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Monadology, Materialism and Newtonian Forces: The Turn in Kant's Theory of Matter

1. Kant's two dynamical theories of matter

The dynamical theory of matter is one of the main steps of Kant's lifelong attempt at connecting metaphysics with Newtonian physics and is also the single Kantian physical doctrine which still raised a little scientific attention in the XXth-century[1]. Along his career Kant gave two quite different systematic accounts of this kind of theory: the first is the *Monadologia physica* (1756), the second is the *Dynamics* chapter of the *Metaphysische Anfangsgründe der Naturwissenschaft* (1786). In the thirty years separating these two expositions Kant's interpretation of Newton's physics and his metaphysical ideas were subjected to parallel transformations. Nonetheless the two theories have significant common features: both provide a *more geometrico* explanation of the basic property of impenetrability by demonstrating the existence of a repulsive and an attractive force – the latter being conceived as the ground of universal gravitation – and thus introducing Newtonian concepts in a demonstrative, deductive framework; both argue that this theory is an example of how metaphysics and mathematical physics can (and should) fruitfully be connected. Among the differences, the disappearance of the monadological framework stands out: while in the *Monadologia physica* the subject of forces is a point-like monad, in the *Metaphysische Anfangsgründe* the subject of forces is a finite part of the continuum of matter, while monadologies of any kind are overtly rejected. The result is a completely different theory of matter, where centres of force no longer correspond to metaphysical substances and whose connection with Newtonian physics faces new, considerable difficulties.

Historical research has helped to trace back both systematic expositions of

[1] Hermann Weyl considered his program of explaning mass in field theory as a realization of Kant's dynamism of the *Metaphysische Anfangsgründe*. See H. WEYL, *Raum Zeit Materie*, Springer, Berlin 1921^4, engl. tr. Dover, Mineola (NY) 1952, pp. 202-203.

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Kant's matter theory to the sources and controversies which provided their original context of elaboration. In this paper I want to focus on the transition from the monadological to the "continuum" dynamical theory of matter. I will argue that the shift in Kant's interpretation of Newtonian forces and his critique of physical monadology originally derived from a single conundrum, long before the completion of criticism provided new and decisive grounds for rejecting physical monads. I will locate Kant's turn around the middle 1760s, presenting the late theory of matter as a way out of controversies about monads and materialism, which characterized the German intellectual world of his time.

Before starting my historical analysis I want to highlight some differences between the old and the new dynamical theory (§ II). I will then detect the turning point in Kant's writings (§ III), investigate its possible sources (§ IV) and draw some conclusions about Kant's resulting Newtonianism (§ V).

2. The turn in Kant's dynamical theory and the systematic incorporation of Newton's physics

2.1. In the *Monadologia physica* Kant contends that metaphysics "which many say may be properly absent from physics, is, in fact, its only support"[2]. He holds this thesis against natural philosophers who only admit "what is immediately revealed by the testimony of the senses" and, by following this path, discover the "laws of nature" but stay "removed from the deeper understanding of the first causes"[3]. On the contrary, Kant wants to "deduce" two moving forces "from the very nature and fundamental properties of the elements"[4].

In these opening paragraphs Kant contrasts the anti-metaphysical trend of Newtonian philosophy, presenting it as the exaggeration of a correct empirical attitude. At the same time, he argues that "Geometry holds [that] universal attraction, or gravitation [...] derives from the forces which are inherent in bodies at rest and which act at a distance"[5], implying that this is the original meaning of Newton's mathematical physics. As a matter of fact Kant overtly contradicts Newton's famous claim that gravity is *not* an essential property of matter – arguing that Newton's own theory logically involved the opposite conclusion – and

[2] I. KANT, *Metaphysicae cum geometria iunctae usus in philosophia naturali, cuius specimen I. continet monadologiam physicam* [= *Monadologia physica*], Hartung, Königsberg 1756, in *Kants gesammelte Schriften*, ed. by the Königlich Preussische Akademie der Wissenschaften in Berlin. Reprint, De Gruyter, Berlin 1900- (= KGS), vol. I, p. 475. English translations are taken from the Cambridge Edition of the Works of Immanuel Kant, which indicates on the margin the corresponding pages of KGS.

[3] KANT, *Monadologia physica* cit., KGS, I, p. 475.

[4] KANT, *Monadologia physica* cit., KGS, I, p. 476.

[5] KANT, *Monadologia physica* cit., KGS, I, pp. 475-476.

also admits repulsive forces as equally essential, showing his debt to later developments in Newtonian physics and chemistry[6]. Both these views are grounded on metaphysics, which – as Kant suggests echoing Newton's phrases in the *Opticks* – could play the deductive role in Newton's analytic-synthetic methodology. This peculiar interpretation of Newton's physics corresponds to a reform of metaphysics: Kant turns Newtonian forces into inherent properties of substances and thereby inserts Newtonian physics into a broadly Leibnizian-Wolffian theory of finite substances. Hence Kant can inject a successful empirical theory into the framework of Wolffian cosmology, providing alternative accounts of inter-substantial dependence and God's rational design of the world[7]. This dynamical theory builds a bridge between the general metaphysics of the *Nova dilucidatio* and the cosmology of the *Allgemeine Naturgeschichte*, in a systematic attempt characterized by the fruitful connection of open issues of both Newtonianism and Wolffian metaphysics[8].

In the *Metaphysische Anfangsgründe*, after the metaphysics of immaterial substances has been abandoned, the integration of empirical and mathematical principles of physics with a "pure" philosophical part of physics takes a new crucial meaning for Kant's main objective of establishing a new metaphysics. As Kant puts it, the aim of this new "metaphysics of corporeal nature" is to furnish "examples (instances *in concreto*) in which to realize the concepts and propositions of the latter (properly speaking, transcendental philosophy), that is, to give a mere form of thought sense and meaning"[9]. Transcendental philosophy, indeed, has been able to "prove" (*Beweisen*) the objective reality of categories, and this has been possible because this philosophical proof is independent of any particular intuition; nevertheless, for the same reason, philosophy still needs a sensible representation in order to provide a particular objective reference to pure concepts such as substance and conflict of realities: this sensible representation – or "exhibition" (*Darstellung*) – is precisely the task of pure physics and turns out to be possible *only* with regards to objects in space[10].

[6] See KANT, *Metaphysische Anfangsgründe der Naturwissenschaft*, Hartknoch, Riga 1786, in KGS, IV, p. 514-515. Among the early Newtonians supporting the essentiality of gravity Roger Cotes and John Keill were both well known to Kant. As regards repulsive forces see M. MASSIMI, *Kant's dynamical theory of matter in 1755, and its debt to speculative Newtonian experimentalism*, in *Studies in History and Philosophy of Science*, 42 (2011), pp. 525-543.

[7] See respectively: I. KANT, *Allgemeine Naturgeschichte und Theorie des Himmels, oder Versuch von der Verfassung und dem mechanischen Ursprunge des ganzen Weltgebäudes, nach Newtonischen Grundsätzen abgehandelt*, Petersen, Königsberg-Leipzig 1755, in KGS, I, p. 225; ID., *Principiorum primorum cognitionis metaphysicae nova dilucidatio*, Hartung, Königsberg 1755 (= *Nova dilucidatio*), in KGS, I, pp. 413-414.

[8] Cf. M. SCHÖNFELD, *The Philosophy of the Young Kant*, Oxford University Press, Oxford 2000, p. 175.

[9] KANT, *Metaphysische Anfangsgründe der Naturwissenschaft* cit., in KGS, IV, p. 478.

[10] Compare the new *General Note on the System of Principles* in KANT, *Kritik der reinen Vernunft*, Hartknoch, Riga 1787[2], pp. 288; 294 (for this work I will use the standard abbreviation KrV, followed by

Empirical physics – let alone mere empirical intuition – is unable to provide these examples *in concreto*: with this statement Kant comes back to the physical side of his systematic strategy, arguing that the standard position of anti-metaphysical physicists is inconsistent. While rejecting the bad concept of metaphysics as unconstrained invention of hypotheses, these "mathematical physicists" (including Newton) ignore that they "have always, and must have always, made use of metaphysical principles (albeit unconsciously)" and, among them, could not avoid using "those that make the concepts of their proper object, namely, matter, a priori suitable for application to outer experience, such as the concept of motion, the filling of space, inertia, and so on"[11]. The point of this "indispensability claim" is – to put it bluntly – that there can be *no merely empirical* physics: in order to justify the objective validity of physical concepts it is necessary to bring metaphysical principles "into union" with mathematical principles[12]. This time Kant's position is not presented as a possible version of Newtonian "orthodoxy". In the *Dynamics* chapter he explicitly claims that Newton, with his denial of the essentiality of gravity, has been "at variance with himself"[13]. In general the *Metaphysische Anfangsgründe* contain treatments of several basic concepts of Newtonian physics, such as absolute space, particles and density, which involve fundamental disagreements with Newton.

2.2. Compared to the old monadological theory, the new a priori dynamical theory of matter leads to weaker results and is less easily connected to Newton's mathematical physics. In order to support this thesis, let us examine some aspects of Kant's dynamical theory of matter in its two versions.

Both theories address a widely debated problem of Newtonian physics. In the *Queries* of the *Opticks* Newton had introduced the hypothesis of microscopic attractive and repulsive forces for the explanation of a number of different phenomena; in the 1717/1718 edition he introduced the hypothesis of ether for the possible explanation of more phenomena[14]. Given the empirical evidence supporting these two different hypotheses, the problem for the interpreters was to connect them both into a single theory of matter. This is what Kant tries to do in both his dynamical theories of matter – with quite different results.

the pagination of the first (A) and/or second (B) original edition). For a detailed analysis of the systematic role of Kant's investigation on the a priori elements of physics see P. PECERE, *La filosofia della natura in Kant*, Edizioni di Pagina, Bari 2009, pp. 154-277.

[11] KANT, *Metaphysische Anfangsgründe der Naturwissenschaft* cit., in KGS, IV, p. 472.

[12] KANT, *Metaphysische Anfangsgründe der Naturwissenschaft* cit., in KGS, IV, p. 478.

[13] KANT, *Metaphysische Anfangsgründe der Naturwissenschaft* cit., in KGS, IV, 515.

[14] J. HEILBRON, *Elements of Early Modern Physics*, University of California Press, Berkeley 1982, pp. 43-47. A. CLERICUZIO, *Materia, vuoto e forze in Isaac Newton* (unpublished paper, read at the workshop "Theories of Matter and Modern Science", University of "Roma Tre", April 14, 2015).

In the *Monadologia physica*, the repulsive force of monads is demonstrated as a condition for the filling of space. These point-like monads are in space, but they fill space by a "sphere of activity"[15]. Their simplicity is thus perfectly compatible with the infinite divisibility of space[16]. A contrary attractive force is needed in order to put a limit to this repulsive action, which would push monads at infinite distances. The volume occupied by the monad is determined by the different laws of the respective forces[17]. Repulsive force, being diffused in a three dimensional volume, is proportional to $1/r^3$, whereas attractive force, being dependent on the distance, is proportional to $-1/r^2$, where r is the distance from the monad. This dynamic interplay results in a status of equilibrium, corresponding to the boundary of microscopic bodies (prop. XII), which are the fundamental elements of mechanics. The latter's specific density depends on a specific *vis inertia* (prop. XI), while their aggregation results in the formation of "ether" or "fire matter" (prop. XIII). In this perspective, the *Monadologia physica* provides a foundation for the empirical hypotheses of *De igne* and the *Allgemeine Naturgeschichte*. Once given the existence of the monads this bridge is completely geometrical, since the general properties of physical bodies are mathematically deduced.

The *Dynamics* of 1786 also contains a demonstration of repulsive force in its *Theorem* 1 (grounded on the new a priori theory of movement in the *Phoronomy*), but before getting to the demonstration of the second, attractive force, Kant diverges from its earlier theory with an important theorem on the divisibility of *matter*. *Theorem* 4 argues that: "Matter is *divisible to infinity*, and, in fact, into parts such that each is matter in turn"[18]. In the *Monadologia physica* Kant similarly defended the infinite divisibility of *space*, but he claimed that matter had to be composed of simple elements in order not to be "deprived [...] of all substantiality"[19]. The novelty in Kant's present proposition is that the repulsive action is associated to "every *part* of space"[20]. The transition from physical monadology to this new theory of material substance as a continuum is defended in *Remark* 1. Here Kant critiques the "sophistry" of the (physical) "monadist", arguing – with a quite difficult argument – that without repulsive action even the smallest parts of space inside the sphere of activity would always be penetrated by the expansion of matter[21]. Indeed Kant now conceives matter as an originally

[15] KANT, *Monadologia physica* cit., prop. VI, in KGS, I, 480.
[16] KANT, *Monadologia physica* cit., prop. VII, in KGS, I, p. 481.
[17] KANT, *Monadologia physica* cit., prop. XI, in KGS, I, p. 485.
[18] KANT, *Metaphysische Anfangsgründe der Naturwissenschaft* cit., KGS, IV, p. 504.
[19] KANT, *Monadologia physica* cit., KGS, I, p. 479.
[20] KANT, *Metaphysische Anfangsgründe der Naturwissenschaft* cit., KGS, IV, p. 504 (my italics).
[21] KANT, *Metaphysische Anfangsgründe der Naturwissenschaft* cit., KGS, IV, pp. 504-505.

elastic fluid, a "quantum continuum"[22], whose physical articulation must be explained by means of dynamical processes.

The new metaphysical background involves a number of novelties on the physico-mathematical side. Forces are associated not to points, but to *volumes* of matter. The repulsive force is a *surface* force[23] and it makes no sense to talk of *finite* distances between repulsive points. As a consequence, the earlier attempt at deriving the volume of particles from the conflict of central forces is abandoned: the volume of bodies cannot be mathematically deduced from the conflict of forces, and is a merely empirical property[24]. Moreover, Kant maintains that the main task of a dynamical theory of matter is to derive the different density of materials from the interplay of attractive and repulsive forces, rather than by mixing hypothetical atoms and void[25]; but this derivation needs additional physical conditions, which cannot be derived a priori. In order to establish the different density of matter by means of the conflict of forces we have to postulate the cohesion of parts of matter and Kant clarifies that this may depend, in turn, on the conflict between original repulsion of matter and the attracted mass of a universally distributed ether[26]. On the whole, a hypothetical material (originally endowed with very low density) appears as a condition for the dynamical explanation of the basic properties of matter[27].

The limitations of Kant's new dynamics depend on metaphysical reasons rather than on different mathematical or physical arguments. Transcendental philosophy has already shown that we cannot allow of material points, since non-extended realities are no object of possible experience: "physical points" are an "absurdity"[28]. The newfound argument (in *Remark* 1 to *Theorem* 4) against

[22] KANT, *Metaphysische Anfangsgründe der Naturwissenschaft* cit., KGS, IV, p. 521.

[23] KANT, *Metaphysische Anfangsgründe der Naturwissenschaft* cit., *Definition* 7 and *Corollary*, KGS, IV, p. 516.

[24] KANT, *Metaphysische Anfangsgründe der Naturwissenschaft* cit., *General Remark to Dynamics*, KGS, IV, 525. Kant discusses once again a version of his earlier hypothesis of the law of conflicting forces derived from mere geometrical arguments in *Remark* 1 to *Theorem* 8, substituting finite with "infinitely small distances" (KGS, IV, p. 520), but comments that this construction now presents a "difficulty" (KGS, IV, p. 521): the distances among parts of matter are merely imaginary, since repulsive parts are actually in contact (KGS, IV, p. 522). He concludes that this attempt, being subject to "doubts", must not be "viewed as necessarily belonging to the goals of my metaphysical treatment of matter" (KGS, IV, pp. 522-523). The new theory demonstrates the existence of forces, but cannot provide an a priori construction of matter by means of forces.

[25] KANT, *Metaphysische Anfangsgründe der Naturwissenschaft* cit., KGS, IV, p. 532.

[26] KANT, *Metaphysische Anfangsgründe der Naturwissenschaft* cit., KGS, IV, pp. 563-564; cf. p. 534.

[27] I do not address here the intricated issue of the role of ether in Kant's new a priori theory. For an attempt to make sense of Kant's balancing argument see M. FRIEDMAN, *Kant's Construction of Nature. A Reading of the* Metaphysical Foundations of Natural Science, Cambridge University Press, Cambridge-New York 2013, pp. 191-202, 512. It must be noted that Kant questioned the empirical status of ether and eventually provided a priori proofs of its existence in the *Opus postumum* (late 1790s). For my detailed account see PECERE, *La filosofia della natura in Kant* cit., pp. 685-774.

[28] KANT, KrV, A 439/467 sqq.

the separation of discrete centres of repulsive forces – whether successful or not – appears, as it were, to be the dynamical execution of orders from above[29]. Indeed, the infinite divisibility of matter would still not rule out the possibility of noumenal substances acting at determinate points in space (cause and effect, in criticism, being heterogeneous concepts – a feature that Kant expounds in the doctrine of free will). The fundamental point, then, is the impossibility of admitting a theory of immaterial, non-localized monads as grounds of moving forces.

Precisely this sort of theory is the object of Kant's *Remark* 2 to *Theorem* 4. This long remark contains a discussion of Leibniz' original monadology based on the core doctrines of transcendental idealism. Starting from this text Kant would begin a polemical campaign against Leibnizians grounded on the thesis that Leibniz had defended an originally "Platonic" view of the world, which was in itself right if referred to things in themselves, but not meant to provide an explanation of phenomena[30]. In other words, Leibniz' theory of monads would have been substantially coherent with the basic tenets of critical philosophy. According to this argument, the *Critique* would be later presented by Kant as the "best apology" of Leibniz against his followers[31].

This second *Remark* on monadology appears as a rhetorical move against Leibnizians, which does not add anything new to what has been already established in the *Critique*. So Kant's exclusion of what we may call "noumenal monadology" from natural philosophy – whether effective or not – provides only a retrospective explanation of the need to abandon the monadological theory of matter. Indeed, this time we can trace this theory back to the prehistory of criticism. In a manuscript reflection, dated around 1775, Kant first wrote that monadology "cannot help in the explanation of phenomena, but in the distinction of intellectual from the phenomena in general. Principles for the explanation of phenomena must all be sensible"[32]. In turn, this rethinking of monadology – far from being grounded in a analysis of Leibniz' original theory – depends on the theory of "subreptitious axioms" in the 1770 *Dissertatio*, where Kant takes pains to separate the principles of sensibile and intelligibile objects. The first axiom (§ 27) is meant to avoid "the idle questions about the places in the corporeal universe of immaterial substances"[33]. The examples are spirits, whose presence is not local (that is, associated

[29] For a very subtle analysis of the argument, which connects it to the pure representation of motion, see FRIEDMAN, *Kant's Construction of Nature* cit., pp. 149-154.

[30] KANT, *Metaphysische Anfangsgründe der Naturwissenschaft* cit., KGS, IV, p. 507.

[31] For a detailed analysis of this point (including textual references) see P. PECERE, *Kant e la monadologia leibniziana: dall'"Anfibolia" all'"Apologia"*, in *Fogli di filosofia*, 4 (2013), pp. 7-41 (in the present paper I modify some passages of this reconstruction).

[32] I. KANT, *Reflexion* n. 41, in KGS, XIV, p. 153.

[33] I. KANT, *De mundi sensibilis atque intelligibilis forma et principiis*, Kanter, Königsberg 1770, in KGS, II, p. 414.

with a particular place) but only "virtual". Significantly, Kant devotes a final note to the explanation of this single, crucial point, writing that souls are not properly localized, while "a determinate place in the universe is [...] attributed to the soul because it is in reciprocal interaction with a certain body"[34].

What is surprising in this conclusion is the admission of an interaction between noumena and phenomena – typical of the metaphysical dualism of the *Dissertation*. In this framework a metaphysical explanation of phenomenal properties such as extension and impenetrability – in the original Leibnizian style – could still be thinkable (although, of course, hardly feasible). And this is precisely what Kant had been maintaining in his previous natural philosophy, where monads were conditions of space, time and the filling of space. Now Kant, with the theory of the *Dissertation*, clearly abandons this program with regards to space and time[35]; but why does he also abandon the program with regards to the filling of space? The present theory of "virtual presence" is explicitly borrowed by Euler's *Lettres à une princesse d'Allemagne*, which had been translated in German in 1769[36]. Euler, besides being a metaphysical substance dualist, had *mathematical* and *physical* reasons to contrast monadism (see section 3 below), but Kant does neither accept nor review these reasons here. So the question remains: which were the reasons for Kant's first abandonment of physical monadism? Once again – as with the *Metaphysische Anfangsgründe* – we come to the conclusion that Kant's arguments, whether successful or not, already belong to an ongoing research program in metaphysics, grounded on the originality of space and time as forms of intuition, while they exclude by principle the previous one (which was actually closer to Leibniz' original attempt of an explanation of the phenomenal world), where space, time and matter had to be deduced by monads. To use more old fashioned epistemological terms, we find ourselves already in the context of justification of Kant's new philosophy, but still miss the original context of discovery of his rejection of monadology. As suggested by the reference to Euler, we have to look for this context in earlier debates on monadology and for the original motives of Kant's turn in the theory of matter.

3. The abandonment of monadology in the 1760s

Kant's early monadism can be considered as a late contribution to the big *Monadenstreit* which inflamed the Berlin Academy of Science in the years 1745-

[34] KANT, *De mundi sensibilis atque intelligibilis* cit., in KGS, II, p. 415.

[35] For an analysis of Kant's previous attempts to deduce space from monads and their abandonment see PECERE, *La filosofia della natura in Kant* cit., pp. 34-153.

[36] Cf. KANT, *De mundi sensibilis atque intelligibilis* cit., KGS, II, pp. 410, 415.

1747, opposing a Wolffian and a Newtonian party[37]. In this context we can better appreciate some crucial features of Kant's original ideas. The Prize question regarded the doctrine of monads, with particular regard to its physical application, asking for the way one can deduce from monadology "an intelligible explanation of the main phenomena of the universe, and in particular of the origin and movement of bodies"[38]. The attack to the doctrine of monads was led by Euler himself, who advanced two lines of criticism, one regarding *extension* and the other regarding *moving force*. The first argument was mathematical: infinitely small beings, conceived as simple elements of bodies, cannot constitute a finite extension[39]. The second argument was physical: the inertia of matter excludes any attribution of active powers to matter; only immaterial substances are able to modify their own physical states[40]. The *pars construens* of this criticism consisted in Euler's conception of matter as essentially constituted by three properties: extension, impenetrability and inertia. Entering into metaphysical issues Euler maintained that the denial of active powers of matter is not only consistent with the principles of mechanics, but also provides a way to admit that the soul, being endowed with the faculty of thinking, "is not material"[41].

While arguing the compatibility of active forces and the principles of mechanics, Kant would give a prominent role to Euler's first argument in the *Monadologia physica*, literally following its formulation[42]. As we have seen, he designs his monads as point-like and still compatible with the infinite divisibility of matter, and by means of their forces he addresses the problem of the filling of space. This connection suggests a relevant question about his concept of monads: in order to escape Euler's charge, Kant's monads, while they are indeed present in

[37] For a first overview see R.S. CALINGER, *The Newtonian-Wolffian Controversy 1740-1759*, in *Journal of the History of Ideas*, 30.3 (1969), pp. 319-333. For a very subtle and documented reconstruction, starting from the publication of Leibniz' *Monadology* in Germany (1720), see E. PASINI, *La prima recezione della* Monadologia. *Dalla tesi di Gottsched alla controversia sulla dottrina delle monadi*, in *Studi Settecenteschi*, 14 (1994), pp. 107-163.

[38] A. HARNACK, *Geschichte der königlichen preussischen Akademie der Wissenschaften zu Berlin*, Berlin 1900, vol. II, p. 305.

[39] L. EULER [s.a.], *Gedanken von den Elementen der Cörper, in welchem das Lehrgebäude von den einfachen Dingen und Monaden geprüfet, und das wahre Wesen der Cörper entdecket wird*, Haude and Spener, Berlin 1746, II, § 65. Here Euler also addresses the Leibnizian thesis of the infinite divisibility of matter, arguing that it cannot lead to simple beings (II, § 62). Euler spelled out these arguments again in later writings.

[40] This argument is already presented in a letter to Bilfinger of November 3, 1738, in *Briefe von Christian Wolff aus den Jahren 1719-1753*, Eggers et comp., St. Petersburg 1860, n. 148, pp. 233-235 (repr. in WOLFF, *Gesammelte Werke*, Olms, Hildesheim-New York 1965-, I, vol. 16) and in L. EULER, *Enodatio quaestionis: utrum materiae facultas cogitandi tribui possit nec ne?*, in ID., *Opuscula varii argumenti*, Spener, Berlin 1746, pp. 281-284.

[41] EULER, *Enodatio quaestionis* cit., p. 286.

[42] The argument was repeated in the essay by J.H. Justi, which received the Prize in 1747. But it was already common in the early reception of monadology, which was often interpreted as a kind of atomism (see PASINI, *La prima recezione* cit., pp. 119-134).

space as elements of matter, cannot also be *components* of space, for this would reproduce the problem of composing a finite volume out of unextended points. That this must be the case can be derived from the contemporary *Nova dilucidatio*, were Kant argues that the very concept of space is "constituted" (*absolvitur*) by means of intermonadic interaction, which is in turn superadded by God to their mere existence[43]. Points, as limits of extension, are thus not originally existent, but dependent on God's choice of creating a "universal connection" (*nexus universalis*), whose phenomenon in space is gravitation. On this background physical monadology has the (almost paradoxical) characteristic that monads are essentially precedent to spatial and temporal relations, while their knowledge is obtained by means of their spatial and temporal relations.

This theoretical detail touches a subtle issue of monadology, which was debated among the followers of Wolff, that is the localization of monads. Leibniz' original view (in his late writings) was that monads, being immaterial, are not localized, while space is a "well-founded phenomenon" of their faculty of representation[44]. Wolff, being unable to understand Leibniz' ambitious phenomenalistic theory of nature, introduced non-representative, indivisible substances ("elements of bodies")[45], which "fill no space"[46]. Since Wolff shares Leibniz' thesis that space is phenomenal, he also has to explain how these elements can constitute space[47]. Wolff argues that extension derives from the joint perception of dissimilar elements, and grounds the latter's dissimilarity on inner, non representative properties. But he admits that these properties were unknown to him[48]. Not surprisingly a number of interpreters and critics – notably Baumgarten and Knutzen – straightforwardly identified Wolff's elements with points[49].

Hence Wolff's theory of physical elements provided the conditions for the coincidence of monads with centres of moving forces, long before Kant ventured on his original enterprise to provide a full account of this theory in terms of *New-*

[43] KANT, *Nova dilucidatio* cit., KGS, I, 414-415.

[44] See PASINI, *La prima recezione* cit., pp. 115-118, and the detailed account in V. DE RISI, *Geometry and Monadology. Leibniz's* Analysis situs *and Philosophy of Space*, Birkhäuser, Berlin 2007, in part. pp. 301-314.

[45] C. WOLFF, *Vernünftige Gedancken von Gott, der Welt, der Seele des Menschen, auch allen Dingen überhaupt*, Hort, Frankurt-Leipzig 1729[4], § 598 (repr. in WOLFF, *Gesammelte Werke* cit., I, vol. 2). Cf. ID., *Anmerkungen über die Vernünftige Gedancken von Gott, der Welt, der Seele des Menschen, auch allen Dingen überhaupt*, Hort, Frankurt-Leipzig, 1740[4], § 215 (repr. in WOLFF, *Gesammelte Werke* cit., I, vol. 3).

[46] C. WOLFF, *Cosmologia generalis*, Renger, Frankfurt a.M., 1731, § 184 (repr. in WOLFF, *Gesammelte Werke* cit., II, vol. 4).

[47] E.g. WOLFF, *Cosmologia generalis* cit., § 176: bodies are aggregates of elements; § 192n: bodies "result" (*resultant*) from elements.

[48] For a late exposition see C. WOLFF, *Von dem Begriff eines Körpers*, in *Kleine philosophische Schriften*, Renger, Halle 1736, p. 247 (repr. in WOLFF, *Gesammelte Werke* cit., I, vol. 21).

[49] According to Knutzen monads "sunt in loco" but "non implent loco" (M. KNUTZEN, *Systema causarum efficentium*, apud J.C. Langenhemium, Leipzig 1745, § 27). Cf. DE RISI, *Geometry and Monadology* cit., pp. 305-307.

tonian forces[50]. Kant's position in the *Monadologia physica* is evidently indebted to this Wolffian background: he posits monads in space and considers substances in general as defined by inner properties. On the other hand, in the *Nova dilucidatio*, he also wants to have a phenomenalistic view of space and matter. Hence his position borrows the circularity of the model with regards to the alleged deduction of space[51] and the difficulty of determining the inner properties of substances independently of what can be known through their *commercium*. Be that as it may, in 1755-1756 Kant clearly attributes a place to *any substance*, and this is a crucial condition for his project of connecting metaphysics to geometry.

In his cosmology, indeed, Kant gives for granted a sort of interdependency of spiritual and material properties – from the observations about the "dependency" of spiritual properties of inhabitants of other planets from their physical structure to the application of a conservation law to "forces of spirit" as well as to movement[52]. At the same time he gives for granted a metaphysical dualism, nominally distinguishing "physical monads" as a "class of simple substances" from "spirits"[53]. But this makes all the more urgent a justification of the difference between both kinds of monads by means of their respective properties.

Indeed, before finding any technical problems in his solution to the problem of divisibility by means of Newtonian forces – as would eventually happen in the *Metaphysische Anfangsgründe* –, Kant would face precisely this problem. In the Prize essay (written in 1762) he presents his physico-monadological theory of matter as the first example of his method of metaphysical analysis[54]. But now he adds a discussion of the way physical and spiritual monads are present in space. "Immediate and reciprocal presence" of bodies can depend on both contact and attraction[55]. As regards souls, it is not clear how we have to conceive their presence. We have a good proof that the Soul "is not matter", but this is not sufficient to prove that the soul is not "of material nature"; in order to draw the latter conclusion one has to prove that the soul is not "a simple substance of the kind which could be element of matter"[56]. Kant, who is writing a paragraph

[50] E.g. Gottsched introduces repulsive (*widerstehende*) forces in order to explain the impenetrability of monads: J.C. GOTTSCHED, *Erste Gründe der gesamten Weltweisheit*, Breitkopfen, Leipzig 1762[7] (1755[1]) I, § 400. Kant's original idea – since the *Gedanken* – was to endow monads also with *attractive* forces.

[51] For this point see M. FRIEDMAN, *Kant and the Exact Sciences*, Harvard University Press, Cambridge (MA) 1992, pp. 25-27.

[52] See respectively KANT, *Allgemeine Naturgeschichte* cit. KGS, I, pp. 351 sqq. and KANT, *Nova dilucidatio* cit., KGS, I, pp. 407-408.

[53] KANT, *Monadologia physica* cit., KGS, I, p. 477.

[54] I. KANT, *Untersuchung über die Deutlichkeit der Grundsätze der Natürlichen Theologie und der Moral*, Haude and Spener, Berlin 1764), in KGS, II, pp. 286-288.

[55] KANT, *Untersuchung über die Deutlichkeit* cit., KGS, II, p. 288.

[56] KANT, *Untersuchung über die Deutlichkeit* cit., KGS, II, p. 293.

about the certainty of metaphysics, concludes with a problematic statement that deserves to be quoted:

> "But this requires a different proof – the proof, namely, that this thinking being does not exist in space in the way in which a corporeal element exists in space, that is to say, in virtue of impenetrability; it also requires proof that this thinking being could not, when combined with other thinking beings, constitute something extended, a conglomerate. But no proof has actually been given yet of these things. Such a proof, were it to be discovered, would indicate the incomprehensible way in which a spirit is present in space".

By 1762 Kant has become aware of a problem in his metaphysical dualism. His separation of empirical from rational psychology, and his project to lecture starting from the former (in 1765-1766[57]), are signs of a growing dissatisfaction with standard accounts of metaphysics, which finds its dramatic expression in the *Träume eines Geistersehers*. Here Kant comes back to the difference between substances endowed with "the power of reason" and physical elements, arguing that the former would be "indistinguishable" from the latter, since man knows only the "powers of their external presence" and has "no knowledge whatever" of their "inner properties"[58]. Again, we can prove that the "indivisible I" is a simple substance, but cannot tell whether this substance is "material" or "immaterial"[59]. Kant claims indeed that even in the case of the material filling of space we empirically "recognise" the activity of a repulsive force, but we do not "understand" it, for here reason reaches its "limit". Therefore, we can suppose the existence of different kinds of substances and envisage the possibility that these substances do not possess a "motive force", but a different kind of "activity (*Wirksamkeit*)" which does not involve "filling space". Still, unless we attribute to these substances our own empirical representations – as Leibniz did –, we would not be able to prove neither the possibility, nor the impossibility of this claim, for both alternatives would "likewise remain incomprehensible"[60].

In other words, Kant is recognizing that Leibniz' original monadology is the only kind of monadology allowing a distinction of material and spiritual monads. The alternative – as paradoxical as it may sound – leads in the direction of materialism. The challenge of materialism is discussed at the conclusion of a long hypothetical conjecture. "Suppose that it is has been proved that the human soul was a spirit (though it is apparent from what has been said before that no such

[57] I. KANT, *Nachricht von der Einrichtung seiner Vorlesungen in dem Winterhalbenjahre von 1765-1766*, Kanter, Königsberg 1765, in KGS, II, p. 309.

[58] I. KANT [originally s.a.], *Träume eines Geistersehers, erläutert durch Träume der Metaphysik*, Kanter, Königsberg 1766, in KGS, II, p. 321.

[59] KANT, *Träume eines Geistersehers* cit., KGS, II, p. 322.

[60] KANT, *Träume eines Geistersehers* cit., KGS, II, p. 323.

thing has yet been proved)" – so begins the conjecture[61] – then you could ask for its space in the world of bodies. According to Kant, there is no evidence that the I has a particular seat in a "microscopically tiny region of the brain", and it rather feels to be "wholly in the whole of body". This would not mean that the soul must be extended, for "immediate presence in the totality of a space only proves a sphere of external activity; it does not prove a multiplicity of external parts"[62]. Kant therefore dismisses the different, Cartesian and post-Cartesian inquiries on the seat of the soul in the brain, which picture the I "as a spider at the centre of its web", that from "its seat in the brain operates the ropes and levers of the whole machine causing voluntary motion as it pleases". These hypotheses "admit only of a very superficial proof, or no proof at all". But Kant's problem, here, is not to engage in a "scholarly" defence of an alterative hypothesis, but to "examine the conclusion to which a theory of this kind may lead me": by supporting this hypothesis I would lack "any characteristic mark" to distinguish the soul from "the raw elements of matter". Kant's conclusion is that monadology can lead to the denial of the immortality of the soul:

> "then the idea jokingly proposed by Leibniz that in drinking our coffee we may perhaps be swallowing atoms destined to become human souls would no longer be a laughing matter. But, in such case, would not this thinking 'I' be subject to the same fate as material natures?"[63]

In a long footnote[64] he claims that philosophers – and here the reference could apply to Wolff as well as to all his followers and adversaries elaborating on his version of "monadology" – have been wrong in laughing at Leibniz' claim that a substance must be provided with representative power, for a substance must possess inner states, and in order to reject Leibniz' hypothesis one has "to invent some other possible inner state". This apparent defence of Leibniz' views is connected to Kant's declaration that he is "inclined to assert the existence of immaterial beings"[65]. At the same time, the argument of the *Träume* is that the way to a metaphysics of spiritual substances is itself closed, and leads to uncontrolled speculations and visions rather than to proper knowledge. Hence the sceptical account of the issue of the intelligible world is presented as a preferable alternative to any positive attempt to solve it that could eventually lead to materialism.

Whatever may have been the origin of the intellectual crisis documented by

[61] KANT, *Träume eines Geistersehers* cit., KGS, II, p. 324.
[62] KANT, *Träume eines Geistersehers* cit., KGS, II, p. 325.
[63] KANT, *Träume eines Geistersehers* cit., KGS, II, p. 327.
[64] KANT, *Träume eines Geistersehers* cit., KGS, II, p. 328.
[65] KANT, *Träume eines Geistersehers* cit., KGS, II, p. 327.

these passages (an issue to be discussed in the next section), it corresponds to the disappearance of monadology from Kant's theory of matter. This process has to be connected to other well known metaphysical developments in his thought. In the late 1760s Kant developed his new theory of space and thus abandoned any idea of a deduction of space by means of the concept of substance (which – as we have seen – was the other fundamental part of Leibniz' ambitious program received by Kant in his metaphysical research)[66]. At the same time, he conjectured a non-monadological theory of matter. In a manuscript reflection, which is broadly contemporary to the *Dissertation*, he writes that:

> "One can assume that the motion of a body is only a successive presence of a great efficacy of impenetrability in space, where the substance does not alter its place, but instead this effect of the impenetrability successively occurs in different locations, as happens, in the case of sound, with the airwaves. One can also assume that there are no substances at all in space, rather a greater or lesser efficacy of a single highest cause in different locations in space. From this it would follow that matter is infinitely divisible"[67].

In the *Dissertation* Kant would connect a similar dependency of the finite minds from a single "infinite force" – as a possible development of his new metaphysics – to Malebranche's philosophy. "Rather than put out into the deep sea of such mystical investigations", he decided to avoid any metaphysical hypothesis – both of the phenomenalistic and the physical kind. In order to support this view – as we have seen above – he joined forces with the arch-enemy of monadology, Euler:

> "As to what constitutes the external relations of force in the case of immaterial substances, whether those relations be between the immaterial substances themselves or between immaterial substances and bodies: that is quite beyond the human understanding, as the extremely perspicacious Euler, for the rest a great inventor and judge of phenomena, penetratingly noted (in letters sent to a certain princess of Germany)"[68].

Apparently Kant was laying down his monadological arms in a late surrender to Euler's line of argument. Nonetheless, he still could not accept Euler's natural philosophy, since the latter was grounded on the absolute impenetrability of particles and he never abandoned the idea of a dynamical explanation of impenetrability. An episode is telling in this regard: the concept of "solidity" defended

[66] See above the references in footnotes nn. 35, 37, 44.

[67] I. KANT, *Reflexion* n. 3986 (1769), in KGS, XVII, pp. 376-377.

[68] KANT, *De mundi sensibilis* cit., KGS, II, p. 410. The reference is apparently to Euler, *Lettres à une princesse d'Allemagne sur divers sujets de physique et de philosophie*, Impr. Acad. Imp., St. Petersbourg 1768, vol. II, letters nn. 92 and 93.

by Lambert, with whom Kant shared in these years the criticism of Wolffian elements and the project of reforming metaphysics, could never satisfy Kant for his own project of a metaphysics of bodily nature[69]. Eventually he would blame "Lambert and others" – Euler may well be included in this list – in the *Metaphysische Anfangsgründe* as supporters of this "empty concept", to be contrasted by his new dynamical account of impenetrability[70]. In the late 1760s this kind of criticism was already in place, but his own monadological dynamism was not available anymore. After giving up monadology, Kant needed to develop a new dynamical theory.

4. Materialism and the turn in Kant's theory of matter

The danger of materialism and Spinozism provided a central argument in the propaganda of both the Wolffians and the Newtonians since the early XVIIIth century[71]. Therefore we have to focus on this background in order to explain the timing of Kant's rethinking of monadology in the above quoted passages of the *Träume eines Geistersehers* and to detect possible sources of Kant's connection of monadology and materialism at the moment of this philosophical turn.

The implicit, open issues of Wolff's metaphysics provided indeed a fertile ground for different kinds of development, including materialism, which was promoted to the status of a noteworthy – although false – philosophical hypothesis by Wolff himself and – especially – by his follower Meier[72]. Indeed Meier, in his handbook of metaphysics (whose second edition appeared in 1765), allowed – following Crusius (see below) – that any kind of substance is extended, eventually choosing to develop a "practical metaphysics" which would leave aside any question not involving moral consequences and in this perspective he downplayed the danger of "psychological materialism"[73]. Although the Wolffians (Meier included) did not endorse materialism, the suspect that Leibniz' thesis of the sensibility of monads may provide "weapons" to the materialist had been critically advanced by Kant's teacher Knutzen as early as 1741[74]. La Mettrie in

[69] See J.H. LAMBERT, *Neues Organon*, Wendler, Leipzig 1764, *Alethiologie*, §§ 19, 93-95.

[70] KANT, *Metaphysische Anfangsgründe* cit., KGS, IV, pp. 497-498, cf. p. 523.

[71] For an overview of "spinozism" charges in the Wolffian context see J. ISRAEL, *Radical Enlightenment*, Oxford University Press, Oxford 2001, pp. 544-558.

[72] For this point, and for a general overview of materialism in XVIIIth century Germany, see P. RUMORE, *Materia cogitans. L'Aufklärung di fronte al materialismo*, Olms, Hildesheim-New York 2013.

[73] G.F. MEIER, *Metaphysik*, Gebauer, Halle 1765^{2} (1755-1759^{1}), resp. §§ 364, 180, 750. For a subtle reading of Kant's *Träume* in the light of Meier's "cryptomaterialism" see W. HESSBRÜGGEN-WALTER, *The Metaphysician Who didn't Know That He Was Dreaming: Kant and the Spirit-Seers* (manuscript). I thank prof. Hessbrüggen-Walter for sharing this unpublished article.

[74] M. KNUTZEN *Philosophische Abhandlung von der immateriellen Natur der Seele*, Hartung, Königs-

L'homme-machine (1748) tendentiously remarked that Leibnizians "with their Monads [...] spiritualized matter rather than materialize the soul"[75]. Moreover, many pietists, such as Rüdiger and Crusius, did not exclude that material and spiritual substances could share a single basis, and the latter even allowed the impenetrability of spirits (the hypothesis discussed by Kant in the *Träume*)[76].

As a matter of fact Kant accepted (and possibly recollected) this kind of problem in his post-*Critique* lectures of metaphysics. In a passage of a lecture (standardly dated 1782-3) he reviews the inferences about simple elements as the grounds of phenomena which were made by Leibniz with his theory of monads, "as well as by materialists from this proposition of Leibniz", contrasting them with his phenomenalistic theory of matter, which excludes composition by simple elements[77]. With this retrospective judgement Kant may have been thinking to different individuals, and he may also have been thinking to his own past ideas and a danger that occurred to himself, as it is the case with his reference to the monadist in the *Metaphysische Anfangsgründe*. An intringuing hypothesis is that, in the present context, he may have been thinking to Maupertuis' theory of matter as a tempting – although materialistic – way out of the troubles of Leibnizian-Wolffian philosophy. Let me show how this idea appears to be supported by the textes.

Maupertuis played a major role for the introduction of Newtonian gravitation in Europe and also for the diffusion of Newtonianism in Germany. Unsurprisingly he was also a major source for Kant's early natural philosophy[78]. In the

berg 1744 (original Latin edition 1741), p. 38. On the reception of materialism among the Wolffians see C. Dyck, *Materialism in the Mainstream of Early German Philosophy*, in *British Journal for the History of Philosophy*, forthcoming special issue ed. by P. Springeborg and F. Wunderlich.

[75] J.O. de La Mettrie, *L'Homme machine* (1747), in Id., *Œuvres philosophiques*, ed. by F. Markovits, Fayard, Paris 1987, vol. 1, p. 63.

[76] C.A. Crusius, *Entwurf der nothwendigen Vernunft-Wahrheiten*, Gleditsch, Leipzig 1745, § 364. That monadology could be interpreted in a materialistic sense had been evident in another very interesting controversy between Rudjer Boscovich and Joseph Priestley. The jesuit Boscovich developed a theory of point-like monads endowed with Newtonian forces, which bears striking analogies with Kant's physical monadology. Priestley argued that this theory confirmed his materialistic ideas, arousing Boscovich's horrified reaction. For a brief outline of this episode see P.M. Heimann / J.E. McGuire, *Newtonian Forces and Lockean Powers: Concepts of Matter in Eighteenth Century Thought*, in *Historical Studies in the Physical Sciences*, 3 (1971), pp. 270-273. There is no evidence that Kant knew Boscovich's theory and/or Priestley's interpretation.

[77] I. Kant, *Metaphysik Mongrovius*, in KGS, XXIX, p. 930: "Now that is the famous doctrine of monads of Leibniz. But that is a mere phantom of the brain [...]. With respect to the noumenal, bodies consist of simple parts. For if I remove the composition of the substantial composite, then the parts still remain [...] But it is otherwise with the phenomenal world. If I remove the composition here, then nothing remains for me. For space and time are here the essentials of composition; without these no thing can appear to me [...] All these inferences, those of Leibniz *as well as those of the materialists from this proposition of Leibniz*, come tumbling down due to the following proposition: matter, or rather its appearances in the sensible world, do not consist of simple parts" (my italics).

[78] See e.g. Kant, *Allgemeine Naturgeschichte* cit., KGS, I, pp. 232, 254-255.

Allgemeine Naturgeschichte Kant shared his cosmological strategy of looking for the wisdom of God not in particular objects but in the general lawfulness of the universe[79] and later, in the *Beweisgrund* (1763), he shared Maupertuis' position about the necessity of the laws of nature[80]. Kant disagreed with Maupertuis' skeptical account of the ground of forces, trying to put his demonstrative account in its place. But in the Prize essay he starts admitting that we may not have insight into the first principle (*Grund*) of gravity in bodies and in the *Träume* he maintains that this limitation is actually intrinsic to human reason[81].

But Maupertuis was also a possible reference for the understanding of monadology. Notwithstanding the polemical exchange with Samuel König regarding the alleged Leibnizian discovery of the principle of least action, Maupertuis was an admirer of Leibniz – "undoubtedly a great spirit, but idolized by his disciples"[82] – and in fact his ideas in cosmology have a "Leibnizian" twist which certainly provided an inspiration for Kant's project of cosmology. Although he was certainly no Wolffian, Maupertuis did not join Euler's anti-monadological campaign when he became President of the Berlin Academy. Indeed, even though he officially sided with Euler's dualism by admitting a separated and immortal soul as a condition of morality[83] and advanced several critiques to the theory of monads, he took this latter seriously and even found reasons supporting similar ideas in his scientific work. In his *Système de la nature* he argues that, in order to explain phenomena of heredity without resorting to immaterial principles of preformism, we must endow matter with "some principle of intelligence, something similar to what we call desire, aversion, memory" and applies this hypothesis to "the smallest parts of matter"[84]. This conception, in turn, leads him toward a materialistic reading of the hypothesis of monads. In his letter on monads Maupertuis maintains that the adversaries (probably the Newtonians with their charges of materialism) have "obliged the monadists to say that monads are invisible beings, representative of everything we see in the Universe, which is in turn nothing else than an assembly of phenomena", while Leibnizian monads may have been

[79] KANT, *Allgemeine Naturgeschichte* cit., KGS, I, pp. 225-230. For Maupertuis' defence of his strategy in natural theology see P.L. DE MAUPERTUIS, *Essai de cosmologie*, in ID., *Oeuvres*, Bruyset (éd.), Lyon 1768, vol. I, p. 44. For Maupertuis' influence in this historical context see H.-J. WASCHKIES, *Physik und Physikotheologie des jungen Kant*, Grüner, Amsterdam 1987, pp. 565-577.

[80] I. KANT, *Der einzig mögliche Beweisgrund zu einer Demonstration des Daseins Gottes*, Kanter, Königsberg 1763, in KGS, II, pp. 99-100. Cf. G. TONELLI, *La nécessité des lois de la nature au XVIII^e siècle et chez Kant en 1762*, in *Revue d'histoire de sciences et de leurs applications*, 12 (1959), pp. 225-241.

[81] KANT, *Untersuchung über die Deutlichkeit* cit., KGS, II, p. 286 and KANT, *Träume eines Geistersehers* cit., KGS, II, p. 335 (quoted below, § V).

[82] P.L. DE MAUPERTUIS, *Lettres. VII. Sur les systêmes*, in ID., *Oeuvres* cit., vol. II, p. 258.

[83] P.L. DE MAUPERTUIS, *Système de la nature*, § LVII, in ID., *Oeuvres* cit., vol. II, pp. 176-177: in order to explain morality we have to admit that we have an "indivisible, immortal soul, entirely distinct from the body and able to deserve eternal punishment and prizes".

[84] MAUPERTUIS, *Système de la nature* cit., § XIV, p. 147; § XVIII, p. 149.

originally meant to be the "first elements of matter, possessing perception and force"[85]. Maupertuis then draws a distinction between a conception of monads as material elements, which raises the issue of their localization in any part of matter (even in a "cup of coffee") and a phenomenalistic reading of monadology, developed by the "followers" of Leibniz in order to avoid this consequence; according to the latter "bodies are not composed of monads"[86]. As we have seen, the phenomenalist reading was actually closer to Leibniz' original view. Anyway, before similar exegetical alternatives clashed in the Academy Prize, Maupertuis had already lamented that the phenomenalistic reading depends on the empirically ungrounded admission of representative force in invisible beings[87]. Apparently Maupertuis, with his "organised molecules", has found an empirical substitute for monads, as conceived in the first way: he is thus directly attributing mental properties to matter. He is not explicitly taking sides in the metaphysical issue, probably because he also takes the phenomenalistic option seriously[88]. But the relevant point, for our purposes, is that he touches on an interpretative crux of Wolffism and shows how the alternative to phenomenalism may lead to materialism.

Although Maupertuis operated with "molecules" rather than point-like monads, the proximity between his ideas and Leibniz' was taken for granted by the German anonymous translator of the *Système de la nature* (a copy of whose translation was possessed by Kant)[89]. On the other hand, the book had aroused Diderot's comments about its materialistic implications, which Maupertuis did not clearly reject[90]. On the whole, Maupertuis could appear to Kant as deriving materialistic consequences from the theory of monads, in particular by a phys-

[85] MAUPERTUIS, *Lettres. VIII. Sur les monades*, in ID., *Oeuvres* cit., vol. II, p. 264 (1752[1]).

[86] MAUPERTUIS, *Lettres. VIII. Sur les monades* cit., p. 262.

[87] MAUPERTUIS, *Essai de cosmologie* cit., p. 29 for a critical passage on the representative force of monads.

[88] Maupertuis writes that if extension and thought are "nothing but properties, they can both belong to a subject, whose essence is unknown to us" (MAUPERTUIS, *Système de la nature* cit., § XXII, p. 151). Cf. the letter *Sur la maniere dont nous appercevons*, in MAUPERTUIS, *Œuvres* cit., vol. II, pp. 232-242, where Maupertuis critically examines different explanations of the interaction between soul and body (including occasionalism, and prehestablished harmony and influx) without taking sides. On Maupertuis' phenomenalism in its historical context see G. TONELLI, *La pensée philosophique de de Maupertuis*, Olms, Hildesheim 1987, pp. 8-16, 26-27, 30-34, 92-104, 126-130.

[89] [s.a.], *Versuch von der Bildung der Körper*, Leipzig [s.l.], *Vorbericht* [s.p.]: "Die Hauptsache scheint mir mit der Monadologie des Herrn v. *Leibniz* einerley zu seyn". Kant's copy is recorded in A. WARDA, *Immanuel Kants Bücher*, Breslauer, Berlin 1929, p. 29. The translator also explicitly disclosed Maupertuis' authorship.

[90] On the editorial history of this text and the debate aroused by the apparent spinozism of Maupertuis' hypothesis on living matter see M. TERRALL, *The Man Who Flattened the Earth. Maupertuis and the Sciences in the Enlightenment*, University of Chicago Press, Chicago 2002, pp. 317-334. On the Maupertuis-Diderot debate also see C.T. WOLFE, *Endowed Molecules and Emergent Organization: The Maupertuis-Diderot Debate*, in *Early Science and Medicine*, 15, 1-2 (2010), pp. 38-65.

ical and Newtonian elaboration of monadology which bears analogies to what Kant had been working on for many years.

Kant's defence of Leibniz's theory of representative monads against "certain philosophers" – besides being a sort of self-critique – may thus involve, via Wolff's physical monadology, an oblique reference to Maupertuis. A number of other passages suggest that Kant may have been thinking to Maupertuis in the *Träume*. First, in the footnote about the hypothesis of representative force as the only means to conceive of a specific difference in monads, Kant repeats an argument by Maupertuis; and when he argues that to assign to substances a "faculty of obscure representative power" does not imply that many material substances can form a "unified thinking unity", he also uses an argument spelled out by Maupertuis in his reply to Diderot's charge of Spinozism regarding his animated molecules[91]. Second, the image of monads in the coffee used by Maupertuis in his letter on monads is also used by Kant in the passage were he agitates the risk of materialism[92].

A third, overt connection, regarding the issue of vitalism, requires a short explanatory *excursus*. In the *Träume* Kant declares that he is looking for a way out of the controversy between Stahl's "organic" explanation of vital phenomena – he also makes reference to the principle of "irritability" – and mechanical explanations by Hoffmann and Boerhaave[93]. In a late manuscript draft of his short critical appendix to Samuel Sömmering's *Über das Organ der Seele*, commenting on the latter's hypothesis of the localization of the soul in the ventricular fluids of the brain, Kant confesses that in the past he had been similarly "tempted to dare a transition from the theory of the soul to physiology (to the nature of living matter)" and "to admit of a special vital force (or irritability, as one otherwise may prefer to call it) in each part of these matters where nerves and their movements are effective"[94]. As an example of this "temptation" he cites Maupertuis' theory of "seminal particles" and the "admonition" represented by Voltaire's attack to this idea in his *Diatribe du Docteur Akakia*, in what can be considered as a tail of the *Monaden-Streit*[95].

Although published as late as 1796, this writing presented Kant's first major

[91] KANT, *Träume eines Geistersehers* cit., KGS, II, p. 328. Compare respectively Maupertuis, *Système de la nature* cit., pp. 142-143 and the *Réponse aux objections*, ivi, p. 208.

[92] KANT, *Träume eines Geistersehers* cit. Cf. MAUPERTUIS, *Lettres*, in ID., *Oeuvres* cit., II, p. 263. This image was not original: it had been first attributed to Leibniz by Michael Hansch in his Latin translation of Leibniz' *Monadology* (M.G. HANSCH, *Principia philosophiae. More geometrico demonstrata*, Monath, Frankfurt 1728, p. 135).

[93] KANT, *Träume eines Geistersehers* cit., KGS, II, p. 331.

[94] See the reprint of this draft in KGS, XIII, p. 398.

[95] A reference to this hypothesis on "animated [...] parts", or "organic molecules" appears in the letter *Sur la generation des animaux*, where Maupertuis makes the hypothesis that the formation of the foetus from these molecules may happen by means of "attraction": this was the point of Voltaire's mockery.

statement about the seat of the soul after the *Träume* and his most articulated defence of the concept of "virtual presence", whose first sympathetic introduction also occurs in 1766 and which had become Kant's official position (borrowed from Euler) starting from the *Dissertation*. Hence the reference of this confession to the *Träume* – with its intertwining of biological and metaphysical issues – and to Maupertuis appears well motivated.

Retrospectively we can conclude that Kant, while reviewing his ideas in order to confront Swedenborg's challenge in 1766, realized that he was inadvertently going in the direction of a materialistic interpretation of monadology – or at least, that his philosophy lacked the means to separate this interpretation and save the immateriality of spirits[96]; moreover, we have many reasons to suppose that he could find in Maupertuis' theories a mirror-image of his previous metaphysics with its materialistic tendency. This must have been – in my view – one side of the metaphysical crisis which resulted, among other things, in the need for a non-monadological theory of matter.

5. Kant's post-monadological Newtonianism

I have argued that Kant's metaphysical crisis in 1766 may have been related not only to his reflections on academic metaphysics, but also to one of the main sources of his Newtonianism[97]. This crisis, as a matter of fact, produced the abandonment of his earlier "demonstrative" Newtonianism. In the *Träume* Kant draws an analogy between Newton's gravitation and moral sense, arguing that we can understand the "moral sentiment", that is the "constraining of our will to harmonize with the rule of the general will", as a "phenomenon of that which takes place within us, without establishing its causes". This would allow to understand the "moral unity" of thinking beings as "the effect of a genuinely active force", in analogy with Newton's way of understanding gravity without entangling in "possible vexatious philosophical disputes" concerning its cause[98]. This ana-

MAUPERTUIS, *Lettres* cit., p. 303 (the first edition appeared in 1752). [VOLTAIRE], *Diatribe du docteur Akakia medecin du pape*, s.e., Rome 1758, p. 5.

[96] A similar conclusion about the meaning of the *Träume eines Geistersehers* is drawn by SCHÖNFELD, *The Philosophy of the Young Kant* cit., pp. 244, 246.

[97] I read this episode in the context of physiological debates in the early XVIII[th] Century about the possibility of a materialistic interpretation of Newtonian physiology (e.g. Haller and Boerhaave), or what could be considered as "the dangers inherent in adapting Newtonianism to animals". A. THOMSON, *Materialistic Theories of Mind and Brain*, in W. LEFÈVRE (ed.), *Between Leibniz, Newton and Kant*, Kluwer, Dordrecht 2001, p. 154. For a critical overview see C.T. WOLFE, *On the Role of Newtonian Analogies in Eighteenth-Century Life Science*, in Z. BIENER / E. SCHLIESSER (eds.), *Newton and Empiricism*, Oxford University Press, Oxford 2014, pp. 223-261.

[98] KANT, *Träume eines Geistersehers* cit., KGS, II, p. 335.

logy shows a way out of philosophical controversies about both spiritualistic and materialistic explanations of powers, which draws on a completely different idea of Newtonianism with respect to the one maintained by Kant in the 1750s. Eventually it would became a basic idea of criticism, thereby acquiring distinctive conceptual features.

In critical philosophy attractive and repulsive forces are still necessary conditions of material substance, but they are no longer "active" forces, the latter denomination being properly reserved to the faculty of representation[99]. Indeed "moving forces" are just "laws" of the alteration of relations (*Verhältnisse*) in space and time[100]. By these relations we can infer the activity of fundamental forces and there we get to a limit of human insight:

> "Everything, even universal attraction as the cause of weight, must be inferred, together with its laws, from data of experience [...] For it lies altogether beyond the horizon of our reason to have insight into (*einsehen*) original forces a priori with respect to their possibility; all natural philosophy consists, rather, in the reduction of forces and faculties (*Vermögen*) that explain the actions of the former, although this reduction proceeds only up to fundamental forces, beyond which our reason cannot go"[101].

It may appear that Kant here is merely accepting a kind of "skeptical" Newtonianism, such as the one that Maupertuis and others had maintained, were cognition is limited to the empirical investigation of laws. Kant's position is slightly different and more articulated[102]. According to Kant (after the *Metaphysische Anfangsgründe*), Newton's gravity first provided "certainty" to Copernican astronomy[103]. In some late manuscript notes (standardly dated around 1799) Newton's gravity is presented as a "universal principle" for the explanation of motions, and therefore as philosophically superior to the "empiricism of the theory of motion" of scientists such as Kepler and Huygens[104]. Now, which is the difference between this conception and the demonstrative Newtonianism of the 1750s? In Kant's logical theory, to have insight (*einsehen*) is to know something "from universal principles according to its grounds" and thus to cognize "not only that it is so [...] but that it must be so"[105]. But the most perfect form of knowledge is "comprehension" (*Begreifen*), which means to know a priori by rational deduction. According to Kant, even mathematicians have only insight into the

99 KANT, KrV, A 274/B 330.
100 KANT, KrV, B 67.
101 KANT, *Metaphysische Anfangsgründe* cit., KGS, IV, p. 534.
102 For a more detailed analysis of this point see P. PECERE, *Kant's Newtonianism: a Reappraisal*, in *Estudos Kantianos*, 2.2 (2014), pp. 172-176.
103 KANT, KrV, B XXII n.
104 I. KANT, *Opus postumum*, KGS, XXII, pp. 521, 528.
105 I. KANT, *Logik Dohna*, KGS, XXIV, p. 730.

properties of circles, but do not *comprehend* "how it happens that such simple figure has these properties". This is because we do know the general properties of space, but cannot deduce them from higher grounds[106].

An analogous point is made regarding moral. In his discussion of freedom in the *Kritik der praktischen Vernunft* Kant writes that "all human insight is at an end as soon as we have arrived at basic powers or basic faculties (*Grundkräften und Grundvermögen*) for there is nothing through which their possibility can be conceived, and yet it may not be invented and assumed at one's discretion". Here Kant's point is that, in moral, "the objectivity of the law cannot be proved by any deduction", although it is "firmly established of itself"[107]. This distinction between *insight* and *comprehension* played a crucial role for Kant's defence from the charges of Spinozism in the 1780s, when he keeps arguing that to know something on the basis of forces does not mean to reduce this effect to a substance, from which its properties could be "derived" (*abgeleitet*)[108].

This original reading of Newtonian powers provides the background for Kant's grand analogy between Newton's physics and critical philosophy in the *Preface* to the second edition of the first *Critique*. Here transcendental idealism is said to fill the empty concept of the unconditioned with "practical data of reason", in a way which is compared to Newton's introduction of the "invisible force" of gravity, for in both cases we know laws a priori without theoretically grasping their grounds[109].

For our present purposes this famous text can be read together with a passage from a letter to Abraham Kästner, were Kant admitted that his metaphysics was pursuing "the same goal" of Leibniz and Wolff – i.e. a systematic metaphysics – by following a "detour", "the union of theoretical and practical philosophy"[110]. This detour included, as we have seen, the elaboration of concepts of Newtonian physics, which were eventually separated from the demonstrative metaphysics of substances. In this perspective, we can see how the turn in Kant's theory of matter involved a reassessment of the relation between metaphysics and natural philosophy. In Kant's early metaphysics the empirical success of Newton's theory of gravitation was given for granted, and provided a new substantive supplement to monadology: in this way physics influenced the reform of metaphysics and

[106] I. KANT, *Logik [Jäsche]*, KGS, IX, p. 65.

[107] I. KANT, *Kritik der praktischen Vernunft*, Hartknoch, Riga 1788, in KGS, V, p. 46.

[108] I. KANT, *Über den Gebrauch teleologischer Principien in der Philosophie*, in *Teutscher Merkur*, 1788, in KGS, VIII, pp. 180-181.

[109] KANT, KrV, B XXII: "In the same way, the central laws of the motion of the heavenly bodies established with certainty what Copernicus assumed at the beginning only as a hypothesis, and at the same time they proved the invisible force (of Newtonian attraction) that binds (*verbindende*) the universe, which would remain forever undiscovered if Copernicus had not ventured, in a manner contradictory to the senses yet true, to seek for the observed movements not in the objects of the heavens but in the observer".

[110] Letter to Kästner, 5 [?] August 1790, KGS, XI, p. 186.

was incorporated in a body of demonstrative knowledge. After Kant's turn, since 1766, things went the other way around: Newtonian physics was originally reinterpreted in the light of the traditional topic of the "ignorance of causes"[111], and this happened primarily because of Kant's intention to avoid the metaphysical danger of a materialistic reading of monadology[112]. The technical problems of his new dynamical theory – regarding the justification of volume, density and other empirical properties of matter conceived as a continuum – can be considered as remote consequences of this turn at the level of metaphysics.

Abstract: Kant elaborated his dynamical theory of matter in two quite different systematic accounts, the first in the *Monadologia physica* (1756), the second in the *Dynamics* chapter of the *Metaphysische Anfangsgründe der Naturwissenschaft* (1786). In this paper I investigate the transition from the monadological to the "continuum" dynamical theory of matter, whose exact timing and motives are not explicitly clarified in Kant's writings. I locate Kant's turn around the middle 1760s, presenting Kant's abandonment of his own physical monadology as a way out of controversies about monads and materialism which characterized the German intellectual world of his time. Among the results of this crucial modification in matter theory stands out the new interpretation of Newtonian forces in the critical writings, which is not only relevant for Kant's account of physics, but also plays a major exemplary role for his critical theory of knowledge.

Keywords: Kant; Dynamics; Monadology; Materialism; Newtonianism.

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[111] See the rich documentation in G. TONELLI, *Die Anfänge von Kants Kritik der Kausalbeziehungen und ihre Voraussetzungen im 18. Jahrhundert*, in *Kant-Studien*, 57 (1966), pp. 417-456; ID., *The "Weakness" of Reason in the Age of Enlightenment*, in *Diderot Studies*, 14 (1971), pp. 217-244.

[112] In this paper I have focused on the issue of materialism. I leave to another occasion an analysis of Kant's relation with spinozism.