Constructionism and Naturalism in Leibniz's Thought

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Abstract

Not only constructionism and naturalism are evidently contradictory, but they seem both perfectly extraneous to Leibniz's thought. Nevertheless, it is possible to find important aspects of his thought that expose one or the other, and at times both attitudes. This paper will examine such aspects, focusing on various doctrines of Leibniz's that might give hints of such views (from general epistemology to philosophy of mathematics, from innatism to the theory of truth), to show that naturalistic and constructionis elements really play a role in Leibniz's view of the system of knowledge. This can also be shown to be connected rather with the richness and variety of his world view, than with an insufficient consistency of his doctrines.

Keywords

Leibniz, Constructionism, Naturalism.

Leibniz is notoriously an immaterialist philosopher; he is often described as an 'idealist' in some sense of the word, and is by his own word a Platonist. On the one hand, nothing in the world of natural, finite, familiar, ordinary objects is really like it seems: dead matter teems with microscopic living creatures, that in turn, as corporeal beings, are the phenomenal reflex of the unextended, soul-like elements of reality. On the other hand, in Leibniz's thought, mathematical entities and truths are referred to as *eternal* truths, coextensive with the divine intellect. Ideally, according to him, every axiom should be demonstrated from the principle of identity or non-contradiction and from definitions (ideally, again, from *real* definitions): natural science is contingent only on some general choice of God's concerning the laws of the universe.

Thus not only constructionism and naturalism are evidently contradictory, but they seem both perfectly extraneous to Leibniz's ideas.[3] Nevertheless, it is possible to find important aspects of his thought that expose one or the other, and at times both attitudes.

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3 Correspondingly, both themes are quite under-represented in the studies, although constructivism appears sporadically. Let me quote Catherine Wilson, "Critical and Constructive Aspects of Leibniz's Monadology", in *The Leibniz Renaissance: International Workshop (Firenze, 2-5 giugno 1986)*, Firenze: Olschki, 1989, 291-303; Sorin Costreie, "Leibniz's Constructivism", *Revue Roumaine de Philosophie* 47 (2003), 67-81.

Definitely, this does not concern his learning doctrines. When the young Leibniz writes at § 21 of the *Nova methodus docendae discendaeque jurisprudentiae* that, since teaching and learning are concerned with habits, and having natural habits, that we have in common with other creatures, already been treated, "restat, ut dicamus de causa habitus hominibus propria: *Institutione*" (A VI, 1, 277)[4], this could smack of constructivism or constructionism. Yet he is not so much interested in the institution or construction of concepts, but of efficacious mnemonic notes. Not 'construction', but 'invention' is the key word to his teaching philosophy, as it is apparent in the *Nova methodus*; and to invention, in very classical fashion, is associated 'disposition', *i.e*. method itself. Also when learning methods and instruments reappear in the more general framework of the *ars characteristica* and of the *encyclopaedia universalis*, even in contexts where Leibniz finds it useful to enounce a "Regula construendorum characterum" (A VI, 4, 182), no such 'construction' has any smack of 'constructionism'.

Some hints of that are present instead in Leibniz's epistemology of mathematics. In a mathematical sense, constructionism or constructivism asserts that it is necessary to 'construct' a mathematical object to prove that it exists. Leibniz has a decided preference for synthetical procedures. Correspondingly, in geometry he privileges construction over analysis – not practically, nor heuristically, but from an epistemic point of view.[5]

Leibniz shares with his mathematical mentor Christiaan Huygens the idea that construction is "the canonical way of giving (and understanding) a curve".[6] In the line of the *verum factum* tradition, construction provides a knowledge of the essence of a geometric entity: "Constructio vero est operatio quaedam exacta cujus requisita in potestate sunt, et qua certum aliquid producitur" (A VI, 4, 315); it is the way things themselves are given (A VI, 4, 317). Construction is epistemologically superior to definition:

4 The abbreviations of Leibniz's works will follow the style of the *Studia Leibnitiana*. In particular, A = *Sämtliche Schriften und Briefe*, Darmstadt-Leipzig-Berlin: Akademie der Wissenschaften zu Berlin, 1923 ff. (series, vol., p.); GM = Leibnizens mathematische Schriften, C. I. Gerhardt ed., Berlin-Halle: Asher & Comp., 1849-1863 (vol., p.); GP = *Die philosophischen Schriften von G.W. Leibniz*, C.I. Gerhardt ed., Berlin: Weidmann, 1875-90 (vol., p.); L = *Philosophical Papers and Letters*, Leroy E. Loemker ed., Chicago: University of Chicago Press 1956; DM = *Discourse on Metaphysics*; *Mon.* = *Monadology*; NE = *New Essays on Human Understanding*; *Théod*. = *Theodicy*.

5 See H.J.M. Bos "The Concept of Construction and the Representation of Curves in Seventeenth-Century Mathematics", in *Lectures in the History of Mathematics*, Providence, RI: AMS – London Mathematical Society, 1993, 23-36. Bos starts from the interchanges between Leibniz and Huygens, to follow the development of the mathematical field of the 'costruction of equations' and its decline. See also Eberhard Knobloch, "Analyticité, équipollence et théorie des courbes chez Leibniz", in *G.W. Leibniz, Interrelations Between Mathematics and Philosophy*, Norma B. Goethe, Philip Beeley, David Rabouin eds., Dordrecht: Springer Netherlands, 2015, 89-110.

6 Bos, *The Concept of Construction*, 25.

> On peut definir une Parabole au sens des Geometres, que c'est une figure dans laquelle tous les rayons paralleles à une certaine droite sont reunis par la reflexion dans un certain point ou foyer. Mais c'est plutôt l'exterieur, et l'effet qui est exprimé par cette idée ou definition, que l'essence interne de cette figure, ou ce qui en puisse faire d'abord connoitre *l'origine*.[7]

Geometers are used to define a parabola as a figure in which parallel rays are brought together by reflection at the focus. But that definition does not express the essence of the figure. Just like other kinds of nominal definitions, this indeed ordinary proceeding does not provide any certainty, nor enough information, concerning the possibility of its object; an effective constitution of the object would only be given, as it were by a real definition, by the construction:

> On peut même douter au commencement si une telle figure, qu'on souhaite et qui doit faire cet effet, est quelque chose de possible; et c'est ce qui chez moi fait connoitre, si une definition est seulement nominale, et prise des propriétés, ou si elle est encore réelle. Cependant celui, qui nomme la Parabole et ne la connoit que par la definition que je viens de dire, ne laisse pas lorsqu'il en parle, d'entendre une figure, qui a une certaine construction ou constitution, qu'il ne sait pas, mais qu'il souhaite d'apprendre pour la pouvoir tracer.[8]

In the same way an indispensable constructive role is given, for the case of non-geometrical curves, to tractorial motions in Leibniz's *Supplementum geometriae dimensoriae seu generalissima omnium tetragonismorum effectio per motum* of 1693.[9]

Conversely, in the *Justification du calcul des infinitesimales* of 1702 Leibniz supports the proposed foundation of his calculus with the assertion that the 'errors' purportedly introduced by the elision of infinitesimal quantities according to critics like Nieuwentijt and Rolle, cannot be given by any construction: "si quelqu'un n'en est point content, on peut luy faire voir à la façon d'Archimede, que l'erreur n'est point assignable et ne peut estre donnée par aucune construction" (GM IV, 105).

Only construction, in the end, brings about the basic condition of a more complete knowledge of geometric entities, to which in turn physical objects might conform:

> lorsqu'il s'agit par exemple de la figure d'un miroir, qui ramasse tous les rayons paralleles dans un point comme foyer, on peut trouver plusieurs proprietez de ce miroir, avant que d'en connoitre la construction, mais on sera en incertitude sur beaucoup d'autres affections, qu'il peut avoir, jusqu'à ce qu'on trouve en lui ce qui répond à la constitution interne des substances, c'est à dire, la construction de cette figure du miroir, qui sera comme la clef de la connoissance ultérieure.[10]

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7 NE III, 10, § 19; A VI, 6, 346.

8 *Ibidem*.

9 GM V, 294-301. See again H.J.M. Bos, "Tractional Motion and the Legitimation of Transcendental Curves", *Centaurus* 31 (1988) 9-62; and Pietro Milici, "A Geometrical Constructive Approach to Infinitesimal Analysis: Epistemological Potential and Boundaries of Tractional Motion", in *From Logic to Practice*, Gabriele Lolli, Marco Panza, Giorgio Venturi eds., Cham (CH): Springer Switzerland, 2015, 3-21.

10 NE IV, 6, § 7; A VI, 6, 402.

The trouble is – and this brings us back to analysis – that "même dans la Geometrie ordinaire, on n'a pas encore de Methode pour determiner les meilleures constructions, quand les problèmes sont un peu composés" (NE IV, 3, §7; A VI, 6, 377). So one should resort again to algebraic and infinitesimal analysis to solve problems; and to *analysis situs* to prepare the instruments of a deeper knowledge, that is as much desired by Leibniz as he remembers that metaphysics was the most desired according to Aristotle:[11]

> rursus deinde necessaria restitutione magnitudinis ad situm, constructionis causa, directe situs per characteres, et figurarum constructiones per calculum repraesententur, quod inde non tantum in inventionibus Geometricis, sed et potissimum in applicatione Geometriae ad physicam maximum fructum promittit.[12]

It might be mentioned here that from a different standpoint, Samuel Levey[13] identifies "a subtle constructivist strand[14] in Leibniz's philosophical views of mathematics", which, he believes, has positive effects, and its drawbacks too: it "leads him into error in his metaphysics of matter, and […] also contributes to the development of his monadism".[15] But the presupposition of this detection is the opposition between "constructivist and actualist philosophies of the infinite",[16] and it is important to remark that in Leibniz, to different kinds of infinite, correspond different constitutions of the concept.

Constructionism, from a slightly different point of view, is the doctrine that all or most of our knowledge is 'constructed', in that it is contingent on convention, perception, personal or social experience. Should this mean that our knowledge does not reflect an external reality, of course it would not appropriately describe Leibniz's idea of the world, and this for many reasons.

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11 "Une telle Métaphysique est ce qu'Aristote demandoit, c'est la science qui s'appelle chez lui, Ζητουμένη, la desirée, ou qu'il cherchoit" (NE IV, 8, § 9; A VI, 6, 431; with reference to *Met*., I, 2, 982*a*4-*b*10, VII, 1028*b*2-7); Leibniz mentions the science "desiderata seu quaesita" also in his *De primae philosophiae emendatione* of 1694 (GP IV, 468).

12 A VI, 4, 723.

13 Samuel Levey, "Leibniz's Constructivism and Infinitely Folded Matter", in *New Essays on the Rationalists*, Gennaro Rocco, Huenemann Charles eds., Oxford: Oxford U.P. 1999, 134-62.

14 Levey quotes Michael Dummett: "Mathematical objects themselves are mental constructions […] they exist only in virtue of our mathematical activity, which consists in mental operations" (*Elements of Intuitionism*, Oxford: Clarendon Press, 1977, 7).

15 Levey, *Leibniz's Constructivism*, 134.

16 Levey, *Leibniz's Constructivism*, 155.

First of all, according to Leibniz truth is not 'constructed' in any way. In a well-known *Dialogus* composed in 1677 he confronts Hobbes's theory of the truth. Leibniz clearly approves of a truth theory that refers to *natura rerum*, the nature of things, eventually combined with the knower's own nature: both natures must be such that, when proceeding by a valid method, the resulting propositions will be found true.[17] But the inevitable expression of truths by means of signs or characters might shed doubts on their independence from arbitrariness:

> *A*. Ergo veritates Arithmeticae aliqua signa seu characteres supponunt? *B*. Fatendum est. *A*. Ergo pendent ab hominum arbitrio. *B*. Videris me quasi praestigiis quibusdam circumvenire. *A*. Non mea haec sunt, sed ingeniosi admodum scriptoris.[18]

According to Hobbes, as his doctrines are depicted there.[19] truth arises from names or characters, and thus depends on the human will: truths are propositions expressed by the means of artificial signs, and so rely on them; such signs are not natural, but arbitrary, and consequently truths are arbitrary as well.

According to Leibniz, of course, truth is in no way such an arbitrary construction. Characters may be arbitrarily formed, but, when used inside propositions, they refer to real relations between things, "sine ullo arbitrio nostro" (A VI, 4, 25). This is, we may say, a *conditioned naturalism*: the nature of things is truthful in itself, under the proviso of its creation by the most perfect being.[20]

Moreover, although for Leibniz certain notions of ours can be the artificial product of socially conditioned attitudes, so that he "borders on social constructionism",[21] nevertheless there are 'naturalistic' (*e.g*. physio-psychological) explanations for such phenomena. But, more important, against constructed fallacies, appropriate counter-constructions can be built, and this process is based on 'naturalistic' remedies, by which the feebleness of human will can be counterpoised. The most conspicuous example of this attitude of Leibniz's is a passage in the *Nouveaux essais*, where it is told that St. Francisco Borgia, who was given to drinking heavily when he was a member of high society, had been able to retrench gradually to almost nothing, by each day letting a drop of wax fall into the flagon which he was accustomed to drinking dry:

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17 "*A*. Sed quoniam causam esse necesse est cur cogitatio aliqua vera aut falsa futura sit, hanc ubi quaeso quaeremus? *B*. In natura rerum puto. *A*. Quid si ea oriatur ex natura tua. *B*. Certe non ex sola. Nam necesse est et meam et rerum de quibus cogito, naturam talem esse, ut quando methodo legitima procedo propositionem de qua agitur concludam seu veram reperiam. *A*. Pulchre respondes" (A VI, 4, 21-22). See L, 183. Nevertheless, certain men of learning believe that truths originate "ab arbitrio humano, et ex nominibus seu characteribus" (A VI, 4, 22).

18 A VI, 4, 22-23.

19 For a modern point of view, see Donald W. Hanson, "Reconsidering Hobbes's Conventionalism", *The Review of Politics* 53 (1991), 627-651; Ioli Patellis, "Hobbes on Explanation and Understanding", *Journal of the History of Ideas* 62 (2001), 445-462.

20 Indeed, it is in the margin of this writing that Leibniz inscribes his famous "Cum Deus calculat et cogitationem exercet fit mundus" (A VI, 4, 22).

21 Justin E.H. Smith, *Divine Machines: Leibniz and the Sciences of Life*, Princeton: Princeton U.P., 2011, 38.

> François de Borgia General des Jesuites qui a esté enfin canonisé, estant accoutumé à boire largement, lorsqu'il estoit homme du grand monde; se réduisit peu à peu au petit pied, lorsqu'il pensa à la retraite, en faisant tomber chaque jour une goutte de cire dans le bocal qu'il avoit accoustumé de vuider. […] En un mot il faut profiter des bons mouvemens comme de la voix de Dieu qui nous appelle, pour prendre des resolutions efficaces.[22]

The world as it is given to our experience seems often to have for Leibniz, in spite of his metaphysics, a reality of its own. Clearly what is given is not automatically 'natural'; in fact, in Leibniz's perspective, what is properly given is the common representation, according to each substance's point of view and law of independent development, of the universe that is shared by all creatures, thanks to the pre-established harmony of their spontanities:

> une meditation plus profonde nous apprend, que tout (même les perceptions et les passions) nous vient de nostre propre fonds, avec une pleine spontaneité.[23]

This affords us the possibility to say that, under Leibnizian premises, even the most constructed among our ideas would come to us in a natural way:

> nous ne formons pas nos idées, parce que nous le voulons; elles se forment en nous, elles se forment par nous, non pas en consequence de nostre volonté, mais suivant nostre nature et celle des choses […] c'est par la preformation divine qu[e l'âme] produit ces belles idées, où nostre volonté n'a point de part, et où nostre art ne sauroit atteindre.[24]

If our faculties were a *camera obscura*, then, as Leibniz writes in the *Nouveaux essays*, "il faudrait supposer que dans la chambre obscure il y eut une toile pour recevoir les especes, qui ne fut pas unie, mais diversifiée par des plis représentant les connoissances innées"; this represents metaphorically the innate components of human cognitive nature. Connected to this ability to condition receptivity and add to it some innate ingredient, there is also a productive ability: "que de plus cette toile ou membrane étant tendue, eût une maniere de ressort ou force d'agir, et même une action ou reaction accommodée tant aux plis passés qu'aux nouveaux venus des impressions des especes" (NE II, 12, § 17; A VI, 6, 144). It is a kind of innatism that Leibniz himself famously qualified as 'virtual', being based on 'natural virtualities':

22 NE II, 21, 35; A VI, 6, 187; see *New Essays on Human Understanding*, P. Remnant, J. Bennett eds., Cambridge, MA: Cambridge U.P., 1996, 187.

23 *Théod*., § 296; GP VI, 292.

24 *Ibidem*. Moreover, there is some ineliminable correspondence between nature and the ideas that come to us naturally, that brings Leibniz to quite contorted formulations: "la Nature peut fournir des idées plus parfaites et plus commodes, mais elle ne donnera point un dementi à celles que nous avons, qui sont bonnes et naturelles, quoi que ce ne soyent peut etre pas les meilleures et les plus naturelles" (NE III, 6, § 30; A VI 6, 323).

> les idées et les vérités nous sont innées, comme des inclinations, des dispositions, des habitudes ou des virtualités *naturelles*, et non pas comme des actions; quoyque ces virtualitez soyent tousjours accompagnées de quelques actions souvent insensibles, qui y repondent.[25]

The most important domain in which Leibniz deploys this kind of innatist constructionism is his theory of the role of common sense, or internal sense: a faculty of the soul that coincides, in the Aristotelian tradition of psychology, with imagination and shows a crucial role, in certain writings of Leibniz's, in building our image of the phenomenal world. The internal sense plays to some extent the role of a channel through which infinitesimal environmental perceptions are collected and organized, where the sentiment of phenomenal reality takes its form and a representation of macroscopic objects is structured, that is then offered both to knowledge and to practice.[26]

The internal sense is responsible for the production of mathematical notions, thanks to that kind of innate disposition to produce general categories on the occasion of experience, to which Kant is so hostile.[27] It provides, by means of innate mechanisms that are part of our nature, the composition of colors, like "les idées du bleu et du jaune dans notre idée sensitive du verd" (NE IV, 6, § 7; A VI, 6, 403), as well as the appearance of continuity and solidity that characterizes our perceptual world, in which we do not distinguish the conspiring movements of the microscopic living components of any apparently un-living thing, with an effect similar to that of the artificial perception of a continuous transparency:

> la perception d'un transparent artificiel que j'ai remarqué chez les horlogers, fait par la promte rotation d'une roue dentelée; ce qui en fait disparaître les dens, et paroitre à leur place un transparent continuel imaginaire composé des apparences successives des dents et de leur intervalles, mais où la succession est si promte que notre phantaisie ne la sauroit distinguer.[28]

25 NE, *Préf*.; A VI, 6, 52. Italic is mine.

26 See my old *Corpo e funzioni cognitive in Leibniz*, Milano: Franco Angeli, 1996; "Perception, Imagination and Leibniz's Theory of Will", in *Leibniz und Europa, VI. Internationaler Leibniz-Kongreß. Vorträge*, Hannover: Leibniz-Gesellschaft, 1994, 581-88.

27 See Kant's treatment of the *Präformationssystem der reinen Vernunft* in *A* 128-29.

28 NE IV, 6, § 7; A VI, 6, 403.

Correspondently, eternal truths such as mathematical laws, in accordance with which the phenomena of nature are structured (GP IV, 292), are embedded in nature; this is what Leibniz has in mind, when he maintains that the truly sufficient criterion for distinguishing real from imaginary phenomena is the success of predicting future phenomena from past and present ones: "potissimum realitatis phaenomenorum indicium quod vel solum sufficit, est successus praedicendi phaenomena futura ex praeteritis et praesentibus".[29]

The fact that insentient nature (although in the end, as it is well known, for Leibniz there is no insentient nature, but macroscopic inanimate objects are aggregates of innumerable microscopic living beings) is so entwined with eternal truths, also allows, by the way, for precise execution of complex processes even at the level of macroscopic, mechanically behaving objects:

> Quelle necessité y a-t-il qu'on sache tousjours comment se fait ce qu'on fait? Les sels, les metaux, les plantes, les animaux, et mille autres corps animés ou inanimés, savent ils comment se fait ce qu'ils font, et ont ils besoin de le savoir? Faut il qu'une goutte d'huyle ou de graisse entende la Geometrie, pour s'arrondir sur la surface de l'eau?[30]

In connection to this, we might consider yet another aspect of our subject. In the Bachelardian sense of 'construction' – a very representative one – the act of expressing a (scientific) question defines, i.e. 'constructs' the object of inquiry prior to any knowledge of it: "Pour un esprit scientifique, toute connaissance est une réponse à une question. S'il n'y a pas eu de question, il ne peut y avoir connaissance scientifique. Rien ne va de soi. Rien n'est donné. Tout est construit"[31].

Leibniz's point of view is at the same time comparable to such positions, and radically different. According to him, our image of the world depends on a variety of circumstances: through technology we can even fabricate for ourselves new organs of perception, *e.g.* "en nous formant des Microscopes" (NE II, 23, § 13; A VI, 6, 220). And to him it is perfectly obvious that we construct theoretical entities, and that such entities are not represented as such in nature. This enables theories so opposite, in principle, as the actually infinite division of the continuous, and atomism, to work both, and work well, although – what's more – both be contrary to reason, in particular to what Leibniz often calls the metaphysical reasons of the laws of nature.

This is especially enlightened by a passage of the famous letter to Varignon of 1702, where Leibniz suggests that, on the one hand, natural processes can be studied by considering infinitesimals as if they were perfect realities: "on peut dire de même que les infinis et infiniment petits sont tellement fondés que tout se fait dans la géométrie, et même dans la nature, comme si c'étaient de parfaites réalités" (GM IV, 93); while, on the other hand, it is perfectly possible to institute an atomistic science of nature:

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29 A VI, 4, 1501; "ego satis reale dicerem, si ratione bene utentes nunquam ab eo deciperemur" (1502). See also L, 363-66.

30 *Théod*., § 403; GP VI, 357.

31 Gaston Bachelard, *La formation de l'esprit scientifique*, Paris: Vrin 1934, 14. "If there has been no question, there can be no scientific knowledge. Nothing is self-evident. Nothing is given. Everything is constructed" (*The Formation of the Scientific Mind*, M. McAllester Jones ed., Manchester: Clinamen Press, 2000, 25).

Cependant on peut dire en général que toute la continuité est une chose idéale et qu'il n'y a jamais rien dans la nature qui ait des parties parfaitement uniformes, mais en récompense le réel ne laisse pas de se gouverner par l'idéal et l'abstrait et il se trouve que les règles du fini réussissent dans l'infini comme s'il y avait des atomes (c'est-à-dire des éléments assignables de la nature) quoiqu'il n'y en ait point, la matière étant actuellement sous-divisée sans fin; et que *vice versa* les règles de l'infini réussissent dans le fini, comme s'il y avait des infiniment petits métaphysiques, quoiqu'il n'y en ait pas besoin; et que la division de la matière ne parvienne jamais à des parcelles infiniment petites.[32]

32 GM IV, 93-94.

The specifically Leibnizian reason for this is that the real is effectively governed by, as he words it, 'the ideal and the abstract'. In fact one can admit infinitesimals as "ideal concepts (*notions ideales*) which shorten our reasoning, similar to what we call imaginary roots in the ordinary algebra, for example, $\sqrt{-2}$"[33]. The rules of the finite are found to succeed in the infinite, and conversely the rules of the finite succeed in the infinite, because everything is governed by reason; and this is guaranteed, plainly, by natural theology: in fact, if it were otherwise, the creation would not conform with the nature of the sovereign principle.

Also for the just mentioned imaginary numbers, or imaginary roots, in the end the 'nature of things' provides a foundation: according to Leibniz, in his *Specimen novum analyseos pro scientia infiniti* (GM V, 350-61), nature, grounded as it is in the divine mind, is so devoted to variety, that it could not do without that 'wonder of analysis', that portent of the, again, ideal world:

> Verum enim vero tenacior est varietatis suae pulcherrimae Natura rerum, aeternarum varietatum parens, vel potius Divina Mens, quam ut omnia sub unum genus compingi patiatur. Itaque elegans et mirabile effugium reperit in illo Analyseos miraculo, idealis mundi monstro, pene inter Ens et non-Ens Amphibio, quod radicem imaginariam appellamus.[34]

Epistemological constructivism is thus just the other side of Leibniz's particular naturalism. Leibniz thought to live in a two-sided world, in which there is perfect correspondence between mechanical phenomena and the reality of unextended, non-material individual substances, as there is between two perfectly symmetrical faces of the same coin:

> L'operation des Automates spirituels, c'est à dire des Ames, n'est point mecanique, mais elle contient eminemment ce qu'il y a de beau dans la mecanique: les mouvemens, developpés dans les corps, y étant concentrés par la representation, comme dans un monde idéal, qui exprime les loix du monde actuel et leur suites, avec cette difference du monde idéal parfait qui est en Dieu, que la pluspart des perceptions dans les autres ne sont que confuses.[35]

33 GM IV, 92; translation of this passage and my overall paraphrase follow L, 543-44; for an analogous train of thoughts in 1698 see Leibniz's letter to Johann Bernoulli in June of that year (GM III, 499-500). See my *Il reale e l'immaginario. La fondazione del calcolo infinitesimale nel pensiero di Leibniz*, Torino, Sonda, 1993; Douglas M. Jesseph, "Leibniz on the Foundations of the Calculus: The Question of the Reality of Infinitesimal Magnitudes", *Perspectives on Science* 6 (1998), 6-40; *Infinitesimal Differences: Controversies Between Leibniz and His Contemporaries*, Ursula Goldenbaum, Douglas M. Jesseph eds., Berlin: de Gruyter, 2008.

34 GM V, 357.

35 *Théod*., § 403; GP VI, 357. Were not for this duplication of activity and passivity, "elle fût un Dieu" (358).

But the two sides, like in Moebius strings, are just one and the same – and the realist view can be reduced to the immaterialist one. Materialism is indeed rejected by Leibniz (since it eliminates spiritual beings), mainly using arguments against the existence of matter as such. Nevertheless, 'naturalism', if we consider it as the idea that the phenomena studied by the natural sciences exhaust reality, is accepted by Leibniz as a partial but correct representation of the created universe. Even 'physicalism', according to which the phenomena studied by *physics* exhaust reality, would also be true in his view, as far as in his opinion everything occurs mechanically in bodies, while everything is to be explained in vital terms in respect to souls:

> omnia in corporibus fieri mechanice, id est per intelligibiles corporum qualitates nempe magnitudines figuras et motus; et omnia in animabus esse explicanda vitaliter, id est per intelligibiles qualitates animae nempe perceptiones et appetitus.[36]

Leibniz's conception of macroscopic reality is physicalist precisely in this sense, that physical causes and mechanistic interactions exhaust explanations; but the principles of mechanism are metaphysical.[37] Thus Leibniz's naturalism does not deny the existence of supernatural realities. On the contrary, natural phenomena, like the laws of motion insofar as they are explained by Leibniz's new concept of force, show that they do exist: dynamics makes allowance for infinite unextended, non-material, spiritual centers of force, of which we have but an indirect knowledge through natural means. And 'infinite' and 'force', in fact, are two-sided concepts, or properties, with both a physical and a metaphysical import.

In Leibniz's immaterialist physicalism, living creatures are a middle term between macroscopic, mechanistic reality and purely immaterialist metaphysics; they play the role, scientifically and metaphysically, of intermediate entities, being, at the same time, 'natural machines' and 'composite substances'. Actually, the living is composed of albeit peculiar and infinitely complicated animated machines.[38]

As a scientist, Leibniz wore mechanicist naturalism as it were a reversible jacket, on the other side of which immaterialism did lure. Various theoretic constructions are able to describe that mechanist 'reality'; but in Leibniz's view dynamics, and the observation of 'live forces', push the scientist for turning the jacket inside out, and find, on the reverse of natural phenomena, the everlasting fashion of metaphysical, absolute reality. By these insuperable bounds Leibniz limits his own constructionism, and naturalism, of which otherwise he makes easily use in both empirical and theoretic science, and that he even combines together – which should be no surprise, since syntheses of incompatible views characterize more than anything Leibniz's thought.

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36 G.W. Leibniz, *Opuscules*, ed. by Louis Couturat, Paris: Alcan, 1903, 12; see also *Philosophical Writings*, G.H.R. Parkinson ed., London: Dent, 1973, 173.

37 GP VII, 344; see *Philosophical Essays*, Roger Ariew, Daniel Garber eds., Indianapolis: Hackett, 1989, 319.

38 This theme, as well as that of the correspondence between nature and reason, realm of nature and realm of grace, efficient and final causes, that I have referred to above, is much worked on in *Leibniz-Forschung*. I cannot go more in deep here, and even a succinct bibliography would require much space.