The Methodological Prescriptions of the "Appendix to the Transcendental Dialectic" of Kant's *Critique of Pure Reason* and the Foundations of Improper Science

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Kant devotes the body of the Transcendental Dialectic of his *Kritik der reinen Vernunft* (KrV) to showing that the ideas of theoretical reason cannot provide knowledge of supersensible objects (the soul, the world and God).[1] At the end of that division, he introduces the brief Appendix to the Transcendental Dialectic (hereafter ATD).[2] The aim of this section is to present the legitimate regulative use of the ideas of theoretical reason in relation to the empirical cognitions of the understanding. Kant maintains that this regulative use must be performed through different methodological prescriptions for the arrangement of those cognitions. These prescriptions can be divided into two main groups: 1) the requirement of employing certain ideas of reason, which I will call "theoretical concepts" here, in empirical hypotheses (A645–6/B673–4); 2) the requirement of systematicity that applies to these hypotheses, as well as to the empirical and theoretical concepts related to them (A646–68/B674–96).

The application of those methodological prescriptions leads to the formation not only of empirical *ordinary* knowledge, but also, and especially, of empirical *scientific* knowledge. Empirical knowledge can be considered as scientific if and only if its laws are, in a sense, necessary. Commentators are divided over the nature and the source of the necessity of empirical scientific laws. Friedman

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[1] I will use the following abbreviations for Kant's works: KrV = Kritik der reinen Vernunft, KU = Kritik der Urteilskraft, Log = Jäsche Logik, MAN = Metaphysische Anfangsgründe der Naturwissenschaft, OP = Opus Postumum and V-Ph/Danziger = Danziger Physik (notes from physics lectures given by Kant in 1785). All references to KrV are to the pagination of the first (A = 1781) and second (B = 1787) editions. All other references to Kant's writings are to the academic edition of his works (Kant, 1900–). In this case, volume and page numbers are given. I shall use the following English translations: Young's Log (Kant, 1992), Guyer and Wood's KrV (Kant, 1998), Guyer and Matthews' KU (Kant, 2000) and Friedman's MAN (Kant, 2004). In several instances, I have slightly modified these English translations in order to give a more literal rendering.

[2] This section contains two parts: "On the regulative use of the ideas of pure reason" (hereafter, ATD1) and "On the final aim of the natural dialectic of human reason" (hereafter, ATD2).

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(1992a, 1992b, 1992c, 2014) maintains that the necessity of these laws can derive only from an *a priori* foundation in the principles of the pure understanding. Other scholars hold that such necessity derives mainly from reason's demand for systematicity (Buchdahl, 1965, 1967, 1969, 1971; Kitcher, 1986, 1994; Krausser, 1987, 1989; Rush, 2000; Santos Garcia, 2004), or mainly from reason's requirement of introducing theoretical concepts (Brittan, 1992; McNulty, 2015). I will contend that these interpretations are innacurate. Friedman's reading cannot adequately account for the status of the laws belonging to what in the Preface to MAN is called "improper" science (MAN, AA 04: 468). The last two interpretations are one-sided because, as I will argue, the fulfillment of both requirements of systematicity and of introducing theoretical concepts is needed in order to ground the necessity of empirical scientific laws. Given that these requirements are demanded by the regulative function of theoretical reason, this necessity may be called "regulative". Those requirements are not necessary for the core of mathematical physics, but for improper sciences such as, at least, chemistry. Indeed, the main objective of this article is to show that those two methodological prescriptions make improper science possible, because their application grounds and explains the regulative necessity of the laws pertaining to this type of science. More precisely, as I hope to show, the regulatively necessary character of these laws, and therefore the scientific nature of improper science, depends on a certain systematic and experimental character of this science; in turn, the systematic character of that science depends on the application of the requirement of systematicity, and the experimental character of that science depends on the application of the requirement of introducing theoretical concepts.

It needs to be stated that Kant does not explicitly limit the scope of his doctrines of theoretical concepts and improper science to chemistry, and does not limit the scope of his doctrine of systematicity to that science. However, for the sake of brevity and in order to provide a unified discussion of these doctrines, I will examine them mainly insofar as they apply to chemistry. On the other hand, the study of Kant's conception of chemistry in OP is beyond the scope of this article.

This article is divided into three main sections. In the first section, I will argue that theoretical concepts are representations of theoretical objects, i.e., ideal entities or elements that have their origin in reason. Theoretical objects are postulated in hypotheses concerning empirical scientific laws that employ the theoretical concepts that correspond to these objects. Such hypotheses make it possible to explain, precisely and economically, the different properties of appearances. An example of a theoretical concept is that of phlogiston. This theoretical concept is employed in hypotheses pertaining to phlogistic chemistry, in order to explain the inflammability of different kinds of empirical objects. In the second section, I will present the principles of theoretical reason that, for Kant, make possible systems of universal rules (empirical and theoretical concepts and empirical scientific laws) of the understanding. In addition, I will argue that the possibility of integrating, for example, hypotheses concerning empirical chemical laws in a system of laws of this kind serves as a criterion for determining the truth-value of such hypotheses. Finally, in the third section, I will contend that, according to Kant, the methodological requirements of systematicity and of introducing theoretical concepts make improper science (i.e., at least, chemistry) possible. The empirical laws that belong to improper science can be considered as regulatively necessary. I will finish this section with a discussion of the interpretations sketched above.

1. The requirement of employing theoretical concepts

In this section, I will examine a methodological prescription demanded by theoretical reason. This prescription consists in the requirement of employing certain ideas of this faculty in empirical scientific hypotheses. These ideas are representations of abstract entities or elements whose use is necessary in theorizing about, at least, chemical phenomena. Since these ideas are used in scientific theories and hypotheses, I will call them "theoretical concepts". I shall present the most important features of these concepts, focusing on their application in the field of chemistry. Kant introduces these ideas of reason in the fifth paragraph of ATD1:

> Admittedly, it is hard to find *pure earth*, *pure water*, *pure air*, etc. Nevertheless, the concepts of them are still needed (which, therefore, as concerning the complete purity, have their origin only in reason) in order properly to determine the share that each of these natural causes has in the appearance; and thus, one reduces all matters to the earths (the mere weight, as it were), to salts and inflammable beings (as the force), and finally, to water and air as vehicles (machines, as it were, by means of which the aforementioned operate), in order to explain the chemical effects of matters on one another according to the idea of a mechanism. (A646/B674).

The examples of theoretical concepts given by Kant in the quoted passage belong to chemistry. In the period of KrV (1781/1787) and MAN (1786), as Friedman puts it, "Kant's chemistry is the traditional phlogistic chemistry developed especially by Georg Stahl" (Friedman, 1992a, p. 265; see also Carrier, 2001; Blomme, 2015).[3] In fact, the expression "inflammable beings" (*brennliche Wesen*) used by Kant in the quoted passage refers to phlogiston, that is, as I already pointed out, the theoretical concept that accounts for the inflammability of different kinds of substances.[4] It is true that Kant does not explicitly deny that the

[3] According to Friedman (1992, p. 289), Kant adopted Lavoisier's anti-phlogistic chemistry not later than 1795. See n. 43 below.
[4] I will briefly present this concept later in this section.

employment of theoretical concepts is allowed in empirical sciences different from phlogistic chemistry. However, as we have seen, he introduces the notion of a theoretical concept by means of examples taken from that chemistry. Furthermore, in this article I am concerned with Kant's conception of improper science (that is, at least, chemistry) and its foundation in the period of KrV and MAN. Therefore, I will limit my discussion of theoretical concepts to the field of phlogistic chemistry.[5]

Kant states that theoretical concepts have their origin in reason as regards their "complete purity" (A646/B674). The understanding, with its categories and empirical concepts, makes possible the experience of, for example, the calcination of lead. However, in order to explain this chemical process, reason must carry out a certain conceptual task. This task consists in interpreting that process as the result of the operation of a certain pure matter or element contained in empirical objects. For instance, in Stahlian chemistry, the calcination of lead, which transforms lead into lead calx, is explained by the release of a pure element, that is, phlogiston, from the heated lead.[6] Since in nature these pure elements are always combined with other elements, the understanding cannot know them adequately in their purity.[7] But, in contrast to the knowledge of the understanding, the activity of reason is not limited to what is given in sensibility. Hence, reason can consider these elements in isolation.[8] I will call these pure elements "theoretical objects", and the ideas of reason that are representations of them, "theoretical concepts", as I already said.[9]

A theoretical concept is a representation of a pure object, i.e., a representation that comprehends all the distinguishing features of such an object. Theoretical objects are postulated in hypotheses concerning empirical chemical laws that are formulated by means of the theoretical concepts that are representations of such objects. Thus, reason introduces theoretical objects in order

[5] I will examine in more detail Kant's conception of chemistry in section 3.
[6] According to phlogistic chemistry, when a metal is intensively heated and converted into an ash-like substance, the phlogiston that was contained in the metal is released. This ash-like substance was called the "calx" of a metal, and this is what we now call the "oxide" of a metal. On this topic, see nn. 11 and 13 below.
[7] I agree on this point with Wartenberg (1992, p. 236).
[8] Previous to the above-quoted passage, i.e., at the beginning of ATD1 (A642–5/B670–3), Kant offers a characterization of ideas of theoretical reason that is valid primarily for these ideas as principles (those of homogeneity, specification and continuity, examined later in ATD1). According to Kant, theoretical reason employs regulatively these ideas in order to impose upon the understanding the task of obtaining the greatest possible systematic unity and extension of its empirical cognitions. The regulative demand for systematicity will be examined in section 2.
[9] The designation "theoretical concept" is employed by Buchdahl (1965, 1969, 1992), Wartenberg (1979, 1992) and Brittan (1984, 1992). Buchdahl also uses the designations "theoretical conception" (1965) and "theoretical construct" (1967, 1992). In contrast, Rauscher (2010) makes reference to "mundane ideas". Brittan (1984, 1992) also employs the expression "theoretical object" in a similar sense to the one introduced in this paper. On the other hand, Carrier (2001) and McNulty (2015) examine the use of the ideas of reason that I call here "theoretical concepts" in the field of phlogistic chemistry.

to account for the chemical properties of empirical objects, as well as for the chemical processes undergone by them. Indeed, such processes (combustion, calcination, etc.) and properties (acidity, hardness, inflammability, etc.) are explained, respectively, by the operations and the presence of theoretical objects thought of as contained in those empirical objects. As Kant says in the above-quoted passage (A646/B674), one has "to determine the share that each of these natural causes [MAA: phlogiston, etc.] has in the appearance" and "to explain the chemical effects of matters on one another according to the idea of a mechanism". This is done, as I already stated, by establishing hypotheses that attempt to explain the chemical properties and processes of appearances.[10]

For Kant, theoretical objects such as salts and phlogiston are neither empirical objects nor constructions of mathematical concepts in pure intuition. Rather, they are merely ideal entities. They are not subjected to the variations that empirical objects suffer in virtue of their being composed of mixtures of pure elements. In fact, theoretical objects can only vary in ways that are determined by the hypotheses that refer to them. In addition, since theoretical objects are not postulated to explain a singular appearance, but a determinate kind of appearances, these objects make possible an explanation of such appearances that is not only accurate, but also economical. Indeed, although the appearances that are considered to contain, as a pure element, the theoretical object relevant for the hypothesis can be different, the theoretical object thought of as contained in them is, by definition, always the same. Hence, a discovery about a theoretical object is valid for all the appearances that supposedly contain such an object. Thus, even though theoretical objects are not constructions of concepts in pure intuition, as mathematical objects are, I agree with Brittan when he states that, in the sense I explained, "theoretical are *like* mathematical objects, entirely representative of the set to which they belong" (Brittan 1992, p. 176).

Now we are in a position to understand the significance of an experiment made by Stahl and mentioned by Kant in his KrV. According to Kant, Stahl "transformed metals into calx and the latter in turn into metal, by removing something from them and restoring it to them" (Bxii–xiii). In the first place, Stahl calcined lead in order to generate lead calx. During this process, the phlogiston contained in the lead was removed from the latter. After that, Stahl burned charcoal in the presence of the lead calx and noticed that the latter was transformed into a piece of lead with its typical properties. This process is explained by the release of phlogiston during the combustion of charcoal and the absorption of the former by the lead calx. This experiment apparently proves, firstly, that all calcination and combustion processes can be accounted for by the same mechanism of release of phlogiston; and secondly, that phlogiston is of the same kind in all three kingdoms

[10] On Kant's conception of hypotheses, see section 2.

of nature, for example, the mineral kingdom (lead) and the vegetal one (charcoal).[11] It is clear that the "something" that, according to Kant, Stahl "removed" and "restored", is phlogiston. This experiment apparently supports a hypothesis that can be formulated in the following way: phlogiston is the principle of inflammability.[12] As I already stated above, hypotheses of this kind make unified explanations of chemical properties of different kinds of appearances possible.[13]

I will finish this section with a discussion of the problem of the objective validity of theoretical concepts. Throughout the first *Critique*, Kant addresses the problem of the objective validity of different kinds of concepts, such as the categories and empirical and mathematical concepts. Broadly speaking, a concept has objective validity if it has adequately corresponding empirical intuitions (A238–46/B297–302).[14] As it is well-known, Kant repeatedly denies the fact that intuitions of this kind correspond to ideas of reason.[15] However, in these negative statements, Kant has primarily in mind ideas of reason that refer to unknowable supersensible objects, such as the soul and God. In contrast, as I have already pointed out, Kant thinks that the referents of theoretical concepts, that is to say, theoretical objects, are contained in empirical objects. Certainly, since theoretical concepts refer to pure elements that can be found in nature only in compounds, they cannot have entirely adequate corresponding empirical intuitions. Nevertheless, the fact that the pure elements represented by theoretical concepts are understood, by definition, to be contained in empirical objects, can be considered

[11] I follow the presentations of this experiment given by Partington (1961, pp. 669–71), Carrier (2001, pp. 217–8), and especially McNulty (2015, pp. 5–6). See Stahl (1718, pp. 119–20). In this passage, Stahl uses the term "*Asche*" (ash) instead of the term "Kalk" (*calx*) used by Kant. Partington notes that Stahl "generally uses the name ash (*cinis*) for the earthy residue after calcination of a metal; the name *calx*, used by later phlogistic chemists, is derived from the Latin *calx*, quicklime (made by burning limestone), extended to the 'earths' formed on heating metals" (1961, p. 670). See nn. 6 and 13.

[12] I agree on this point with McNulty (2015, pp. 5–6).

[13] In the passage quoted at the beginning of this section, Kant mentions other theoretical objects, such as salts and earths (A646/B674). According to Kant, phlogiston and salts are active elements, whereas earth is a passive element. For instance, as we have already seen, the calcination of lead is explained by the release of phlogiston from this metal. This process leaves behind a residue of an inert earthy substance (i.e., a calx). Such earthy calx was previously combined with phlogiston in the lead. For the sake of simplicity, I will not examine the distinction between active and passive elements in the present article (see nn. 6 and 11 above). As regards air and water, they are not elements, but vehicles or instruments. Carrier (2001, p. 218) states that, "[i]n contrast to the elements, instruments do not enter compounds; they rather contribute to initiating, continuing, stopping, or suppressing reactions". For example, air "serves as an instrument for maintaining combustion" (Ibid.). Air carries away the phlogiston released from burning bodies. "Otherwise, the accumulation of phlogiston near the body would block the further escape of phlogiston so that combustion would stop" (Ibid.). On the other hand, salts need water as an instrument for their activity (see V-Ph/Danziger, AA 29: 161–2, and also Carrier, 2001, p. 220). It is worth mentioning that, according to V-Ph/Danziger, the chemical instruments are fire and water (AA 29: 161–2). On this problem, see Carrier (2001, pp. 219–21).

[14] I will abstract from the question as to whether Kant makes a distinction between the concepts of "objective validity" and "objective reality".

[15] See Kant (A313/B370, A315/B372, A327/B383, A327/B384, A336/B393, A338/B396, A462/B490, A621/B649, A677/B705)

as a criterion for their objective validity. For, in this way, theoretical concepts can have reference to adequate empirical intuitions, though not to entirely adequate empirical intuitions, as in the case of, for example, empirical concepts.

Additionally, I have already stressed that, for Kant, reason postulates theoretical objects in hypotheses concerning empirical chemical laws. These hypotheses are formulated by means of the theoretical concepts that correspond to these objects, and they attempt to explain the chemical properties of given appearances. Therefore, I maintain that the objective validity of theoretical concepts depends also on the successful testing of such hypotheses through experiments or careful observations.[16]

2. The requirement of systematicity

In this section, I will firstly expound Kant’s conception of empirical scientific hypotheses, focusing on their role in unified explanations of appearances. Secondly, I will present Kant’s account of the regulative requirement of systematization for empirical scientific hypotheses and the empirical and theoretical concepts related to these hypotheses. As I will argue, the possibility of integrating a concept or a hypothesis in the corresponding system is one of the criteria to be used in determining the adequacy of the concept or the truth-value of the hypothesis. For reasons of space, I will only examine Kant’s presentation of the aforementioned two topics in ATD1. Although in this text Kant does not limit his conception of hypotheses and systematicity to chemical laws and their system, I will focus on this system and its laws because they are the most relevant for the purpose of this article.

In the sixth paragraph of ATD1, Kant discusses what he calls the “apodictic” and “hypothetical” uses of reason. According to the apodictic use of reason, one begins by considering a universal rule that “*is in itself certain* and given”, and then one necessarily determines its corresponding particular cases (A646/B674). As regards the hypothetical use of reason, Kant writes,

> the universal is assumed only *problematically* and it is a mere idea; the particular is certain, but the universality of the rule for this consequence is still a problem: then several particular cases, which are all certain, are tested by the rule, to see if they flow from it; and in this case, if it seems that all the particular cases that can be indicated follow from it, the universality of the rule is inferred, including all subsequent cases, even those that are not given in themselves (A646–7/B674–5).

[16] Although the probability of those hypotheses can grow in virtue of successful empirical testing, such hypotheses can never attain genuine necessity and universality. See section 2.

The hypothetical use of reason presupposes the existence of certain given particular cases. One assumes "*problematically*" a universal rule, that is, for example, a law or a concept, in order to explain these particular cases as consequences of that law or as instances of that concept. For the sake of simplicity, in this paragraph and in the next one, I will only take laws into consideration. According to Kant, problematic judgments are accompanied with the consciousness of their mere possibility, i.e., they are not regarded as true or false, and their main condition is the absence of contradiction.[17] Hence, the hypothetical use of reason involves the *assumption* of *coherent* empirical laws. On the other hand, Kant states that the assumed universal "is a mere idea". This expression may indicate that the empirical law assumed according to the hypothetical use of reason must be formulated by means of at least one theoretical concept. If this is the case, then this hypothetical use would entail the assumption of laws such as those of chemistry. In any case, it is clear that laws of this kind *may* be assumed by reason in its hypothetical use.[18]

The probability of a hypothesis concerning an empirical scientific law can develop into an analogue of apodictic certainty, when all the tested particular cases can be explained according to it. However, such a hypothesis can never attain genuine universality. In order to conclude that this hypothesis is an apodictically certain universal truth, it would be necessary to know that all the possible consequences of this hypothesis are empirically confirmed. Since this is not possible for finite beings like us, we affirm analogically that, if all the consequences of the hypothesis that we have considered are empirically confirmed, then all the other possible ones will also be empirically confirmed.[19] By contrast, if a single consequence of a hypothesis turns out to be empirically false, then the hypothesis itself is also false (A791/B819).[20]

Shortly after the above-quoted passage, Kant connects the hypothetical use of reason with a regulative requirement of systematization. Kant states: "The hypothetical use of reason is therefore directed at the systematic unity of the understanding's cognitions; the latter, however, is the *touchstone of truth* for rules." (A647/B675; cf. A651/B679). The hypothetical use of reason consists in the employment of problematically assumed universals on behalf of the explanation of

[17] "The soul of man may be immortal" is an example of a problematic judgment. See Kant's discussions of this topic in KrV (A74–76/B99-101) and Log (AA 09: 108–9).
[18] According to Rajiva (2006, 117–9), the expression "mere idea" can refer to what I here call "theoretical concepts" or to the more abstract principle of systematicity. Now I am interested in the role played by theoretical concepts in hypotheses. As regards this point, it is noteworthy that the statement, according to which in the hypothetical use of reason "the universal is assumed only *problematically*, and it is a mere idea", appears in the text immediately after the passage where the notion of a theoretical concept is introduced (A646/B674). I will present Kant's regulative requirement of systematicity later in this section.
[19] See KrV (A646–7/B674–5, A790–1/B818–9) and Log (AA 09: 84–5).
[20] For an analysis of Kant's conception of empirical hypotheses, see Krausser (1987, 1989).

particular appearances. Here I am mainly interested in theoretical concepts and the hypotheses concerning empirical laws formulated by means of the former. As I pointed out in section 1, these hypotheses make possible unified or economical explanations of various kinds of appearances. Hence, it may be said that the hypothetical use of reason is "directed at the systematic unity of the understanding's cognitions". On the other hand, this systematic unity is a criterion for the truth of the rules of the understanding. For example, the possibility of integrating a hypothesis in a system of empirical chemical laws is one of the criteria to be used in determining the truth-value of the hypothesis.[21] Although hypotheses cannot attain genuine universality, when a hypothesis that was formulated by means of theoretical concepts and was also successfully empirically tested is integrated in a system, it can be regarded as regulatively necessary.[22] Accordingly, the possibility of integrating an empirical or theoretical concept in the corresponding system is one of the criteria to be used in determining the adequacy of the concept.

Thus, the exigency of systematicity leads to the formation of two different kinds of hierarchical systems. On the one hand, there are the classificatory systems of empirical and theoretical *concepts*. On the other hand, there is at least one explanatory system, namely, that of empirical scientific *laws*, such as those of chemistry. The explanatory system of empirical chemical laws is the most important for my present purpose.[23] It is noteworthy that the aforementioned systems are mutually dependent. First, in order to formulate empirical chemical laws that employ theoretical concepts, it is necessary to have at least a rudimentary system of empirical concepts of the different kinds of appearances that these laws attempt to explain. Second, the properties that these empirical chemical laws attribute to theoretical objects thought of as contained in empirical objects may be included in the content of the empirical concepts that correspond to these empirical objects.[24]

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[21] On this view, see Okruhlik (1986, pp. 318–20), Kitcher (1986, pp. 209ss.; 1994, pp. 257ss.), Krausser (1987, pp. 180–1, 184–5; 1989, pp. 125–9), Stepanenko (1996, pp. 98–102), Santos García (2004, p. 207) and Abela (2006, pp. 419ff.).

[22] See section 3 for a discussion of the regulative necessity of empirical scientific laws.

[23] In this article, I will not consider empirical generalizations. First, given that these generalizations do not involve the employment of theoretical concepts, they do not unify different kinds of appearances by relating them to a single theoretical object. Second, as these generalizations depend entirely upon what an individual has as yet perceived, they are not necessarily consistent among themselves. Therefore, empirical generalizations cannot be integrated in strictly consistent systems. Thus, these generalizations are not laws even in the regulative sense that I will present in section 3. An example of an empirical generalization is: "intense cold freezes water". On the other hand, the fundamental part of mathematical physics is also systematic. However, this systematicity does not depend on the application of the three systematizing principles of theoretical reason that I will present later in this section, but on the systematic character of the table of categories of KrV (see MAN, AA 04: 473ff.). I will present the concept of mathematical physics in section 3. In this article, I deal only with the problem of the systematicity of sciences that contain laws formulated by means of theoretical concepts, such as the laws of chemistry.

[24] See the discussions of Allison (2001, p. 31) and Geiger (2003, p. 276). See also Kant (A664/B692).

Now, I will further examine Kant's regulative requirement of systematicity. At the beginning of ATD1, Kant presents a general concept of ideas of theoretical reason that applies mainly to these ideas as principles (those of homogeneity, specification and continuity, examined later in ATD1). According to Kant, theoretical reason uses these ideas to impose on the understanding the task of obtaining the absolute systematic unity and extension of its empirical cognitions. However, since an absolute system of cognitions cannot be attained in our finite experience, the former serves as an unreachable goal that necessarily directs all possible empirical actions of the understanding towards the progressive realization of the most complete possible systematicity of its cognitions (A642–5/B670–3).

Reason employs ideas as principles in order to systematize empirical scientific laws, as well as empirical and theoretical concepts. The fact that most examples of systematization of knowledge given by Kant in ATD1 belong to phlogistic chemistry shows that my emphasis on this discipline is not arbitrary.[25] Following Kant, and for reasons of space, I will now present the regulative use of ideas as principles mainly insofar as it leads to the formation of systems of concepts.

According to the principle of homogeneity, it is necessary to seek the identity of the species in different empirical objects and the identity of the genus in different specific empirical and theoretical concepts (A651–4/B679–82).[26] The application of this principle leads to the greatest possible systematic *unity* of empirical and theoretical concepts. This search for identity among concepts of ever higher orders can stop only if a highest genus is reached. Such a genus is a concept that can no longer be understood as a species of a more generic concept.[27]

The principle of specification, conversely, makes it necessary to attempt to divide or specify each genus into different species and each species into different subspecies (A654–7/B682–5). According to Kant, it is always possible to find among particular cases of a certain concept, apart from the properties that are

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[25] In ATD1, Kant offers four examples of systematization of knowledge in the field of phlogistic chemistry: homogenization of salts, earths, and salts and earths together (A652–3/B680–1), and specification of absorbent earths (A657/B685). He also gives one example of systematization of knowledge in the domain of empirical psychology (A648–9/B676–7), and another one in the field of astronomy (A662–3/B690–1). As regards empirical psychology, Kant offers the example of the possible reduction of the different powers of the mind (such as sensation and imagination) to a single fundamental power. For my present purpose, it suffices to point out that this fundamental power cannot be understood as a theoretical object of the same kind as those of chemistry, because it is not possible to conduct experiments in the field of empirical psychology (see MAN, AA 04: 471 and n. 41 below). For the connection between theoretical objects and experimentation, see section 1. As for astronomy, see n. 43 below and section 3. Regarding ATD2, see n. 32.

[26] Reason produces jointly theoretical objects and concepts. Therefore, there cannot be theoretical objects without their corresponding theoretical concepts.

[27] Kant offers three examples of the application of this principle in the field of phlogistic chemistry in ATD1 (A652–3/B680–1). There, Kant states, for example, that chemists reduced "all salts to two main genera, acidic and alkaline" and "even attempt to regard also this distinction as merely a variety or different expression of one and the same fundamental material".

common to all these cases (properties whose discursive and universal representations—that is, discursive marks—constitute the content of that concept), sets of significant differences that make it possible, for instance, to grant objective validity to two possible species of the concept.[28] Therefore, the principle of specification can be indefinitely applied. In fact, Kant says that reason demands that no species be regarded as “the lowest” (A655/B683). In this way, the principle of specification leads to the greatest possible systematic *extension* of concepts.[29]

Finally, the principle of continuity makes it necessary to try to introduce, between two species of the same genus initially considered as proximate, more and more intervening species. The difference between, on the one hand, such intervening species and, on the other, the first and the second species, is smaller than the difference between the first and the second species. Hence, the principle of continuity aims at the production of a continuous transition among the different species of each genus (A657–61/B685–9).[30] It seems that, for Kant, we can always find, between the two sets of objects of two apparently proximate species, common properties that are different from the properties that these objects share in virtue of being particular cases of species of the same genus. Thus, it is always possible to grant objective validity to a possible intervening species between those two. This principle can be indefinitely applied because, from the standpoint of reason, there cannot be immediately adjacent species (A659/B687).

I take Kant to hold that the possible empirical or theoretical concept that expresses the identity of content among two or more concepts of the same order (homogeneity), the division of the content of the same concept (specification), or the relative continuity among the species of the same generic concept (continuity) is created by theoretical reason. These concepts remain possible until the understanding, oriented by reason and together with sensibility, grants them certain objective validity through observation (empirical concept) or experimentation (theoretical concept).[31] Hence, the application of ideas as principles to theoretical concepts may lead to the design of novel experiments.[32]

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[28] Within the framework of the discussion of the principles of specification and continuity, the particular cases of theoretical concepts are not only the corresponding theoretical objects, but also the different empirical objects where the latter are thought of as contained. These empirical objects are considered insofar as they contain the relevant theoretical objects, and in order to obtain indications concerning possible new properties of the latter.

[29] In ATD1, Kant presents an example of the application of the principle of specification in the field of phlogistic chemistry (A657/B685). There, Kant says that the principle of specification made it possible to discover that “absorbent earths are of different species (chalky and muriatic earths)”.

[30] Kant gives the example of the application of the principle of continuity to the laws of the movement of celestial bodies (A662–3/B690–1). For his part, Goldberg (2004, p. 407) proposes an example of the application of this principle taking into account later developments in science. If the mind were equipped with the concepts “carbon-12” and “carbon-14”, the application of such principle would lead to the production of the possible theoretical concept “carbon-13”. See n. 31 below.

[31] I agree on this point with Goldberg and Rauscher, though Goldberg does not distinguish between empirical and theoretical concepts and Rauscher does not sufficiently emphasize this distinction. See Goldberg (2004, pp. 407, 419) and Rauscher (2010, pp. 295–7). In ATD1, Kant writes: “Reason never relates directly to an object, but

3. The grounding of "improper" science

In the previous two sections, I examined two different methodological prescriptions demanded by the regulative function of theoretical reason, as well as their application to phlogistic chemistry. These methodological prescriptions are the requirements of systematicity and of introducing theoretical concepts. In this section, I will deal with the problem of the kind of discipline that requires the application of both methodological prescriptions to be regarded as a science, though in an improper sense. According to Kant, this conception of improper science applies at least to phlogistic chemistry.[33]

Some passages from the Preface to MAN allow us to obtain a better understanding of Kant's conception of phlogistic chemistry and its improper scientific nature. In that Preface, Kant states that the "doctrine of nature" can be

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solely to the understanding […] it does not *create* any concept (of objects) but only *orders* them" (A643/B671). Although this passage seems to contradict the thesis that reason can create concepts of objects, I maintain that the systematizing activity of this faculty involves the creation of possible concepts, in order to be able to fill in the "gaps" in the system of concepts of existing objects and thus to establish relationships among these last concepts. As only the understanding, together with sensibility, can grant objective validity to these possible concepts, this interpretation does not contradict Kant's thesis that reason does not refer *directly* to objects, but to the understanding.

[32] On this conception of experimentation, see Vanzo (2012). On the other hand, in ATD2, Kant examines the regulative function of a different triad of ideas of theoretical reason, i. e., those of the soul, the world and God. In order to perform that function, it is necessary to relate appearances to what Kant calls objects "in the idea" (A670–1/B698–9, A679/B707, A687/B715, A693/B721, A696–8/B724–6). These objects are not existing supersensible objects, independent of the aforementioned ideas, but they constitute the logical content of these ideas, insofar as this content is considered as an object or, more precisely, as a quasi-object (see Caimi, 1996, pp. 76ff. The expression "quasi-object" / "*Quasi-Gegenstand*" is introduced by Zocher. See Zocher, 1958, p. 48). It may be said that these quasi-objects are intentional objects corresponding to those ideas (Allison, 2004, p. 438). According to Kant, we can and must systematically represent empirical objects by relating them to these intentional objects. For example, the intentional object corresponding to the idea of the soul makes it possible and necessary to obtain the greatest possible systematic unity of the determinations of the mind, inasmuch as these determinations are understood as belonging to the same simple and permanent substance (i.e., the soul) and, therefore, as entirely different from outer appearances (A672/B700; A682–4/B710–2. It is important to note that, in this way, we do not gain any insight into what the soul is in itself). In contrast to ideas as principles, the intentional objects corresponding to the ideas of the soul, the world and God are not used to systematize empirical and theoretical concepts and empirical scientific laws, but certain domains or aspects of appearances. Hence, the regulative function presented in ATD2 is not immediately related to laws and concepts such as those of chemistry. In fact, in ATD2, there is no mention of chemistry nor of theoretical concepts. For this reason, and for reasons of space, the regulative function of the ideas of the soul, the world and God will not be further discussed in this article. It is noteworthy that some commentators hold that the regulative functions of the two aforementioned triads of ideas are different aspects of the same theory (Morrison, 1989, pp. 164–6; Caimi, 1995, p. 319; Allison, 2004, pp. 438–9). The divergence between the conceptions of ideas of ATD1 and ATD2 was previously stressed by Zocher (1958, p. 58; 1966, p. 225). I further developed the interpretation of Morrison, Caimi and Allison elsewhere (Arias Albisu, 2012).

[33] Kant does not explicitly say that chemistry is the only improper science. However, the only example of improper science he mentions is that discipline. Additionally, there is not enough space here to further discuss the problem of whether disciplines other than chemistry can be regarded, according to Kant, as improper sciences. See n. 43 below.

divided into "natural science" and "historical doctrine of nature" (MAN, AA 04: 468). Here, I am especially interested in Kant's conception of natural science.[34] This science is classified into proper natural science (i.e., mathematical physics) and improper natural science (i.e., chemistry) (see n. 33). The former contains, as its foundation, a pure part. Such pure part is composed of natural laws of an *a priori* character, and hence reaches apodictic certainty (MAN, AA 04: 468–9). This pure part consists of a transcendental and a metaphysical part. The transcendental part contains the *a priori* laws that determine the form of a nature in general. These *a priori* laws are the principles of pure understanding presented in KrV (for example, the axioms of intuition and the analogies of experience; see A148/B187ff.). The metaphysical part, or metaphysics of corporeal nature, is the *a priori* knowledge about the totality of corporeal objects that can be obtained taking as a starting point a very general empirical concept of matter. This metaphysics is expounded in MAN and it grounds the application of mathematics to the appearances of outer sense (MAN, AA 04: 469–73).

Kant holds that chemistry, in contrast to mathematical physics, is a natural science only in an improper sense. He gives two reasons for this statement. In the first place, chemistry does not have a metaphysical pure part containing apodictically certain laws, but only contains laws of experience, i.e., empirical laws (MAN, AA 04: 468–9). In the second place, mathematics cannot be adequately applied to the domain of chemistry (MAN, AA 04: 470–1).[35] Therefore, "chemistry can become nothing more than systematic art or experimental doctrine, but never proper science" (MAN, AA 04: 471).[36]

In the last quotation, Kant makes a distinction between what is not possible for chemistry to become (proper science) and it is possible for chemistry to become (systematic art and experimental doctrine). As chemistry can reach a scientific status, I propose to interpret the previous sentence in the following way: the scientific status of chemistry is closely related to the experimental and systematic nature of this discipline. More precisely, I will try to show that the scientific character of chemistry depends on its systematic and experimental character. First,

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[34] According to Kant, the historical doctrine of nature contains "systematically ordered facts about natural things" and may be divided into "natural description" and "natural history" (MAN, AA 04: 468). See n. 36 below.

[35] The examination of the sense in which mathematics cannot be properly applied in the field of chemistry lies beyond the purview of this article. On this problem, see Nayak and Sotnak (1995), van den Berg (2011) and McNulty (2014).

[36] I agree with Blomme (2015, pp. 490–1) when he states that, according to V-Ph/Danziger (AA 29: 97–100) and the Preface to MAN (AA 04: 468–70), it is necessary to distinguish between the following disciplines: 1) Natural sciences: 1.1) Mathematical physics (has *a priori* principles and is a proper science) and 1.2) Chemistry (has *a posteriori* principles and is an improper science). 2) Historical doctrines of nature: 2.1) Natural description (no science) and 2.2) Natural history (no science). However, see n. 33 above. For the purpose of this article, it is not necessary to study the difference between natural description and natural history. On this problem, see Sloan (2006).

Kant connects systematicity and scientificity both in KrV[37] and in MAN.[38] Second, in a well-known passage from the Preface to the Second Edition of KrV (Bxii–xiv), Kant explicitly connects the conduction of experiments in Stahlian phlogistic chemistry with a scientific character.[39] In addition, I hold that the systematic and experimental character of phlogistic chemistry depends on the application of the two methodological prescriptions examined in the previous two sections of this article. As regards systematicity, in section 2 I stated that in ATD1 Kant offers examples of the application of the systematizing principles of homogeneity and specification in the field of phlogistic chemistry.[40] As for experimentation, in section 1 I contended that, in the field of Stahlian phlogistic chemistry, there is a connection between the realization of experiments and the employment of theoretical concepts. The hypotheses formulated by means of theoretical concepts pertaining to this chemistry, such as phlogiston, must be tested through experiments.[41] Therefore, the two most important methodological prescriptions examined in ATD1 (i.e., the requirements of systematicity and of introducing theoretical concepts) make improper science possible.

The two aforementioned methodological requirements are not unrelated. Firstly, the requirement of systematicity leads to the formation of a system of theoretical concepts. Secondly, the employment of theoretical concepts in hypotheses concerning empirical chemical laws makes accurate and economical explanations of appearances possible.[42] This simplification can be understood as a

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[37] "[S]ystematic unity is that which first makes ordinary cognition into science, i.e., makes a system out of a mere aggregate of it" (A832/B860).

[38] "Every doctrine, if it is to be a *system*, that is, a whole of cognition ordered according to principles, is called science" (MAN, AA 04: 467).

[39] In that passage, Kant links Stahl's experiment (which was presented in the first section of this article), along with an experiment conducted by Galileo and another one by Torricelli, with a "revolution in the way of thinking" that put natural science in the highway of genuine science. Kant states there that he considers natural science only inasmuch as it is based on empirical principles. According to the new way of thinking, in natural science, understood in that way, reason must approach nature with principles and experiments designed according to these principles. Thus, reason is taught by nature, "but not in the character of a pupil, who lets the teacher tell him whatever the latter wants, but in that of an appointed judge, who compels witnesses to answer the questions that he puts to them" (Bxiii). The opposition between intently listening to all that the teacher has to say and compelling witnesses to answer determinate questions refers to the opposition between "accidental observations, made according to no previously designed plan" and the carrying out of experiments in accordance with a determinate plan.

[40] See nn. 25, 27 and 29 above. As regards the systematicity of the fundamental part of mathematical physics, see n. 23 above.

[41] I maintain that, for Kant, empirical psychology cannot be considered as a science, even in an improper sense, because it is not possible to conduct neither experiments nor rigorous observations in the domain of inner sense (see MAN, AA 04: 471; and n. 25 above). It is true that empirical psychology can acquire a systematic form. However, this psychology consists in a *description* and *classification* of inner appearances. In fact, Kant holds that empirical psychology belongs to "natural description", which in turn belongs to the "historical doctrine of nature" (see MAN, AA 04: 468; and nn. 34 and 36 above). Thus, this *classificatory* system of inner appearances is different from the *explanatory* system of empirical chemical laws. The hypotheses concerning these laws are formulated in order to explain appearances, and they must be tested through experiments. See n. 33 above.

[42] See section 1 and n. 23 above.

necessary condition for the formation of a system of such laws. In fact, if those hypotheses are successfully empirically tested, they can be integrated in unified and coherent systems of empirical chemical laws. Thirdly, the application of the systematizing principles of reason may lead to the postulation of new theoretical objects. The hypotheses that employ the theoretical concepts that refer to these objects must be tested through experiments (see section 2). As a result, the requirements of systematicity and of introducing theoretical concepts can be interpreted as elements of the same methodology.[43]

Now, I will argue that the application of the aforementioned methodology makes improper science possible because it grounds the regulative necessity of laws belonging to this kind of science. At the beginning of the third section of the System of the Principles of Pure Understanding (KrV), Kant writes:

> Even laws of nature, if they are considered as principles of the empirical use of the understanding, at the same time carry with them an expression of necessity, thus at least the presumption of a determination by grounds that are *a priori* and valid prior to all experience. But without exception all laws of nature stand under higher principles of the understanding, as they only apply the latter to particular cases of appearance. (A159/B198).

According to this passage, even empirical laws of nature can be regarded as necessary. In this way, such laws are at least presumed to be determined by "grounds that are *a priori* and valid prior to all experience". These laws are particularizations of the principles of the pure understanding, but they cannot be deduced from them alone (cf. B165, A216/B263). I hold that the *a priori* grounds mentioned by Kant in the quoted passage are the ideas of reason that make the

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[43] Friedman holds that MAN shows "how the domain of the properly empirical can be determinately grounded in the transcendental concept of a nature in general." MAN "accomplishes this for the particular case of the Newtonian theory of gravity—by applying the transcendental principles of the understanding to the empirical concept of matter and thereby grounding the empirical law of universal gravitation." (Friedman, 1992a, p. 263). There is no space here to discuss Friedman's interpretation. (It is worth considering the different readings of Buchdahl, Butts and Wartenberg. See Buchdahl, 1965, pp. 202, 207–8; 1971, pp. 34–44; Butts, 1986, pp. 190ff.; and Wartenberg 1979, pp. 412–3; 1992, pp. 240–1. In ATD1, Kant gives the example of the systematization of the laws of the movement of celestial bodies, and he briefly alludes to gravitational force as the cause of them. See A662–3/B690–1. However, I am not acquainted with enough textual basis to be able to value Buchdahl and Butts' proposal that gravitational force is a theoretical concept of the same order as the others. See Buchdahl, 1967, p. 217; 1992, pp. 258, 264–5 and Butts, 1986, pp. 190ff.). Here I would like to stress that, according to Friedman (1992a, pp. 174ff., 240–2, 250ff., 263–4, 266–7), sciences such as Stahl's chemistry and the totality of the purely experimental part of physics are not comprehended by MAN's grounding. Furthermore, Friedman (1992a, p. 239, n. 38) states that, in the eighteenth century, those disciplines belonging to "experimental physics" were distinguished from those belonging to "mathematical physics", i.e., rational mechanics, optics, astronomy and Newton's theory of universal gravitation. Finally, Friedman (1992a, pp. 263–4) maintains that one of the goals of OP is to provide a foundation for the emerging new sciences of light, heat, magnetism and electricity, as well as for Lavoisier's anti-phlogistic chemistry (see pp. 264-341. Friedman affirms that Kant adopted Lavoisier's system "by 1795 at the latest"; p. 289). There is no space in this article to examine the problem of whether Kant, in the period of KrV and MAN, considers Stahlian phlogistic chemistry in isolation or as part of the group of disciplines that Friedman calls "experimental physics". On the problem of Kant's conception of chemistry in OP, see also McNulty (2016). Further discussion of this conception is beyond the purview of the present article.

systematization of the cognitions of the understanding possible, as well as the ideas of reason employed in the hypotheses pertaining to improper science, that is, theoretical concepts.[44]

Furthermore, in ATD1 Kant states: "Accordingly, this idea [MAA: that is, of the form of a whole of cognition] postulates complete unity of the understanding's cognition, through which this cognition comes to be not merely a contingent aggregate, but a system interconnected in accordance with necessary laws." (A645/B673). This passage can be understood in the following way: only the empirical scientific laws that are part of the complete system of empirical cognitions can be regarded as necessary. As I have already remarked, although this system directs the operations of the understanding, it is an unreachable goal for them.[45]. Anyway, I think that an empirical scientific law formulated by means of theoretical concepts can be considered as necessary if it is integrated in a system of laws of that kind, because in this way it is possible to *assume* that this law could be integrated in the complete system of such laws. However, the system of laws in which the law in question would be integrated could be falsified in the future, or be replaced by another system with more explanatory power or capable of producing more precise explanations. Consequently, empirical scientific laws, such as those of chemistry, cannot ultimately attain, in our finite experience, nothing more than what may be called a "regulative necessity". This necessity is regulative because it presupposes the application of the methodology demanded by the regulative function of theoretical reason. Empirical scientific laws can attain higher degrees of precision, simplicity and explanatory power than empirical generalizations, because the former employ theoretical concepts and can thus be integrated in strictly consistent systems. On the other hand, empirical generalizations are not necessarily connected, or even consistent, among themselves. Moreover, these generalizations do not usually have a wide and accurate explanatory power (see n. 23 above). Therefore, in contrast to empirical scientific laws, such generalizations cannot even be *supposed* to belong to the complete system of cognitions of the understanding, and thus, they cannot be considered as regulatively necessary.

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[44] Hence, I agree with Buchdahl when he states that both the demand for systematicity and the requirement of introducing what I call here "theoretical concepts" are conditions of a certain necessity of empirical scientific laws that can be denominated "empirical" or "regulative". This necessity is different from the "constitutive" or "transcendental" necessity of the pure principles of the understanding. However, Buchdahl unilaterally emphasizes the demand for systematicity and does not address in detail the problems of the characteristics of these two methodological requirements and of the relationships between them. See Buchdahl (1965, 1967, 1969). In a subsequent article (1971), Buchdahl considers only the requirement of systematicity.

[45] Rush (2000, pp. 846–7) holds that the total system of empirical laws would be truly necessary in virtue of its exclusivity. Such systematic totality cannot be attained in experience. However, as the system approaches completion it rules out competing empirical theories and, "to the extent it does this, the system and its laws seem exclusive and a fortiori necessary." (p. 847). I think Rush's interpretation helps to explain why the empirical laws belonging to a complete system of cognitions of the understanding would be truly necessary. For a similar interpretation, see Kitcher (1994, pp. 267–8).

I have argued that Kant considers that the scientific character of improper science (that is, at least, phlogistic chemistry) is grounded by the application of methodological requirements demanded by the regulative use of ideas of theoretical reason. In virtue of this application, empirical laws belonging to improper science attain regulative necessity. I will finish this section by showing that my reading is more comprehensive than the three different kinds of interpretations that I sketched at the beginning of this article.

In the first place, Friedman holds that the necessity of the aforementioned laws can derive solely from an *a priori* foundation in the transcendental principles of the understanding. These principles must be specified into the metaphysical principles of pure natural science. This is accomplished in MAN by the application of the principles of the pure understanding to the empirical concept of matter. In this way, one grounds the highest empirical law (universal gravitation). According to Friedman, the role of theoretical reason (or the reflecting power of judgment)[46] is to systematize the manifold of empirical laws under more and more general empirical laws in order to "approximate to the *a priori* necessity issuing from the understanding and from the understanding alone." (Friedman 1992b, p. 190. See also Friedman 1992a, 1992c, 2014). In other words, empirical laws, such as those of chemistry, must be brought into connection with the metaphysical principles presented in MAN in order to be regarded as necessary. I maintain that this interpretation cannot explain the passages from Kant's works where the necessity of empirical laws is connected with the requirement to achieve the highest possible systematicity of knowledge (see the passage from A645/B673 quoted above).[47] On the other hand, Friedman's interpretation of the status of the Newtonian theory of universal gravitation need not be discussed here, because in this article I am only interested in improper science (see n. 43 above).

The second and third kinds of interpretations were proposed, with differences in detail, by several commentators. According to the second group of interpretations, the necessity of empirical laws derives mainly from the application of the requirement of systematization (Buchdahl, 1965, 1967, 1969, 1971; Kitcher, 1986, 1994; Krausser, 1987, 1989; Rush, 2000; Santos Garcia, 2004). According to the third group of interpretations, such necessity depends mainly on the application of the requirement of introducing theoretical concepts (Brittan, 1992; McNulty,

[46] The examination of the transcendental principle of the reflecting power of judgment presented in KU lies beyond the scope of the present article.

[47] As regards KU, see AA 05: 179–80. In this passage, Kant connects the necessity of empirical laws with a principle of the systematic unity of these laws that can be understood as the transcendental principle of the reflecting power of judgment (see AA 05: 180–6). Allison (1994, pp. 303–5) remarks the importance of this passage in his critique of Friedman. Allison focuses on two articles published by Friedman in 1992 (i.e., 1992b and 1992c). Friedman considers that passage in an article published in 2014 (pp. 545ff.), but he still holds that the necessity of empirical causal laws can arise only from the constitutive operations of the understanding (pp. 545, 553).

2015).[48] Above, I argued that the regulative necessity of empirical scientific laws, such as those of chemistry, requires the application of the two aforementioned requirements. Therefore, these two groups of interpretations must be rejected because they do not give the same importance to those two methodological prescriptions.

Conclusion

I hope to have shown that, for Kant, two methodological prescriptions demanded by the regulative function of theoretical reason must be applied to, at least, concepts and hypotheses of phlogistic chemistry. The first methodological prescription is the requirement of employing theoretical concepts in hypotheses, and the second one is the requirement of systematicity for empirical and theoretical concepts and the hypotheses formulated by means of the latter. These requirements can be understood as elements of the same methodology. The application of this methodology grounds the regulative necessity of empirical laws belonging to improper science, that is, at least, phlogistic chemistry. Indeed, the regulatively necessary character of these laws, and hence the scientific nature of improper science, depends on a determinate systematic and experimental character of this science, and this character depends on the application of the aforementioned methodology. In fact, the systematic character of improper science depends on the application of reason's regulative requirement of systematicity, and the experimental character of this science depends on the application of reason's regulative requirement of introducing theoretical concepts. This interpretation accounts for more passages from Kant's texts than the three different kinds of interpretations discussed in section 3.

[48] It is worth mentioning that, while Friedman thinks that the necessity of empirical scientific laws depends on a connection between these laws and (ultimately) the categories effected by the application of the requirement of systematicity, McNulty holds that this necessity depends on a connection between those laws and the ideas of reason, which I call here "theoretical concepts", effected by the application of this requirement. By contrast, I maintain that the regulative necessity of empirical scientific laws derives from the possibility of integrating them in a system of laws of that kind, and that this possibility equates to the formulation of these laws by means of theoretical concepts and the successful empirical testing of such laws.

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Abstract: In the Preface to his *Metaphysical Foundations of Natural Science*, Kant holds that empirical disciplines, such as –at least– chemistry, are *improper* natural sciences. What he has primarily in mind is the phlogistic chemistry mainly developed by Georg Stahl. Contrary to mathematical physics, phlogistic chemistry is not a *proper* natural science because it lacks a metaphysical pure part and mathematics cannot be adequately applied to its domain. The aim of this article is to show that the scientific character of improper sciences, such as –at least– phlogistic chemistry, depends on the application of two methodological prescriptions demanded by the regulative function of theoretical reason. These prescriptions are presented by Kant in the Appendix to the Transcendental Dialectic of his *Critique of Pure Reason*. The first prescription requires the use of certain ideas of reason in empirical scientific laws. The second one consists in a demand of systematicity for those laws.
Keywords: Kant, "Improper" Science, Laws, Foundation, Regulative

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