us to derive the maximum number of consequences (fruitfulness). This analysis also suggests that Kant adopted the perfection of extensiveness, and that he took systematicity to further the ideal of extensiveness, because his maxim of species directs us to continuously divide species into subspecies, thus ensuring that our cognition is applicable to as many objects as possible.

There are also similarities between Meier's and Kant's remarks on truth. Kant argues that systematicity is necessary for cognizing truths. Without systematic unity we have 'no sufficient mark of empirical truth' (*KrV*, A651/B679). Remarks such as these have led to much debate. Allison (2000 82: 84–6) argues, following Ginsborg (1990: 171–92), that systematicity is necessary for the formation of determinate empirical concepts, and thus a necessary condition for knowledge of empirical truths. This may be true, but we can explain Kant's ideas in a simpler fashion if we take into account the position of Meier.

According to Meier, as we have seen, we know that a cognition is true if it is (i) a consequence of true grounds and (ii) a ground of consequences all of which are true. Hence, a systematic interconnection of grounds and consequences is necessary to cognize truths. In the *Jäsche Logik*, Kant puts forward a similar theory, arguing that a true cognition (x) has (true) grounds from which it follows and (y) does not have false consequences (*JL*, 9: 51). With respect to (y), Kant notes that 'from the *truth of the consequence* we may infer the *truth* of the cognition as *ground*, but only negatively: if one false consequence flows from a cognition, then the cognition itself is false' (*JL*, 9: 52). Hence, in line with Meier's condition (ii), we may infer from the truth of all consequences to the truth of the ground, although Kant notes that one cannot know the totality of consequences of a ground and that we can therefore only use this criterion to establish hypothetical or probable truths (ibid.). In the first *Critique*, Kant relates Meier's condition (ii) to what he calls the hypothetical use of reason. If we employ the hypothetical use of reason, we assume a universal problematically, and test whether several particular consequences follow from it. If these consequences follow from the rule, then the universality of the rule is inferred, although, again, we can only approximate universality through this mode of inference (A 646–7/B674–5).

The hypothetical use of reason thus tests whether the consequences that follow from a rule are true and infers to the universality of the rule itself. As such, the hypothetical use of reason illustrates Meier's condition (ii). Since we know truths on the basis of a systematic interconnection of grounds and consequences, it is no surprise that Kant claims that systematicity is necessary for knowing (empirical) truths. The basic idea adopted by Meier and Kant is that we can only know truths (whether apodictic or probable) through inferential relations, and this presupposes that cognitions are systematically ordered.

We have seen that, for both Meier and Kant, the ideal of systematicity and the logical perfections of knowledge are intimately related. A properly systematic science satisfies the logical perfections of knowledge, which all sciences should satisfy to the highest extent. Hence, it is no surprise that Meier and Kant took systematicity to be an ideal for science.

5. Lambert and Kant on Systematicity and Completeness

In this section I turn to Lambert's account of systematicity and its impact on Kant. In section 5.1 I will first, following Sturm (2009), discuss passages in Lambert's *Neues Organon* that illustrate his notion of systematicity. I will then argue that Lambert took systematic sciences to be complete and analyse what this means. Finally, I argue that Lambert rejected Wolff's mathematical method but nevertheless accepted the Classical Model, which elucidates Lambert's conception of systematicity. In section 5.2, I will argue that Kant's idea that systematic sciences are constructed on the basis of an idea of a whole and are complete can be fruitfully understood on the basis of Lambert's ideas of completeness.

5.1 Lambert on Scientific Knowledge, Completeness and the New Mathematical Method

In his *Neues Organon* (1764), Lambert distinguishes between common knowledge and scientific knowledge (see also Watkins 2018: 181–4). Scientific knowledge is characterized by *dependency relations*, whereas common knowledge is not (Lambert 1764: 389). Lambert construes sciences as deductive systems in which consequences are deduced from fundamental principles (394–5). Hence, he construes sciences as axiomatic deductive systems (Wolters 1980: 51, 55). Lambert states that scientific judgements are regarded as a systematic *whole*, in which every judgement is related to others (390). Hence, an axiomatic science, in which non-fundamental judgements are demonstrated on the basis of fundamental ones, satisfies Lambert's criteria for a system of judgements.

According to Lambert, systematicity is the defining characteristic of scientific knowledge (Sturm 2009: 141). Lambert also argues that *completeness* is a characteristic of systematic sciences. Sturm (142) notes that completeness for Lambert involves having a principle that guides research. In the following, I will extend Sturm's analysis and explain the notion of completeness.

In his *Architectonic*, Lambert states that completeness is a perfection of the foundational sciences (Lambert 1771: 29). In his *Neues Organon*, he notes that a scientific doctrine is complete if we can specify how all of its parts are to be treated (1764: 75). As an example of a complete science, Lambert mentions trigonometry (1764: 406; cf. 1771: 13). The example of trigonometry illustrates Lambert's notion of completeness. In his *Mathematisches Lexicon* (1716), Wolff defined trigonometry as a science that allows one to derive from three given parts of a triangle the other three parts. Wolff thinks that all problems in trigonometry reduce to a limited number of cases: (i) if two sides are given and one angle, to find the other two angles and the third side, (ii) if two angles are given and one side, to find the other two sides and the remaining angle, (iii) if three sides are given, to find the three angles, and (iv) in spherical triangles, if three angles are given, to find the three sides (Wolff 1716 [1965], 1428–9).

The cases above describe all the (types of) problems of trigonometry and the way in which they are to be treated. It is this feature that Lambert associates with completeness: it is the enumeration (*Abzahlung*) of all cases (*Fälle*) and the specification of the *rules* (*Regeln*) in accordance with which these cases are to be treated (*traktirt*) that makes a doctrine complete (1764: 75). This matches Lambert's general idea of a system as a whole with parts that are related to each other (Waibel 2007: 53). Interestingly, Lambert also remarks that, since the realm of truths is infinite, completeness is often an ideal that we can only approximate (1771: 30–1). In the next section, we will see that Kant argues, like Lambert, that the completeness of a systematic science consists in being able to say how all of its parts are to be ordered. In addition, like Lambert, he argues that the completeness of a science is an ideal that we can only approximate.

If we turn our attention to Lambert's *Anlage zur Architectonic* (1771), it becomes clear that he rejected Wolff's mathematical method. According to Lambert, as Heis and several other interpreters have shown (Heis 2014: 616–17; Dunlop 2009: esp. 48–54; Laywine 2010: 114–21; Wolters 1980: 51–4), not every concept can be defined, since some concepts are simple. Because simple concepts cannot be defined, propositions that contain only simple concepts cannot be inferred from definitions. Hence, *pace* Wolff, postulates and axioms, which contain simple concepts, cannot be inferred from definitions. Rather, the possibility of every concept that is defined needs to be proven on the basis of postulates or axioms, which show how a certain concept is possible or consistent (Heis 2014: 616–17; on Lambert's postulates, see Laywine 2010: 114–21; Dunlop 2009: 52–62; Wolters 1980: 88–95; Wellmann 2017: 142–6). In short, definitions do not ground axioms and postulates, but the converse is true: axioms and postulates ground the possibility of definitions (Lambert 1771: 10–12). This new mathematical method distinguishes Lambert's conception of axiomatics from that of Wolff.

Although Lambert adopted a new mathematical method, he accepted the axiomatic conception of science articulated by the Classical Model. In the *Anlage zur Architectonic*, Lambert specifies the simple concepts that ground the so-called foundational sciences (1771: 46; Wellman 2017:

141–2). For example, Lambert argues that the concept of *identity*, together with the concepts of *force* and *solidity*, form the basis for the foundational science called *calculus quantitatum* (47). Similarly, the fundamental concept of extension, together with the concept of unity, constitutes the basis of geometry (51). In this way, Lambert considers relations between simple concepts and specifies which combinations of concepts form the basis of which science. Lambert's simple concepts ground non-fundamental concepts insofar as non-fundamental concepts are composed of simple ones (1764: 420–2). As Lambert puts the point, if we analyse composite concepts (*zusammengesetzte Begriffe*) we arrive at simple concepts (*einfache Begriffe*), which provide the foundation of all knowledge (ibid.). Hence, Lambert accepts conditions (2a) and (2b) of the Classical Model. Moreover, through combining simple concepts Lambert obtains fundamental propositions of sciences, since axioms and postulates consist of combinations of simple concepts (1771: 20). From these fundamental propositions, we derive non-fundamental ones, as stipulated by conditions (3a) and (3b) of the Classical Model. Hence, Lambert adopts the Classical Model and this model elucidates his conception of systematic science.

5.2 Kant on the Completeness of Systematic Sciences

Kant follows Lambert by arguing that systematic sciences are *complete* and that completeness is an ideal for science. In the first *Critique* he notes that a system is based on an idea of the whole that precedes and determines *each* part (and hence is complete):

> I understand by a system, however, the unity of the manifold cognitions under one idea. This is the rational concept of the form of a whole, insofar as through this the domain (*Umfang*) of the manifold as well as the position of the parts with respect to each other is determined *a priori*. (A832/B861; cf. A645/B673)

The nature of this idea of the whole is obscure. Zinkstok (2013: 95) argues that Kant took this idea to be an idea of the highest genus of a Porphyrian tree. This is partly correct. Kant often construes the highest genus of a system of concepts as a transcendental idea that functions as a *focus imaginarius* when unifying our cognition. These ideas specify a certain domain of investigation, and thus allow us to distinguish a particular science from another science in terms of their different domains. For this reason, Kant claims that through transcendental ideas the domain (*Umfang*) of a science is determined (Rauscher 2010: 296).

However (as an anonymous referee has stressed), it is not clear how a transcendental idea confers unity among the parts of a science. In our discussion of Lambert, we have seen that he took complete sciences to be sciences in which all the parts are specified and we have rules in accordance with which to treat these parts. Kant adopts a similar idea, insofar as he argues that a systematic and complete science is a science based on an idea of the whole, which means that we have *a priori* rules that allow us to relate *all* the parts of a science. It is for this reason that Kant claims that through the idea of the whole 'the position of the parts with respect to each other is determined *a priori*' (*KrV*, A 832/B 861).

An example from natural history illustrates the idea of a whole. (Here I follow van den Berg 2014: 23–4, which draws on Müller-Wille 2007: 546–7; Anderson 2005; Oittinen 2009: 63–9. On the impact of Kant's natural history and theory of race on his account of systematicity, see Sandford 2018.) In Linnaeus' classification of plants, he divides the plant realm into *classes* by specifying the number of stamens, and into *orders* by specifying the number of pistils. We provide definitions of classes by specifying the genus 'plant' and by specifying the number of stamens ('with one stamen', 'with two stamens', etc.). We further specify the classes and provide definitions of orders by specifying a particular class as genus and by specifying the number of pistils ('with one pistil', 'with two pistils', etc.). We thus have *a priori* rules that govern the construction of a system of concepts and that determine the relation between these concepts. This is Kant's point when he says that a system is based on an idea of the whole that determines the place of each part: we must, as was stressed by Lambert, have rules that specify how we are to treat and relate the parts of a science. For Kant, moreover, a complete empirical specification of genera and species in natural history (a 'finished natural history') is a regulative ideal. Hence, like Lambert, Kant saw completeness in this sense as an ideal for science that we can only approximate.

6. Conclusion

Kant's idea of systematicity is anticipated by Meier and Lambert. This is not surprising given that these authors construed the notion of systematicity on the basis of a widely accepted axiomatic idea of science. More specifically, Kant's conception of systematicity can be understood against the background of de Jong and Betti's Classical Model of Science (2010), which was accepted by Kant and by his predecessors Meier and Lambert. I have shown that Kant's adherence to the Classical Model is compatible with his critique of the mathematical method, and that conditions (2) and (3) of the Classical Model capture Meier's and Kant's account of systematicity. I have further argued that systematicity furthers several traditionally accepted logical ideals of scientific cognition, which explains why eighteenth-century authors insisted that sciences should be systematic. Although there is much continuity between Kant and his predecessors, Kant's ideas that systems are constructed on the basis of *transcendental* ideas and on the basis of *regulative* principles were certainly novel. However, the ideal of a system understood as an axiomatized body of knowledge was standard in the eighteenth century. If we do not stress the link between systematicity and axiomatic science, we lose sight of the historical context and nature of Kant's ideal of systematicity.[10]

Notes

1 I use the following abbreviations for works of Kant. *JL*= *Jäsche Logik*, *KrV* = *Kritik der reinen Vernunft*, Log-D = Logik Dohna-Wundlacken, Log-W = Wiener Logik, *MFNS* = *Metaphysische Anfangsgründe der Naturwissenschaft*, NTM = Untersuchung über die Deutlichkeit der Grundsätze der natürlichen Theologie und der Moral. Citations of *KrV* refer to the A/B pagination. Other citations refer to the Akademie edition of Kant's works (Kant 1900–) through volume and page number(s). English translations are taken from the Cambridge University Press edition of Kant's works (Kant 1992–).

2 The present paper draws in part on my previous van den Berg 2011 and 2014: ch. 2, where I used the Classical Model to elucidate Kant's ideas on systems of concepts.

3 On the influence of Meier's logic on Kant, see Pozzo 2005.

4 Note that the Classical Model (de Jong and Betti 2010) is a refined version of earlier versions of the model. On Bolzano's views on systematic science, see Betti 2010: 288.

5 Plaass (1994: 235–6) argues that Kant cannot adopt an axiomatic conception of (natural) science because he (Plaass) cannot see how empirical principles have a role in axiomatic sciences (Sturm 2009: 153 follows Plaass). However, as shown in van den Berg 2014: ch. 2, and van den Berg and Demarest 2020, Wolff and Kant allow for the possibility that (natural) sciences have empirical principles and are axiomatically structured. Walsh (1940) wrongly argues that propositions of empirical sciences cannot count as knowledge. However, empirical propositions can constitute knowledge (see van den Berg 2014: ch. 2).

6 I am grateful to an anonymous referee for pressing me to make this point.

7 On Wolff's mathematical method, see Blok 2016: 13–45, Shabel 2003: 49-52, Dunlop 2013, Gava 2018: 279-84. Here, I only discuss the basics of Wolff's mathematical method.

8 On the perfections of simplicity and fruitfulness, Kant's take on them and the relation between perfections and theoretical virtues, see also van den Berg 2020, which draws on the present article.

9 In this section, I follow my van den Berg 2014: 17–24 and 2011: 8–11. This account is indebted to Falkenburg (2000).

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