

Kant's functional cosmology.

Teleology, measurement, and symbolic representation in the *Critique of Judgment*

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Abstract

In the 1780s Kant's critique of rational cosmology clearly identified the limits of theoretical cosmology in agreement with the doctrine of transcendental idealism of space and time. However, what seems to be less explored and remains still a *desideratum* in the literature is the thorough investigation of the implications of transcendental philosophy for Kant's view of cosmology in the 1790s. This contribution fills this gap by investigating Kant's view of teleology and measurement in the *Critique of Judgment* and explores their implications for Kant's late view of cosmology. By considering the historical and scientific context in which Kant developed his reflection, I advance the proposal to read Kant's late view of the universe in terms of "functional cosmology".

Keywords: Kant, cosmology, measurement, symbolic representation, teleology

Acknowledgement

This result is part of the PROTEUS project that has received funding from the European Research Council (ERC) under the Horizon 2020 research and innovation programme (Grant agreement No. 758145).

1. Introducing Kant's foundations of cosmology

Kant's interest for cosmology assumed deep relevance for the elaboration and development of his theoretical and moral philosophy and shaped the way in which he addressed metaphysical and epistemological questions. Not only did Kant author a cosmogony and cosmology in 1755, titled *Universal Natural History and Theory of Heavens*, but he further investigated the foundations of cosmology and developed a critique of rational cosmology in the 1780s.¹ In the *Critique of pure Reason*, Kant maintains that the antinomy of pure reason in its cosmological ideas can be removed by showing that it is a conflict due to an illusion arising from the fact that “one has applied the idea of absolute totality, which is valid only as a condition of things in themselves, to appearances that exist only in representation, and that, if they constitute a series, exist in the successive regress but otherwise do not exist at all” (Kant 1787/1998, 519). The resolution (*Auflösung*) of the conflict generated by the mathematical antinomies (Kant 1787/1998, 524-528) is based on a cosmological principle considered as a rule compatible with transcendental philosophy and its pillars. The cosmological principle is a regulative one (Kant 1787/1998, 520-524) and prescribes a regress in the series of conditions for given appearances, in which regress it is never allowed to stop with an unconditioned (Kant 1787/1998, 520). Furthermore, Kant added that the only allowed regress to admit in cosmology “extends

¹ The relevance of the transcendental dialectic is the object of an ongoing and rich debate in Kant studies aiming at the re-evaluation of its positive implications for the metaphysical foundations. For a recent summary, see (Meer 2018).

indeterminately far (*in indefinitum*)” and not to a mathematical infinity (Kant 1787/1998, 522).² Nevertheless, despite being a critique of rational cosmology, the *Antinomy of pure Reason* cannot be read as the *pars construens* of Kant’s cosmology. As a matter of fact, in 1791 Kant agreed with the publication of a short excerpt of his cosmological work edited by J. F. Gensichen and titled *Auszug aus Kants Naturgeschichte und Theorie des Himmels*. This move shows that Kant did not repudiate cosmology *tout court* and accepted a *pars construens* for it. Indeed, thanks to the exceptional results on the study of nebulae prompted by the observations of William Herschel in 1780s and early-1790s (Hoskin 1979), an important step in the history of observational cosmology led Kant to investigate the foundations of cosmology by including the results of the *third Critique*. This resulted in deepening the foundations of the *pars construens* of a practical understanding of the universe based on the concept of natural end, as well as on the capacity of representing the universe as a whole through analogy to build up our knowledge in view of experience (*Erkenntnis für die Erfahrung*).³ In his correspondence with Christian Garve (21 September 1798), Kant presented the concept of “World” (*Welt*) and the dilemmas associated to its representation as a fundamental guideline to interpret his own work (see Kant 1999, 551-552). Furthermore, we have evidence that in the preparatory manuscript of *What real progress has metaphysics made in Germany since the time of Leibniz and Wolff?* (1793/1804),⁴ Kant devoted attention to the antinomies of pure reason and indicated them as a fundamental step in the history of German metaphysics (see Allison and Kant 2002). Indeed, in the 1790s Kant proceeded in spelling out that the progress of German philosophy coincided with the architectonic and systematic unity of theoretical and practical reason under the concept of purposiveness of Nature (Allison and Kant 2002, 382-383).

² For a detailed analysis of the difference between indefinite and indeterminate series in the first Critique, see De Bianchi (2015).

³ Not only in *Critique of Judgment*, but also in (Allison and Kant 2002), Kant remarks that knowledge in view of experience must include schematism by analogy that embodies the reality of the idea for the pure practical reason and its use.

⁴ The manuscript appeared posthumous in 1804 and was edited by Friedrich Theodor Rink.

Therefore, in order to grasp the features of Kant’s late cosmology and its foundations based on a teleological approach,⁵ we should primarily consider the *Critique of Judgment* (1790). A previous article by (Nesteruk 2012) attempts at framing cosmology within the teleological picture drawn by Kant, but in my contribution, I suggest that to reconstruct Kant’s late cosmology one should also consider his reflections on measurement (Kant 1790, 137-140) and symbolic hypotyposis (Kant 1790, 225-228) contained in the third *Critique*. Indeed, to attribute objective reality to the World as unconditioned and as a totality is contrary to the spirit of the purified theoretical reason, but it is not the case from the standpoint of practical reason and for the regulative use of the reflective power of judgment. To symbolize the universe as a whole as if it were an organism, for instance, or to think of it by analogy as a system of systems whose unit measure is the infinite is not prohibited, provided that this representation is not the result of our determining power of judgment and schematism, but rather the one of a symbolic hypotyposis, which by means of an analogy does not offer knowledge, but awareness of our supersensible destination as practical beings. Furthermore, to highlight the interrelation— so far not very much explored by the literature – between symbolic hypotyposis, practice of measurement and cosmology is very intriguing to capture a fundamental tension between Kant’s approach to cosmology and the revival of Platonic and Neoplatonic studies of that time⁶ that were inspiring guiding principles of hylozoism and pantheism (Zammito 1992).⁷ Indeed, previous studies on different forms of teleological explanation, such as (Woodfield 1976) and

⁵ Of course, an approach devoid of contradictions generated by an objective teleology.

⁶ In between 1785 and 1794, taking the cue from William Herschel’s observations, Kant tried to ground observational cosmology on a solid basis by developing both transcendental and epistemological principles that could drive empirical investigation (De Bianchi 2013, 2016, 2018). Contrary to some research strains in both the Royal Society and to early idealist in Germany, he firmly rejected the idea of explaining the arrangements of the planets in the solar system on the ground of number theory and proportions and to use them as primary heuristic tools in scientific research.

⁷ The term derives from ancient Greek: ὕλη, *hýlē*, “matter” and ζοή, *zoé*, “life”, it refers to the doctrine that conceives matter as a living dynamic force that possesses animation, movement, and sensitivity without any intervention of external animating principles. Hylozoism represented the whole world as a living thing endowed of *anima mundi* with a clear reference to Platonism. A British Platonist, Ralph Cudworth (1617-1688), used this term for the first time with reference to Strato of Lampsacus and Spinoza.

(Ariew 2002) support the need of a reinterpretation of Kant's approach to cosmology in the 1790s as a reply to other Neoplatonic stances.⁸ In particular, I argue that in the *Critique of Judgment* Kant laid down the foundations of transcendental cosmology, an approach that I have called "functional cosmology" (De Bianchi 2021). Thus, after framing Kant's late reflections on cosmology within the debates surrounding hylozoism and Platonism (Section 2), I spell out the characteristics of Kant's functional cosmology (Section 3). Section 4 deepens the interrelation between Kant's critique of rational cosmology and the third *Critique*, by exploring the impact of his reflections upon teleology and measurement on his late view of cosmology. In fact, there is an advancement with respect to the discussion and critique of rational cosmology supported by Kant until 1787. In 1790 Kant opens the path for an approach to cosmology that has to do with system analysis and functional explanation shaped by the principle of purposiveness (*Zweckmässigkeit*), by our capacity of symbolizing super-sensible objects, as well as by the necessity of systematically connecting natural and moral philosophy.

2. Kant's late cosmology as a reply to hylozoism

As (Zammito 1992) underlined, the early German Idealism was dominated by the question of determining the origin of culture in the Ancient World and the primacy was assigned to the Greeks. This debate, which included scholars in the German academy and in England, was the outcome of the flourishing philosophical studies of Plato's works in the 1780s and 1790s. Plato's dialogues were considered in the light of positions either asserting vital principles of matter depending on the world soul or the implementation of doctrines of intellectual intuition and the dropping of Kant's tenet of the clear separation between intuition, understanding and

⁸ For a study on the renaissance of Platonic studies in England and continental Europe at the end of the 18th century see (Gatti 2007).

reason. The second move corresponds to a position that can be ascribed, at least from Kant's standpoint, to *Schwärmerei* rather than to hylozoism *per se*. For the sake of space here, I just mention that Kant's criticism of *Schwärmerei* engaged him for many years, especially after the publication of the *first* Critique (Hinske 1988a)⁹ and that within Kant's list of its proponents also appeared the name of Plato.¹⁰ It is not my intention to reconstruct all the debates surrounding the edition of Plato's dialogues and Neoplatonic works in 1780s and 1790s, but I want to emphasize two main points. Soon after the publication of the *Zweibrücke* edition of Plato's work in the early 1780s, a great interest for Plato's cosmology had grown together with philologic and monographic studies on his dialogues. A clear example of it is Dietrich Tiedemann's *Dialogorum Platonis Argumenta exposita et illustrata* (1787), but more importantly, one should notice that in the early 1790s the systematic interpretation of Plato was used to establish and test Kant's idea of a history of pure reason, as clearly emerges from the work of Wilhelm Gottlieb Tennemann (1791). In *On a recently prominent tone of superiority in philosophy* (1796) Kant argued that Plato asked the question of synthetic a priori judgments but didn't rely on transcendental idealism of space and time, rather on intellectual intuition to grasp the ideal character of interactions and attributed it to things in themselves rather than to phenomena (see Kant 1796/2002, 437-438). This interpretation of Plato's theory of knowledge is trivial, as Kant himself recognized, but helps us in understanding why, in Kant's view, exponents of *Schwärmerei* tried to use Plato's philosophy¹¹ to shape their theory of matter soul to go beyond transcendental philosophy. Furthermore, Plato's dialogues, in particular the *Timaeus*, by means of metaphors and analogies, highlighted similar problems that astronomers

⁹ The definition of *Schwärmerei* offered by Kant refers to those who "throw away reason and experience as the [only vehicles] rudder of knowledge and to venture out onto the ocean of knowledge that goes beyond the world" (translation is mine), see (Hinske 1988b).

¹⁰ In (Hinske 1988b), Kant's list of proponents of *Schwärmerei* includes Antoinette Bourignon, Pascal, Swedenborg, Pietists, Herrnhuter, Böhme, Jeanne Marie Bouvier de la Motte-Guyon, Sebastian Frank, Plato, Rousseau, St. Pierre and Lavater.

¹¹ In Plato's *Timaeus*, published in the *Zweibrücke* edition in 1786, the cosmos is portrayed as a living thing, an organized whole endowed of the structure of the world soul.

had at the end of the 18th century, i.e. to justify the arrangement of the stars and planets exactly as they are and to measure their relative distances or the plurality of elements constituting the moving forces of matter.¹² The Platonic organicist view of the cosmos not only influenced the reflection of theologians, natural scientists, and philosophers, but inevitably stimulated Kant's reply. Indeed, Kant not only took part polemically against the Spinozism of Jacobi, Herder and Maimon (Lord 2011), but also against any hylozoism representing matter as animated by the soul as it emerges in the *Critique of Judgment* (Kant 1790/2000, 246-247; 263). Thus, from the second half of the 1780s, Kant was pressed to provide an alternative view to hylozoism and to organicism applied to cosmology. An attempt that failed to a certain extent as (Zammito 1992, 12-13) underlined, because of the misinterpretation of Kant's doctrine of natural end and principle of reflective judgment in its regulative use.¹³ When referring to hylozoism in §§ 72-73 of the third *Critique*, Kant labels any doctrine that grounds natural ends on an analogue faculty that can act with intention and is believed to be within matter itself resulting in a "spiritualization of matter" (Zammito 1992, 192). Among the contemporary targets of his criticism is Johann Gottfried Herder's notion of 'Kraft' appearing in *Gott einige Gespräche* (1787), in which a pantheistic vision of the universe is provided together with the appreciation for the Platonic doctrine of the immortality of the soul (Nisbet 1970, 11). To sum up, Kant's critique of objective teleology aimed at defending the pillars of his transcendental dialectic, but it also aimed at showing that the history of pure reason moved toward the direction of his transcendental positions and that cosmology should not have been based just on pure numbers, theory of proportions and speculations on animated matter, but on observations and the application of the laws of physics and a complex theory of matter. However, the substantial problem was to develop a theory of provisional judgment and a heuristic when observations

¹² For instance, see (Wünsch 1778 – 1779, 1791, 1794).

¹³ Kant's alternative to hylozoism relied on the assumption of the concept of the technique of nature, which however, is just a heuristic tool that we use to think of the unitary generation of natural products. For a detailed discussion, see (De Bianchi 2011).

were not available and could not have been immediately related to physical laws. What kind of principles can guide our experience in agreement with the limits of our faculties when talking about the internal structure of the cosmos? This question concerned, for instance, the way in which the systematic structure of the galaxies could have been interpreted in relationship to the whole universe, but it also represented the need of our reason to continue the investigation of the world in which we live and act by following other than constitutive principles.

3. Grounding Kant's functional cosmology

Thus, the first property of what I label as Kant's "functional cosmology" has to do with our way of talking about the universe according to the regulative principle of the reflective power of judgment, e.g. purposiveness, and should implement a pragmatic knowledge that Kant calls '*Erkenntnis für die Erfahrung*' in the 1790s. In the *Critique of Judgment*, Kant borrowed terms from Platonism, e.g. hypotyposis, but attributed to them a different meaning to elaborate his doctrine of symbolic exposition, which is fundamental to present the cosmos in analogy with the idea of life and as an organized whole without explaining the underlying mechanism for its organization and without attributing intentionality to matter (De Bianchi 2021). The need of recognizing a special status to the object of cosmology, i.e. the universe as a whole in which we live and act, together with the insight that objective teleology was insufficient to ground any acceptable approach to cosmology worked as engines for the elaboration of Kant's functional cosmology. In order to make a discourse regarding the universe in agreement with transcendental philosophy and in view of pragmatic knowledge only a symbolic hypotyposis of the cosmos as a whole was acceptable (see Kant 1790, 225-226; Allison and Kant 2002, 369-370, 411-412). According to Kant, "our language is full of such indirect presentations, in

accordance with an analogy, where the expression does not contain the actual schema for the concept but only a symbol for reflection” (Kant 1790, 226).

Second, one notices that symbolic hypotyposis occurs when concepts of reason are involved, i.e. ideas, and that the power of judgment only imitates what the understanding does in the schematic hypotyposis with respect to the procedure and not with respect to the conceptual content determined by the understanding. In other words, according to Kant, symbolic presentation of ideal content is possible only thanks to a form of analogical reasoning. This applies to concepts of reason, such as the idea of totality as a whole and therefore to the universe as *Weltall* that can be presented for instance “as if it were” a living thing and its parts could be then represented as its organs.

Thus, the second property of functional cosmology consists in representing the part-whole relation of the universe structuring the way in which we think of the latter as a system of systems. This definition of the universal structure already appeared in Kant’s cosmology in 1755, but received philosophical grounding in 1790 only, when Kant interpreted the observations of new astrophysical objects, such as nebulae (De Bianchi 2016, 2018). Thanks to William Herschel’s observations, Kant realized that his hypothesis regarding the multiplicity of galaxies to be systems like our Milky Way was highly plausible. Therefore, he also wanted to provide a possible way of judging and advancing in our knowledge of the observational universe. In other words, a function must have been attributed to such a systematic organization of the world, but a universally known mechanism generating and disposing galaxies in the way they are was not available. Whether there was a divine design or not behind it, its meaning and implications were fundamentally unknown. Whether there was a physical ground for the collocation and distances of galactic systems was not entirely describable by means of gravitational effects, and other hypotheses had to be employed, such as those implying the existence of the aether endowed with a repulsive force continuously acting and determining the

expansion of the universe.¹⁴ However, in 1790, Kant more prudently suspended his judgment and in the didn't explicitly talk about the cosmic aether (Falkenburg 2020, 210; De Bianchi 2013, 17-45; Ferrini 2004). Especially when a suitable physical explanation for the constitution and dynamics of the universe is not available, Kant's functional cosmology offers the possibility to build up a discourse about the cosmos, according to which one should not consider astronomical objects, e.g. the Sun, from a purely mechanical standpoint but also from a functionalist one, as being part of an organization (see Kant 1790, 246 footnote). The same holds for galaxies or nebulae, once we assume that what counts in judging of the organization of the universe are the questions: "How do I consider this object X as not only means but also end of a certain structure?" or "What is the function of a certain object X that I can consider as means and end to the organization of the universe?". In other words, Kant's approach suggested to ask questions regarding the function that a certain celestial body has within the whole organization of the system it lives in. This approach did not survive in modern cosmology, in so far as we do not ask questions, such as "what purpose serves a black hole at the centre of our galaxy?" or "what is the function of galaxies with respect to the whole cosmic structure?". These questions are not posed in these terms nowadays and therefore are questions without an answer, but they show that it is perfectly possible to look at the universe and ask different questions as those formulated following the ground of what Kant called the "determining power of judgment". However, Kant's view is even deeper than this. Indeed, if we consider astronomical objects as ends *per se*, we can also judge of them by looking at their beauty only. In other words, thanks to his theory of symbolic hypotyposis and doctrine of reflective power of judgment, Kant provided a systematic account of the reason why we find a connection between astronomical observation and beauty, or between cosmological and moral

¹⁴ In the absence of the identification of this ground and physical laws governing the observed phenomena, only the assumption of the concept of a technique of nature and an exposition of the systematic order of the cosmos in terms of system analysis could be allowed in agreement with transcendental principles.

considerations. Therefore, Kant's functional cosmology is an approach that builds up a bridge between science, morals, and aesthetics by means of the elaboration of the notion of symbolic hypotyposis and by admitting only a limited teleological perspective. There is, however, a third ingredient that Kant needed to justify a symbolic presentation of the universe, and, as shown in the following Section, this consists in giving a more detailed account of measurement.

4. From the Antinomy to the functional explanation of the universe

As recalled in Section 1, the relevance of the concept of the 'World' for the elaboration of Kant's antinomy and the entire edifice of his philosophy. In his Critical writings Kant connects the idea of the World to the foundations of producing regressive spatio-temporal or numerical series, but he was not the first in doing so. It is worth mentioning that the definition of the world in terms of the totality of a series can be found in Weigel's *Philosophia Mathematica* (Weigel 1693, 368), which certainly influenced the definition of the world provided by Leibniz in a letter to de Bosses dated 20th November 1708, and Wolff's definition of cosmology in his *Cosmologia rationalis*.¹⁵ A systematic account of "Cosmologia," however, already appeared when Erhard Weigel published *Cosmologia nucleum Astronomiae & geographiae, ut & usum Globorum* in 1680 and even earlier Johannes Scharf had published *Cosmologia seu Disputatio Physica de Mundo* in 1625.¹⁶ In (Weigel 1693, 55-57) the notion of *Mundus* is intrinsically connected to time (*tempus*), and the section *Phoronomy* deals with the notion of universe ($\pi\alpha\nu$) as totality (Weigel 1693, 366-368). The first definition of World implies a givable series, the second one represents a given totality of the members of the series. In the latter, *Mundus* can

¹⁵ In this work, Wolff introduced the term "Teleology" as a special branch of physics, defining it as "part of natural philosophy which studies the ends of things". Teleology responds to the metaphysics of the natural world, or Cosmology and is propaedeutic to Natural Theology, to which Teleology stands as "experimental natural theology." For our purposes, it is relevant to consider that Kant's critique of rational cosmology also represented a critique of the way in which Wolff portrayed the relationship between cosmology and teleology.

¹⁶ For further details on this point, see (Brancato 2016b).

be understood ordinaliter and/or cardinaliter and its representation is explicitly related to the generation of number series. Thus, it is no surprise that Kant's critique of rational cosmology is an attempt to spell out the limits of the foundations of mathematics of Leibniz's master and successors.¹⁷ Kant's critique concluded that the concept of infinity that they applied to the universe as a whole is mathematical rather than philosophical (Kant 1787/1998, 521ff.) and that a cosmology purified of dilemmas should never apply the notion of mathematical infinity to the totality of the members of an empirical regressive spatio-temporal series. However, at Kant's time, Weigel was not just considered one of Leibniz's masters and sources of inspiration for Wolff, he was also considered an eminent scholar who diffused Pythagorean and Platonic doctrines in Germany in the second half of the seventeenth century. Therefore, if one really wants to deeply grasp the implications of Kant's antinomy of pure reason and its link to the elaboration of transcendental cosmology in the early 1790s, one should deepen Kant's critique of Leibniz's work on the notion of infinity and his theory of arithmetic influenced by his master Erhard Weigel and British Platonism (Mercer 1996, 2007). Indeed Kant's big change of perspective on the foundations of cosmology included the elaboration of a doctrine of measurement compatible with observational cosmology and with the limited teleological approach that Kant attributed to functional explanation in the *Critique of Judgment*. According to the latter any astronomical ensemble should be considered as a subsystem of a larger one and so forth indefinitely and can be represented as a part functional to the organization of the whole.

Let us first consider how Kant presents the universe in 1790. In the Sections devoted to the sublime, Kant presents the notion of what is absolutely great beyond comparison. Intuitively, this definition not only applies to the sublime, but also to the universe and this follows from

¹⁷ For a reconstruction of Leibniz's education and the impact of Weigel's work, see (Mercer 1999) and (Habermann and Herbst 2016).

the fact that there is nothing external to the universe that can be used to compare its magnitude (see Kant 1790/2000, 131-132). The universe as a unique object is certainly an absolute as a whole, and in its totality cannot be known by pure theoretical reason. It is immeasurable, as stated in the following passage:

“Examples of the mathematically sublime in nature in mere intuition are provided for us by all those cases where what is given to us is not so much a greater numerical concept as rather a great unity as measure (for shortening the numerical series) for the imagination. A tree that we estimate by the height of a man may serve as a standard for a mountain, and, if the latter were, say, a mile high, it could serve as the unit for the number that expresses the diameter of the earth, in order to make the latter intuitable; the diameter of the earth could serve as the unit for the planetary system so far as known to us, this for the Milky Way, and the immeasurable multitude of such Milky Way systems, called nebulae, which presumably constitute such a system among themselves in turn, does not allow us to expect any limits here. Now in the aesthetic judging of such an immeasurable whole, the sublime does not lie as much in the magnitude of the number as in the fact that as we progress we always arrive at ever greater units; the systematic division of the structure of the world contributes to this, representing to us all that is great in nature as in its turn small, but actually representing our imagination in all its boundlessness, and with it nature, as paling into insignificance beside the ideas of reason if it is supposed to provide a presentation adequate to them” (Kant 1790/2000, 140).

Thus, the universe is a very peculiar object, even from a metaphysical standpoint, because contrary to the idea of the Soul or the idea of God, we know that at least parts of what we call “universe” exist, e.g. galaxies. Furthermore, we can measure its parts and we can have an empirical and observational approach to the study of its inner structure, by using appropriate

standards and units. Moreover, the previous passage clearly shows how the aesthetic judging of the universe as a system of systems of astronomical objects leads to our awareness of a supersensible and moral destination as human beings. But how can we reconcile Kant's statement regarding our possibility of symbolically presenting the organized structure of the universe with his critique of rational cosmology? The answer, I claim, is in the theory of apprehension and measurement spelled out in the third *Critique*. In Kant (1790/2000, 137) measuring is presented as "something objectively purposive in accordance with the concept of an end" but certainly not as something pleasing for the aesthetic judgment. Measuring the universe is not pleasant, but certainly teleologically relevant for human reason and it is unavoidable. The justification for this claim is offered in the same passage where Kant describes how imagination proceeds in treating magnitudes:

"There is also in this intentional purposiveness nothing that would necessitate pushing the magnitude of the measure and hence the comprehension of the many in one intuition to the boundaries of the faculty of imagination and as far as the latter might reach in presentations. For in the understanding's estimation of magnitudes (in arithmetic) one gets equally far whether one pushes the composition of the units up to the number 10 (in the decadic system) or only to 4 (in the tetradic system); the further generation of magnitude in composition, or, if the quantum is given in intuition, in apprehension, proceeds merely progressively (not comprehensively) in accordance with an assumed principle of progression. In this mathematical estimation of magnitude the understanding is equally well served and satisfied whether the imagination chooses for its unit a magnitude that can be grasped in a single glance, e.g., a foot or a rod, or whether it chooses a German mile or even a diameter of the earth, whose apprehension but not composition is possible in an intuition of the imagination (not through *comprehensio aesthetica* though certainly through *comprehensio logica* in a numerical

concept). In both cases the logical estimation of magnitude proceeds unhindered to infinity” (Kant 1790/2000, 138).

At stake here is the problem of producing series in the progress of apprehension exactly as it was the case for the description of the synthetic activity in the first two antinomies of pure reason. The inextricable link between the production of series of judgments in syllogisms and number series according to a rule is confirmed by Kant in 1790 and once again the cosmological problem is related to the foundations of computation. Second, the reference to the possibility of using decadic or tetradic system as a basis for the estimation of magnitudes is reminiscent of the debates between Leibniz and Weigel on the foundations of arithmetic as they emerge in the Weigel-Leibniz correspondence in 1679 (Brancato 2016a). The reference to (Weigel 1673) is highly probable because in it he suggested a way of counting in a base-four system, instead of the usual base-ten one.

Here Kant is clearly aiming at reconciling different positions on the opportunity to use one system or the other in measuring, by reminding that philosophy is meant to provide a unified theory as a basis for any kind of numerical system used in the estimation of magnitudes and therefore grounding any measurement consisting in a logical comprehension of the parts in an intuition under a numerical concept. However, whichever basis we pick up to build up numerical series, it does not affect the case of thinking of the idea of totality including all given magnitudes, i.e. the universe, whose parts cannot be apprehended all at once, but that are judged as if they were entirely given in intuition, i.e. as organs of a body and are susceptible of a symbolic representation. This descends from the first property of Kant’s functional cosmology discussed in section 3. Nevertheless, when dealing with the cosmological problem and with observational cosmology things get more complicated:

“But now the mind hears in itself the voice of reason, which requires totality for all given magnitudes, even for those that can never be entirely apprehended although they are (in the sensible representation) judged as entirely given, hence comprehension in one intuition, and it demands a presentation for all members of a progressively increasing numerical series and does not exempt from this requirement even the infinite (space and past time), but rather makes it unavoidable for us to think of it (in the judgment of common reason) as given entirely (in its totality). The infinite, however, is absolutely (not merely comparatively) great. Compared with this, everything else (of the same kind of magnitude) is small. But what is most important is that even being able to think of it as a whole indicates a faculty of the mind which surpasses every standard of sense. For this would require a comprehension that yielded as a measure a unit that has a determinate relation to the infinite, expressible in numbers, which is impossible. But even to be able to think the given infinite without contradiction requires a faculty in the human mind that is itself supersensible. For it is only by means of this and its idea of a noumenon, which itself admits of no intuition though it is presupposed as the substratum of the intuition of the world as mere appearance, that the infinite of the sensible world is completely comprehended in the pure intellectual estimation of magnitude under a concept, even though it can never be completely thought in the mathematical estimation of magnitude through numerical concepts.” (Kant 1790/2000, 138)

Even if the intuition of the entire universe is not directly given to our senses, we think of it as if it were given, and we cannot do otherwise. This capacity of thinking of the whole implies “an enlargement of the mind which feels itself empowered to overstep the limits of sensibility from another (practical) point of view” (Kant 1790/2000, 138). Indeed, in order to measure the universe as a whole, we would need to use the concept of absolute infinity as a standard unit, which in Kant’s view is impossible, at least when we want to generate a schematic hypotyposis.

Nevertheless, we can think of the universe as great beyond comparison and think of it by means of symbolic hypotyposis.

According to Kant, this reveals our capacity to go beyond the sensible world and discloses our supersensible dimension for the regulative use of pure theoretical reason and for a constitutive one of practical reason. Furthermore, the pure intellectual estimation of a magnitude under a concept such as that of infinity – to be understood this time in terms of indefinite limit – is perfectly possible when we do cosmology, because we presuppose the universe as a whole as if it were given and therefore givable and measurable in all its spatio-temporal series, namely we must think of the universe as if it were completely given, but we must be aware that it is not *to us*, and that to know the last unconditioned term of a regressive series is impossible according to the cosmological principle. This assumption, which is the result of the *Critique of pure Reason*, implies that only symbolic hypotyposis of an organized whole is the condition to make the parts of the universe comparable and therefore measurable. Indeed, the very same possibility of cosmology is the result of the need of reason to ask questions about the world considered as noumenon, which is not knowable but certainly thinkable, in view of our experience as human beings in the world i.e., for practical purposes. This explains why Kant argues that in the spatio-temporal apprehension the *regressum* to greater units, such as it is in the case of larger planets or galaxies to capture the “greatness” of the world, is something necessary for the human mind (Kant 1790/2000, 141-142). It is therefore in these passages that Kant clearly connects the foundations of cosmology to his doctrine of magnitudes and measurement, as well as to his critique of teleology accomplished in 1790. This connection has not been underlined so far in the literature, but it has strong implications for Kant’s late writings and for the history of cosmology, because it spells out the strength and limits of grounding cosmology on computation and because it portrays the universe’s boundaries as indetermined but admits to think of the cosmos as natural end by exploring new functions that could be

attributed to our way of reflecting upon celestial objects. This clarifies why Kant considered the transcendental concept of natural end (*Naturzweck*) as the notion marking the progress of German metaphysics from Leibniz and Wolff's times.

5. Closing Remarks: From the Idea of the World to the Idea of Man in the World

In this contribution, I have shown that Kant's *Critique of Judgment* should be regarded as a huge advancement in the history of cosmology precisely because it allowed an understanding of the universal structure as deeply connected to a theory of measurement and computation. Furthermore, in 1790 Kant fostered his reflections upon the idea of the World and admitted that it was possible to judge of the universe as a whole by means of analogical reasoning and on the ground of a transcendental approach to teleology (Section 3). In Section 4, I have investigated how Kant justified in the *Critique of Judgment* the fact that the parts of the physical universe can be measured because it is portrayed as a structure whose parts can serve as units of a whole that, albeit symbolically, must be considered to be given but only for the regulative use of our faculties. The understanding of the universe as a complex organization implied the elaboration of what I called "functional cosmology", namely in my view Kant admitted the possibility of asking questions that are clearly teleological, but must only serve as heuristic guidelines, until a physical law or a mechanism is found to explain a certain behaviour of the universe and its parts. Kant's position mirrored the need to reject the positions of hylozoism and Spinozism disseminated at the end of the 1780s and that were meant to be reconciled with the Platonic and Neoplatonic writings. Therefore, another important aspect that makes Kant's 1790 work as alternative to the proposals of his time is to ground his functional cosmology on epistemological principles, thus introducing a feature leading to the inevitable separation of theology and cosmology. Indeed, the systematic connection between cosmology and morals

culminated in the deeper understanding of cosmology from an anthropological standpoint.¹⁸ Cosmology is a noble and unique human practice that only human beings, neither gods nor angels would do, because they have no senses like us, they do not possess sensible intuition separated from the understanding and cannot produce the same mathematics and symbolic hypotyposis that we do, nor they can force their form of inner sense, i.e. time, and think of duration, simultaneity and instantaneity in the same way as humans do.

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¹⁸ In this respect, Kant’s position on the foundations of cosmology is very far from the tendency that we observe in current philosophy of cosmology forcing a connection between the latter and theology.

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