Theory and History of Ontology (www.ontology.co) by Raul Corazzon | e-mail: rc@ontology.co

Selected bibliography on the History of *Mathesis Universalis*

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The section History of Ontology includes some pages on the philosophy of René Descartes

General studies

Études en Français

1. De Buzon, Frédéric. 1998. "Mathesis universalis." In *La science classique: XVIe-XVIIIe siècle. Dictionnaire critique*, edited by Blay, Michel and Halleux, Robert, 610-621. Paris: Flammarion.
2. Desanti, Jean-Toussaint. 1972. "Réflexion sur le concept de Mathesis." *Bulletin de la Société Française de Philosophie* no. 77:1-22.
   Repris dans: J. T. Desanti, *La philosophie silencieuse ou Critique des philosophies de la science,* Paris: Le Seuil, 1975, pp. 196-219.
   Nouvelle édition avec une Introduction de Jacques Sédat dans *Figures de la psychanalyse,* 2005/2 (12), pp. 103-137.
3. Dumoncel, Jean-Claude. 2002. *La tradition de la mathesis universalis. Platon, Leibniz, Russell*. Paris: Unebévue.
4. Rabouin, David. 2009. *Mathesis universalis. L'idée de "mathématique universelle" d'Aristote à Descartes*. Paris: Presses Universitaires de France.
   Table des matières: Introduction 9; La constitution de la "mathématique universelle" comme problème philosophique 33; I. Aristote 37; II. "Mathématique universelle" et théories mathématiques: Aristote, Euclide, *Epinomis* 85; III. Le moment néo-platonicien 129; Vers la science de l'ordre et de la misure 193; Introduction 193; IV. La renaissance de la mathématique universelle 195; V. La *mathesis universalis* cartésienne 251; Conclusion 347; Annexe I. *La quaestio de scientia mathematica communi* 363; Annexe II. Essai bibliographique sur la *mathesis universalis* chez Descartes et Leibniz 367; Bibliographie 375; Index nominum 397-402.

English Studies

1. Knobloch, Eberhard. 2004. "Mathesis - The Idea of a Universal Science." In *Form, Zahl, Ordnung. Studien zur Wissenschafts- und Technikgeschichte. Festschrift für Ivo Schneider zum 65. Geburtstag*, edited by Seising, Rudolf, Folkerts, Menso and Hashagen, Ulf, 77-90. Stuttgart: Franz Steiner.
   " “I know much, it is true, yet I’d like to know everything”: Obviously Wagner, the self-confident servant of Goethe’s *Faust* (verse 601) wanted to compare with God whereas in universal topic of humanism and baroque times - the historical Faust died in the 1530ies - should only enable men to participate in God's universal knowledge. The epoch overflowed with universalisms, like universal arithmetic, art, characteristic, harmony, instruments, language, magic, mathematics, method, science, symbolism. By all means, universality or at least generality corresponding to unity ranked above diversity corresponding to plurality. “Pluralitas num quam est ponenda sine necessitate”, Ockham had already said, “plurality must never be assumed without necessity”.
   Evidently this attitude corresponded to the political situation of the 17th century. It was the time of absolutism, of absolute monarchs. Yet, we must be careful not to rush to conclusions. 19th and 20th centuries physicists of democratic societies liked and like reductionist unifications: the Grand Unified Theory (GUT) and even the hypothetical Theory Of Everything (TOE) are taking shape.
   Harmony instead of controversy, certainty instead of uncertainty, evidence instead of obscurity: Since Platonic times mathesis was the discipline which seemed to be especially appropriate to guarantee these ideals. The better if it even seems to grant immortality: For ‘‘Archimedes will be remembered when Aeschylus is forgotten

because languages die and mathematical ideas do not. 'Immortality' may be an inappropriate word, but probably a mathematician has the best chances of whatever it may mean", as the English mathematician Godefrey Harold Hardy asserted (1993, 81). (*)
No wonder that mathesis played a crucial role in the history of the idea of a universal science. I would like to discuss five essential aspects of this history:
1. Capstone; 2.Tree of science; 3. Human reason; 4. Ocean of sciences; 5. Theory with practice; Epilogue." (p. 77)
(*) [G. H. Hardy, *A Mathematician Apology*, Cambridge: Cambridge University Press 1993 (first edition 1940).]

2. Marciszewski, Witold. 1984. "The Principle of Comprehension as a Present-Day Contribution to Mathesis Universalis." *Philosophia Naturalis* no. 21:523-537.

3. Mittelstrass, Jürgen. 1979. "The philosopher's conception of "Mathesis Universalis" from Descartes to Leibniz." *Annals of Science* no. 36:593-610.
"In Descartes, the concept of a 'universal science' differs from that of a 'mathesis universalis', in that the latter is simply a general theory of quantities and proportions. Mathesis universalis is closely linked with mathematical analysis; the theorem to be proved is taken as given, and the analyst seeks to discover that from which the theorem follows. Though the analytic method is followed in the *Meditations*, Descartes is not concerned with a mathematisation of method; mathematics merely provides him with examples. Leibniz, on the other hand, stressed the importance of a calculus as a way of representing and adding to what is known, and tried to construct a 'universal calculus' as part of his proposed universal symbolism, his 'characteristica universalis'. The characteristica universalis was never completed-it proved impossible, for example, to list its basic terms, the 'alphabet of human thoughts'-but parts of it did come to fruition, in the shape of Leibniz's infinitesimal calculus and his various logical calculi. By his construction of these calculi, Leibniz proved that it is possible to operate with concepts in a purely formal way."

4. Poser, Hans. 1998. "Mathesis universalis and Scientia Singularis. Connections and Disconnections between Scientific Disciplines." *Philosophia Naturalis* no. 35:3-21.
"Introduction.
Since Einstein sought a unification of relativity theory and quantum theory, two generations of physicists have tried to establish such a theory in order to unify the most efficient macroscopic theory with the extremely powerful microscopic one, but up to now they have not managed it. In many disciplines we are confronted with competing models that are successful within different and even overlapping areas, but which are at the same time incompatible with each other, seen from a more universal standpoint. To develop a unifying theory, is thus one of the greatest challenges.
Why do we take this as a challenge at all? In a historical perspective, this is far from evident: for nearly two thousand years, nobody felt disturbed by the fact that, to locate the position of a planet by means of the Ptolemaic system, one had to make three different mathematical calculations with no theory in common. The method developed by Copernicus, was by no means more precise in its results, nor was it simpler in its calculations, it had only one advantage, not belonging to physics, but to metaphysics, as it proposed one uniform procedure! Differing from the methodology of the School, which, for each quaestio postulated its correspondent appropriate method, and which, therefore, could not lead to universal theory, we are now confronted with the idea of unity, corresponding to an absolutely different image of science, the idea there should be a unity of science or even a unified science! At the beginning, reasons for this had been vague, they hinted at the unity of Gods creation; and its echo might be seen in a secularized version in C. Fr. v. Weizsäcker's *Unity of Nature* (*). The first theoretical approach is developed in the rationalistic tradition, more precisely, in Descartes and his embracing *Mathesis universalis*. The same aim is to be found in Leibniz and his proposal of a *Scientia*

generalis, as well as in the intention of Rudolf Carnap and the Vienna circle in postulating a Unified science. In all these cases we are confronted with the question how this all-embracing universal science is related to the singular and diverging sciences, and what the borders of the principles of subordination are."
(...)
"Our search for a link among changing and mutual exclusive sciences shall take the way from Descartes to Leibniz and Neurath on the one hand and Collingwood and Kuhn on the other. It leads to a discussion of Toulmin s thesis of an evolutionary character of all scientific development, a thesis which is taken as support for the post-modern worldview. Against all these attempts, the guiding thesis of this paper is to show that we have to accept truth as a regulative idea behind each scientific undertaking." (pp. 3-5)
(*) [New York: Farrar Straus Giroux, 1980]

Ancient and Medieval period

Études en Français

1. Breton, Stanislas. 1969. *Philosophie et mathématique chez Proclus*.
Suivi de *Principes philosophiques des mathématiques d'apres le Commentaire de Proclus aux deux premiers livres des Eléments d'Euclide*, par Nicolai Hartmann ; traduit de l'allemand par Geneviève de Pesloüan.
2. Rabouin, David. 2005. "La 'mathématique universelle' entre mathématique et philosophie, d'Aristote à Proclus." *Archives de Philosophie* no. 68:249-268.

English Studies

1. Rabouin, David. 2005. "La 'mathématique universelle' entre mathématique et philosophie, d'Aristote à Proclus." *Archives de Philosophie* no. 68:249-268.
2. Bechtle, Gerald. 2007. "How to Apply the Modern Concepts of *Mathesis Universalis* and *Scientia Universalis* to Ancient Philosophy. Aristotle, Platonisms, Gilbert of Poitiers, and Descartes." In *Platonisms: Ancient, Modern, and Postmodern*, edited by Corrigan, Kevin and Turner, John D., 129-154. Leiden: Brill.
Abstract: "This chapter concentrates on applying modern concepts like *mathesis universalis* and *scientia universalis* to the Ancient Philosophy of Aristotle, Platonisms, Gilbert of Poitiers and Descartes and to reconsider the available evidence so as to view seemingly well-known doctrines in a new light. To do this one needs to find an appropriate instrument for this, as Napolitano (*) undoubtedly has; the new conceptual tool should not only be some kind of gadget, but should also be made to do real work. In the present case, a distinction between, rather than a conscious conflation of, *mathesis universalis* (common or universal mathematic) and *scientia universalis* (universal science), might help us to consider some well-known (though obviously often uncertain) doctrinal facts about well-known philosophers from a new perspective. It has surprising shifts of emphasis and the introduction of new distinctions may eventually cause us to ask new systematic questions."
"However, the emphasis of this paper lies, with regard to the concept of *mathesis universalis* not so much on the historical details as on the more general systematical outlines. Therefore it should suffice to begin our work with an understanding of *mathesis universalis* that implies not much more than *universal* (or *general* or *common*) *mathematical science*, which of course still allows for a range of diverse meanings. What matters is to remain true to the sense of *mathesis universalis* while not confusing the two very different notions somehow inherent in the Latin, i.e., that of *universal mathematic* on the one hand and that of universal science on the

other. A clear line should be drawn between these two concepts, of which the former is *mathematical* (even though sometimes in a wider sense), the latter not. I trust that it will become clear in this paper that both for historical and systematical reasons it is not only justified, but even necessary, to draw this general distinction between *universal mathematic* and *universal science* in this way." (p. 130)
(*) Linda M. Napolitano Valditara, *Le idee, i numeri, l'ordine. La dottrina della* mathesis universalis *dall'Accademia antica al neoplatonismo*, Napoli: Bibliopolis 1988.

3. Cantù, Paola. 2010. "Aristotle's prohibition rule on kind-crossing and the definition of mathematics as a science of quantities." *Synthese* no. 174:225-235.
"The article evaluates the Domain Postulate of the Classical Model of Science and the related Aristotelian prohibition rule on kind-crossing as interpretative tools in the history of the development of mathematics into a general science of quantities. Special reference is made to Proclus' commentary to Euclid's first book of *Elements*, to the sixteenth century translations of Euclid's work into Latin and to the works of Stevin, Wallis, Viète and Descartes. The prohibition rule on kind-crossing formulated by Aristotle in *Posterior analytics* is used to distinguish between conceptions that share the same name but are substantively different: for example the search for a broader genus including all mathematical objects; the search for a common character of different species of mathematical objects; and the effort to treat magnitudes as numbers."

4. Klein, Jacob. 1968. *Greek Mathematical Thought and the Origin of Algebra*. Cambridge: MIT Press.
Translated from the original German: *Die griechische Logistik und die Entstehung der Algebra*, published in Quellen und Studien zur Geschichte der Mathematik, Astronomie und Physik, Abt. B, Studien, v. 3, 1934.
Reprinted: New York, Dover Publications, 1992.
See in particular: Chapter 11.3: The reinterpretation of the *katholou pragmateia* as *Mathesis Universalis* in the sense of a*rs analytice*, pp. 178-185, and Chapter 12: The cconcept of *number*: A. In Stevin (186), B. In Descartes (197), C. In Wallis, pp. 211-224.

Studi Italiani

1. Napolitano Valditara, Linda M. 1988. *Le idee, i numeri, l'ordine. La dottrina della mathesis universalis dall'Accademia antica al neoplatonismo*. Napoli: Bibliopolis.
Indice: Capitolo Primo: Per una definizione di *mathesis universalis*: notazioni storiche ed indicazioni semantiche.
La definizione cartesiana di *mathesis universalis*, 11; Il concetto di *mathesis universalis* nei secoli XVI e XVII, 26;
Capitolo Secondo: Le principali fonti (storiche e teoriche) della *mathesis universalis:* Platone, Aristotele, Euclide, Proclo.
L'uso delle fonti 45; Le fonti storiche: dai " problemi" ai "teoremi"; dal numero figurato alla *quantitas* 50; Le fonti teoretiche: Euclide 74; Le fonti teoretiche: Proclo, 96;
Capitolo Terzo: Il progetto della *mathesis universalis* nell'Accademia antica.
Riflessioni introduttive, 149; Speusippo, 156; Senocrate 185; Eudosso di Cnido e la teoria delle proporzioni. Teorie e problemi dell'*Epinomide* 209; Conclusioni sull'Accademia antica 229;
Capitolo Quarto: La flessione della *mathesis universalis* fra il III ed il I scolo a. C. L'Accademia scettica e l' "irrazionalità" dell'epoca ellenistica 283; La prima Accademia scettica: Arcesilao di Pitane 286; La nuova Accademia scettica: Carneade di Cirene 293; Filone di Larissa, Antioco di Ascalona e la ripresa del realismo 306; La scuola scientifica di Alessandria fra teoria e tecnica. Rigore ed invenzione in Archimede 310;
Capitolo Quinto: Alcune connessioni tra *mathesis universalis*, filosofia medioplatonica e neo-pitagorismo 343.

Estudios en Español

1. Ortiz de Landázuri, Carlos. 2000. "Mathesis universalis en Proclo de las aporias cosmologicas al universo euclideo." *Anuario Filosofico* no. 33:229-257.
English Abstract: "The author shows how Proclo is a precursor of 'Mathesis universalis' concept, without admitting the aporetic method of mathematics which is in Plato, Aristotle and Euclides thought. Today, his paradigm is rejected but it is a decisive factor to understand the sources of Western thought. This study deals with the works of Brisson, Cleary, Trudeau, Beierwaltes and Schmitz."

Renaissance period

Études en Français

1. Angelini, Annarita. 2006. "« Un autre ordre du monde » : Science et mathématiques d'après les commentateurs de Proclus au *Cinquecento*." *Revue d'histoire des sciences* no. 59:265-283.
2. Bonnet, Stéphane. 2005. "La philosophie mathématique de Giordano Bruno." *Archives de Philosophie* no. 68:315-330.
3. Helbing, Mario Otto. 2000. "La fortune des Commentaires de Proclus sur le premier livre des *Éléments* d'Euclide à l'époque de Galilée." In *La philosophie des mathématiques de l'Antiquité tardive. Actes du colloque international Fribourg, Suisse (24-26 septembre 1998)*, edited by Bechtle, Gerald and O'Meara, Dominic J., 173-193. Fribourg: Éditions Universitaires Fribourg Suisse.
4. Mehl, Édouard. 2010. "La science capitale: Johann Valentin Andreae et les mathématiques." In *Religion und Naturwissenschaften im 16. und 17. Jahrhundert*, edited by Greyerz, Kaspar von, Kaufmann, Thomas, Siebenhüner, Kim and Zaugg, Roberto, 124-142. Gütersloh: Gütersloher Verlagshaus.
5. Rabouin, David. 2010. "Le rôle de Proclus dans les débats sur la 'mathématique universelle' à la Renaissance." In *Études sur le Commentaire de Proclus au premier livre des Eléments d'Euclide*, edited by Lernould, Alain, 217-234. Villeneuve d'Ascq: Press Universitaires du Septentrion.

Énglish Studies

1. Bockstaele, Paul. 2009. "Between Viète and Descartes: Adriaan van Roomen and the *Mathesis Universalis*." *Archiv for History of Exact Sciences* no. 63:433-470.
"Adriaan van Roomen published an outline of what he called a *Mathesis Universalis* in 1597. This earned him a well-deserved place in the history of early modern ideas about a universal mathematics which was intended to encompass both geometry and arithmetic and to provide general rules valid for operations involving numbers, geometrical magnitudes, and all other quantities amenable to measurement and calculation. '*Mathesis Universalis*' (MU) became the most common (though not the only) term for mathematical theories developed with that aim. At some time around 1600 van Roomen composed a new version of his MU, considerably different from the earlier one. This second version was never effectively published and it has not been discussed in detail in the secondary literature before. The text has, however, survived and the two versions are presented and compared in the present article. Sections 1-6 are about the first version of van Roomen's MU the occasion of its publication (a controversy about Archimedes' treatise on the circle, Sect. 2), its conceptual context (Sect. 3), its structure (with an overview of its definitions, axioms, and theorems) and its dependence on Clavius' use of numbers in dealing with both rational and irrational ratios (Sect. 4), the geometrical interpretation of arithmetical operations multiplication and division (Sect. 5), and an analysis of its content in modern terms. In his second version of a MU van Roomen took algebra into account, inspired by Viète's early treatises; he planned to publish it as part of a new edition of Al-Khwarizmi's treatise on algebra (Sect. 7). Section 8 describes the conceptual background and the difficulties involved in the merging of algebra and geometry; Sect. 9 summarizes and analyzes the definitions, axioms and theorems of the second version, noting the differences with the first version and tracing the influence of Viète. Section 10 deals with the influence of van Roomen on later discussions of MU, and briefly sketches Descartes' ideas about MU as expressed in the latter's *Regulae*."

2. Cifoletti, Giovanna. 2006. "From Valla to Viète: The Rhetorical Reform of Logic and Its Use in Early Modern Algebra." *Early Science and Medicine* no. 11:390-423.
"Lorenzo Valla's rhetorical reform of logic resulted in important changes in sixteenth-century mathematical sciences, and not only in mathematical education and in the use of mathematics in other sciences, but also in mathematical theory itself. Logic came to be identified with dialectic, syllogisms with enthymemes and necessary truth with the limit case of probable truth. Two main ancient authorities mediated between logical and mathematical concerns: Cicero and Proclus. Cicero's 'common notions' were identified with Euclid's axioms, so that mathematics could be viewed as core knowledge shared by all human kind. Proclus' interpretation of Euclid's axioms gave rise to the idea of a universal human natural light of reasoning and of a *mathesis universalis* as a basic mathematics common to both arithmetic and geometry and as an art of thinking interpretable as algebra. "

Studi Italiani

1. Crapulli, Giovanni. 1969. *Mathesis universalis. Genesi di una idea nel XVI secolo*. Roma: Edizioni dell'Ateneo.
Indice: Premessa 7; I. Il V libro degli *Elementi* di Euclide, il *Commento al I libro degli Elementi* di Proclo e la problematica di una scienza matematica comune 9; II. La 'scientia communis' matematica nel *Commentarium de certitudine mathematicarum* di A. Piccolomini (1547). L'insegnamento delle matematiche allo Studio padovano sulla metà del sec. XVI: F. Delfino, P. Catena, F. Barozzi 33; III. Il *Commento* di Proclo nelle interpretazioni di P. Ramo e C. Dasipodio: 'dialectica' e 'communis scientia universalis' 63; IV. La 'scientia mathematica communis' in analogia alla 'prima philosophia' secondo B. Pereira 93; V. Il progetto della 'prima mathesis' nell'*Apologia pro Archimede* di A. van Roomen 101; VI. La 'mathematica generalis' nella *Methodus admirandorum mathematicorum* di J. H. Alsted (1613) 125; VII. Conclusioni sulla *mathesis universalis* nel sec. XVI;

Estudios en Español

1. Vieira Oliveira, Zaqueu. 2011. "Vida e Obra de Adriaan van Roomen (1561-1615)." *Anais do IX Seminário Nacional de História da Matemática*:1-12.
English Abstract: "Adriaan van Roomen (Louvain, 1561 – Mainz, 1615) was mathematician and physician. He studied mathematics and philosophy in Cologne, then studied medicine in this city and then in Louvain and Italy. In 1585, on a trip to Rome, received the degree of *medicinae licenciatus*.
From 1586 to 1592 was professor of mathematics and medicine at the University of Louvain and in 1593 became the first professor of medicine at the newly founded University of Wurceburgo. In 1594 received the degree of doctor of medicine in Bologna. Between 1596 and 1603 was the Chapter mathematician's Cathedral of Wurceburgo [Würzburg]. Many of his works are medical theses defended his students who taught classes at universities. Already some of his work in astronomy, botany, meteorology and fireworks are just compilations of works by ancient authors or their períod. Already in mathematics, some of his works also contain references to ancient authors, but his ideas about *mathesis universalis* and trigonometry, show the originality of van Roomen and present it as a big calculator. The most important mathematical works of van Roomen are: *Ideae Mathematicae pars prima* (1593), *Problema Apolloniacum* (1596) and *In Archimedis circuli dimensionem* (1597) and astronomy *Ouranographia sive caeli descriptio* (1591) and *Speculum Astronomicum* (1606). Van Roomen also communicated with various scholars of his time through correspondence. The Jesuit Priest Christoph Clavius was the most correspondent goals, however we find letters to the astronomers Johannes Kepler and Christoph Grienberge."

René Descartes

René Descartes: les *Regulae ad directionem ingenii* et la recherche de la *mathesis universalis*

Gottfried Wilhelm Leibniz

Études en Français

1. Berlioz, Dominique. 1993. "Langue adamique et caractéristique universelle chez Leibniz." In *Leibniz and Adam*, edited by Dascal, Marcelo and Yakira, Elhanan, 153-168. Tel Aviv: University Publishing Projects.
2. Couturat, Louis. 1901. *La logique de Leibniz: d'aprés des documents inédits*. Paris: Felix Alcan.
Reprint: Hildesheim, Olms, 1961 e 1985.
3. Gérard, Vincent. 2006. "Leibniz et la mathématique formelle." *Philosophie* no. 92:29-55.

4. Knecht, Herbert. 1981. *La logique chez Leibniz. Essai sur le rationalisme baroque*. Lausanne: L'Age d'Homme.
Voir le Chapitre III: *La mathématique universelle* pp. 91-123.

5. Rauzy, Jean-Baptiste. 1995. "Quid sit natura prius ? La conception leibnizienne de l'ordre." *Revue de Métaphysique et de Morale* no. 98:31-48.

6. Schmitz, François. 2000. "La pyramide de Leibniz. Note sur le logiquement possible et la logique modale." *Cahiers de Philosophie du Langage* no. 4:63-99.

English Studies

1. Weingartner, Paul. 1983. "The ideal of the mathematization of all sciences and of "more geometrico" in Descartes and Leibniz." In *Nature Mathematized. Historical and Philosophical Case Studies in Classical Modern Natural Philosophy*, edited by Shea, William R., 151-195. Dordrecht: Reidel.

2. Westerhoff, Jan C. 1999. "'Poeta Calculans': Harsdorffer, Leibniz, and the "mathesis universalis"." *Journal of the History of Ideas* no. 60:449-467.
"This paper seeks to indicate some connections between a major philosophical project of the seventeenth century, the conception of a "mathesis universalis", and the practice of baroque poetry. I shall argue that these connections consist in a peculiar view of language and systems of notation which was particularly common in European baroque culture and which provided the necessary conceptual background for both poetry and the *mathesis universalis*."

3. Dascal, Marcelo. 1987. *Leibniz. Language, Signs and Thought*. Amsterdam: Benjamins Publishers.

4. Mittelstrass, Jürgen. 1985. "Leibniz and Kant on mathematical and philosophical knowledge." In *The Natural Philosophy of Leibniz*, edited by Okruhlik, Kathleen and Brown, James Robert, 227-261. Dordrecht: Reidel.
See in particular § 2 *Mathesis universalis* pp. 232-239.

5. Pombo, Olga. 1987. *Leibniz and the Problem of a Universal Language*. Münster: Nodus Publikationen.

6. ———. 2002. "Leibniz and the encyclopaedic project." In *Ciência, tecnologia y bien comun: la actualidad de Leibniz*, 267-278. Valencia: Editorial de la Universidas Politecnica de Valencia.
"My talk will have three moments. In a *first moment*, I will try to identify the main determinations of encyclopaedic project in its whole. Since Varro (116-24 b.c.), *Rerum Divinorum et Humanorum Antiquitates*, St. Isidorus (560-636) *Etimologies*, Alsted *Encyclopaedia Omnia Scientiarum* (1630), or Diderot and D'Alembert *Encyclopédie ou Dictionnaire Raisonné des Sciences, des Arts et des Métiers* (1751-1765), to the *Internet* - which constitutes (I will argue) the most recent and eloquent development of the history of encyclopaedism - the aim will be to look for what is common to all this kind of excessive works. In a *second moment*, I will attempt to understand how Leibniz's idea of encyclopaedia inserts itself in that project of all times, what specific place Leibniz occupies within those many attempts. In the *third moment*, I will try to estimate the presence of Leibniz's idea of encyclopaedia in subsequent developments of encyclopaedism, namely in the XX / XXI century. This will be my humble contribution to this Congress whose major purpose is to think out the actuality of Leibniz."

7. Rabouin, David. 2012. "Interpretations of Leibniz's *Mathesis universalis* at the beginning of the XXth Century." In *New Essays on Leibniz Reception. In Science and Philosophy of Science 1800-2000*, edited by Krömer, Ralf; and Chin-Drian, Yannick, 187-201. Dordrecht: Springer.
"In his doctoral dissertation, completed in 1922 under the direction of Edmund Husserl and published in 1925 in the *Jahrbuch für Philosophie und Phänomenologische Forschungen*, Dietrich Mahnke proposed a very valuable

overview of the so-called “Leibniz Renaissance”. As indicated by the choice of his title: *Leibnizens Synthese von Universalmathematik und Individualmetaphysik*, this renaissance was seen by Mahnke as marked by a tension between two Leibnizian programs: that of a “universal mathematics” and that of a “metaphysics of individuation”. His agenda was to propose a way of reconciling these two programs through a point of view inspired by the development of Husserlian phenomenology. In this paper, I will concentrate on the first program, “universal mathematics” or *mathesis universalis*, and see how the interpretation of this Leibnizian theme was indeed a key point in the demarcation between different ways of articulating logic, mathematics and philosophy at the beginning of the XXth century. I will pay particular attention to the way in which commentators carefully selected their texts in the Leibnizian corpus. It will be an occasion to exhibit certain postulates lurking behind classical interpretations of Leibniz in the studies by Russell, Couturat, Cassirer, or Brunschvicg. I will then contrast these readings with another interpretation of Leibniz’s *mathesis universalis*, permitted by a better access to the texts and a somewhat calmer discussion around the relationship between logic, mathematics and philosophy. " (p. 187)

8. ———. 2019. "Mathematics and Imagination in Early Modern Times: Descartes and Leibniz’ mathesis universalis in the light of Proclus’ Commentary of Euclid’s Elements." In *Knowledge and the Power of Imagination, 17th-18th Centuries*, edited by Vermeir, Koen. Dordrecht: Springer.
   Not yet published.

Deutschen Studien

1. Danek, Jaromit, and Möckel, Christian. 2000. "Idee der Mathesis universalis - die logische Vernunft: Leibniz und Husserl." In *Phänomenologie und Leibniz*, edited by Cristin, Renato and Kiyoshi, Sakei, 88-121. Freiburg: Alber.
2. Heinekamp, Albert. 1975. "Natürliche Sprache und Allgemeine Charakteristik bei Leibniz." In *Akten des II Internationalen Leibniz-Kongresses. Hannover, 17-22. Juli 1972. Vol IV: Erkenntnislehre, Logik und Sprachphilosophie*, 257-286. Wiesbaden: Franz Steiner.
3. Mahnke, Dietrich. 1925. "Leibnizens Synthese von Universalmathematik und Individualmetaphysik." *Jahrbuch für Philosophie und Phänomenologische Forschungen*:305-612.
   Reprint: Stuttgart: Frommann 1964.
4. Poser, Hans. 1979. "Signum, notio und idea. Elemente der Leibnizschen Zeichentheorie." *Zeitschrift für Semiotik* no. 1:309-324.
   English Abstract: "Leibniz' approach towards a "*characteristica universalis*", a "universal art of signs" (Zeichenkunst), as an essential instrument of human knowledge is rooted both in the Cartesian ideal method of a universal mathesis and in the *ars magna* as a universal language comprising all the simple concepts and their combinations. The *signum* (sign vehicle) expresses a *notio* (concept) based on an idea fundamental to the *res* (object). The assumption here is that an isomorphic relationship between the logical and ontological areas is the precondition enabling denotation. However, the deficiency of human thought prevents characterization in its entirety; a multitude of sign systems - "Bereichscharakteristiken", area-specific characteristics - take the place of this ideal. Under these conditions it is also possible to transpose ordinary language into a *lingua rationis*. Beyond that, the importance of ordinary language consists in its correlating sign and meaning."
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1. Cardoso, Adelino. 1996. "Mathesis Leibniziana." *Philosophica: Revista do Departamento de Filosofia da Faculdade de Letras de Lisboa*:51-77.
"Dans cet article, l'auteur essaie de montrer qu'on trouve chez Leibniz une "mathesis", c'est-a-dire une conception du savoir et de l'organisation des savoirs, originale, laquelle est entierèment discernable d'autres "mathesis" qui ont été proposées par ses contemporains du XVIIe siecle. Du point de vue thématique, l'auteur croit que cette " mathesis" reçoit son intelligibilité de la relation que Leibniz établit entre la métaphysique et les mathématiques. Sous ce rapport, on constate des vraies transformations dans la pensée de Leibniz, dès le moment où il fait son adhesion au mécanisme (1668) jusqu'à la formulation de sa dernière pensée. Dans cette évolution, la correspondance avec de Volder joue un role décisif."

After Leibniz

Études en Français

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English Studies

1. Jesseph, Douglas M. 2010. "The “merely mechanical” vs. the “scab of symbols”: seventeenth century disputes over the criteria of mathematical rigor." In *Philosophical Aspects of Symbolic Reasoning in Early Modern Mathematics* edited by Heeffer, Albrecht and Van Dyck, Maarten, 273-288. London: College Publications.
"This paper deals with seventeenth-century understandings of rigorous demonstration. Although there was a widely-shared concept of rigor that has its origins in classical Greek sources, philosophers in the early modern period were divided over how to characterize the ultimate foundation for mathematics. One group (whom I term the “geometric foundationalists”) held that seeming physical concepts such as space, body and motion, were properly foundational. The other group (whom I call “algebraic foundationalists”)
claimed that the true foundations of mathematics must be abstract notions of quantity which were the subject of algebra, or even a more general *mathesis universalis* that encompassed all reasoning about number and measure.
The geometric foundationalists faced the objection that they had introduced “merely mechanical” or insufficiently abstract principles into the foundations of mathematics. In contrast, the algebraic foundationalists needed to rebut the accusation that they based mathematics on a “scab of symbols”, or empty notation divorced from anything real or substantial. I argue that this episode offers some useful insights into general questions about foundations, and can help us understand what is at stake in disputes over foundational issues, as well as how such disputes rise to prominence and then fade away."
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Inhaltsverzeichnis: Vorwort: V; Einleitung 1; I. Zur Herausbildung der "Matematischen Methode" im Zusammenhang der Entwicklung des Begriff der Methode 15; II. Descartes' Begriff der Methode im Verhältnis zu seiner Konzeption einer "Mathesis Universalis" 29; III. Zur Auffassung der "Mos Geometricus" un der "Mathesis Universalis" in der zweiten Hälfte des 17. Jahrunderts 69; IV. Das Verhältnis von matematischer Methode und "Mathesis Universalis" in der Philosophie von Leibniz 99; V. "Methodo Scientifica" und "Mathesis Universalis" in der Metodenlehre Christian Wolffs 125; VI. Johann Heinrich Lamberts Konzeption einer Wissenschaflichen Grundlehre 149; Literaturverzeichnis 161; Sachregister 166; Namenregister 169-170.
2. ———. 1979. "Die Semiotik Christian Wolffs als Propädeutik der ars characteristica combinatoria und der ars inveniendi." *Zeitschrift für Semiotik* no. 1.
English Abstract: "The central thesis in Wolff's approach towards semiotics is that a semiotically classified representation of philosophical sciences is a prerequisite to the development of an *ars inveniendi*. Assuming that an isomorphic relationship between concepts, signs, and things as well as between their differences and relations exists, Wolff develops a system of concepts resulting in a real *Organon* for philosophy. Wolff's method follows the ideal of explicating concepts originating in ordinary language, which, because of this origin, become lexicographically applicable, even independently of the theoretical context. While here (and this is true to Daries) all content of consciousness is assumed to be accessible to an analysis notionum and to be solely conveyed by signs, later on, language and signs are regarded as media capable of evoking their own effects."
3. Peckhaus, Volker. 1997. *Logik, Mathesis universalis und allgemeine Wissenschaft. Leibniz und die Wiederentdeckung der formalen Logik im 19. Jahrundert*. Berlin: Akademie Verlag.
Inhalt: Vorwort VII-VIII; 1. Einleitung 1; 2. Die Idee der *mathesis universalis* bei Leibniz 25; 3. Die frühe Rezeption Leibnizscher *mathesis universalis* und Logik 64; 4. Die "logische Frage" und die Entdeckung der Leibnizschen Logik 130; 5. Leibniz und die englische Algebra der Logik 185; 6. Ernst Schröder: "Absolute Algebra" und Leibnizprogramm 233; 7. Schluss 297; Verzeichnisse 309-412.

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Edmund Husserl

Études en Français

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Thèse inédite presentée à l'Université d'Ottawa.
2. Gérard, Vincent. 2001. *Mathématique universelle et métaphysique de l'individuation. L'élaboration de l'idée de mathesis universalis dans la phénoménologie de Husserl*.
Thèse inédite.
Résumé: "La *mathesis universalis* est-elle l'ontologie formelle ? Telle est la question à laquelle nous nous proposons de répondre dans ce travail. Dans la première partie, on trouve la genèse de l'idée de *mathesis universalis* comme

ontologie formelle. Dans la deuxième, les délimitations ontologiques de la *mathesis universalis* par rapport a la géométrie et l'axiologie formelle. dans la troisième, l'élucidation phénoménologique de la *mathesis universalis* comme théorie des sens apophantiques purs. Dans la quatrième, son articulation sur une métaphysique formelle ou théorie de l'individuation: la *mathesis universalis* est alors réarticulée sur l'ontologie formelle, mais en un autre sens de l'ontologie formelle. Les résultats auxquels nous sommes parvenu sont les suivants : 1) Husserl emprunte son concept de *mathesis universalis,* non pas à la *Règle* IV-b de Descartes, soit pour en accomplir le sens, soit pour la détourner de son sens, mais a la tradition arithmétisante de Van Schooten, Wallis, Newton et du Leibniz de 1695; 2) l'élaboration husserlienne de l'idée de *mathesis universalis* est une tentative pour identifier un ensemble de noyaux régulateurs (principe de permanence de Hankel, etc.) qui norment les possibilité d'admission d'objets dans le champ analytique formel; 3) la géométrie comme science de l'espace est exclue de ce champ; 4) il existe en revanche une analogie radicale entre l'axiologie formelle et la *mathesis universalis*; 5) Husserl n'est pas seulement redevable a Leibniz de l'idée de *mathesis universalis*, mais également de sa conversion philosophique; 6) la *mathesis* philosophique pensée a la lumière de la théorie de la connaissance telle qu'elle est élaborée par Leibniz vers 1684 n'est, ni ne veut être, une théorie de l' être, mais une théorie pure de la signification; 7) cette théorie de la signification s'articule sur une métaphysique formelle dont Husserl emprunte le concept a Lotze. Elle a pour tâche de décrire les formes idéales auxquelles doivent correspondre les relations entre les éléments d'un monde, quel qu'il soit."

3. ———. 2002. "La *mathesis universalis* est-elle l'ontologie formelle?" *Annales de Phénomenologie* no. 1:61-98.

4. ———. 2012. "*Mathesis universalis* et géométrie: Husserl et Grassmann." In *Philosophy, Phenomenology, Sciences. Essays in Commemoration of Edmund Husserl*, edited by Ierna, Carlo, Jacobs, Hanne and Mattens, Filip, 255-300. New York: Springer.

5. Ierna, Carlo. 2012. "La notion husserlienne de multiplicité : au-delà de Cantor et Riemann." *Methodos [en ligne]* no. 12.
"En raison du rôle changeant qu’il joue dans les différents ouvrages de Husserl, le concept de *Mannigfaltigkeit* a fait l’objet de nombreuses interprétations. La présence de ce terme a notamment induit en erreur plusieurs commentateurs, qui ont cru en déterminer l’origine dans les années de Halle, à l’époque où Husserl, ami et collègue de Cantor, rédigeait la *Philosophie de l’arithmétique*. Mais force est de constater qu’à cette époque Husserl s’était déjà ouvertement éloigné de la définition cantorienne de *Mannigfaltigkeit* en s’approchant plutôt de Riemann, comme le montrent les nombreuses études et leçons qui lui sont consacrées. La *Mannigfaltigkeitslehre* de Husserl semble donc plus proche de la topologie que de la théorie des ensembles de Cantor. Ainsi, dans les *Prolégomènes*, Husserl introduit l’idée d’une *Mannigfaltigkeitslehre* pure en tant qu’entreprise méta-théorique dont le but est d’étudier les relations entre théories, à savoir la manière par laquelle une théorie est dérivée ou fondée à partir d’une autre. Dès lors, lorsque Husserl affirme que le meilleur exemple d’une telle théorie pure des multiplicités se trouve dans les mathématiques, cela risque donc de prêter à confusion. En effet, la théorie pure des théories ne saurait être simplement identifiée aux mathématiques qui relèvent de la topologie, mais considérée en tant que *mathesis universalis*. Bien qu’une telle position ne fût sans doute pas entièrement claire en 1900-01, Husserl ne tardera pas à relier explicitement théorie des multiplicités et *mathesis universalis*.En ce sens, la *mathesis universalis*, théorie des théories en général, est une discipline formelle, apriori et analytique qui a pour but l’analyse des catégories sémantiques suprêmes et des catégories d’objets qui leur sont corrélées. Dans cet article j’essayerai de comprendre le développement de la notion de *Mannigfaltigkeit* au sein de la pensée de Husserl (de ses débuts mathématiques jusqu’au rôle central qu’elle jouera plus

tard) à partir de l'arrière-fond et du contexte mathématique du développement de la philosophie de Husserl lui-même."

6. Rabouin, David. 2006. "Husserl et le projet leibnizien d'une *mathesis universalis*." *Philosophie* no. 92:13-28.
7. Safou, Jean-Bernard. 2002. *Husserl et la métaphysique de Descartes: essai d'une interprétation phénoménologique du projet de la Mathesis universalis*. Thèse inédite disponible sur l' Atelier National de reproduction des Thèses - ANRT (Ref. 31760).
8. Winance, Eleuthère. 1966. "Logique, mathématique et ontologie comme '*mathesis universalis*' chez Edmund Husserl." *Revue Thomiste* no. 66:410-434.

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2. Hopkins, Burt C. 2011. *The Origin of the Logic of Symbolic Mathematics: Edmund Husserl and Jacob Klein*. Bloomington: Indiana University Press.
3. Lerner, Rosemary R.P. 2012. "*Mathesis Universalis* and the Life-World: Finitude and Responsibility." *The New Yearbook for Phenomenology and Phenomenological Philosophy* no. 12:136-154.
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6. Tito, Johannes Maria. 1990. *Logic in the Husserlian Context*. Evanston: Northwestern University Press.
7. Wiegand, Olav K. 2000. "Phenomenological-semantic investigations into incompleteness." In *Phenomenology on Kant, German Idealism, hermenutics and logic. Philosophical Essays in honor of Thomas M. Seebohm*, edited by Wiegand, Olav K., Dostal, Robert J., Embree, Lester, Kockelmans, Joseph and Mohanty, Jitendra Nath, 101-132. Dordrecht: Kluwer.
   See in particular § 2. *Husserl's phenomenological analysis of the mathesis universalis,* pp. 105-111.
   "Husserl's analyses of the mathesis universalis, in keeping with their detailed presentation in FTL [Formal and Transcendental Logic 1929], continue to offer a durable foundation for more extensive phenomenological investigations of the formal sciences. Here Husserl makes a particularly important distinction, one of exemplary significance for the whole of phenomenological description. In the first place, the mathesis universalis understood as objectively existing science -- in Husserl's terminology as objective logic (26) -- is to be phenomenologically-descriptively analyzed. In the second place, these investigations directed toward objective logic are to be supplemented through a subjective logic i. e., (27) through analyses of the cognitive structures of mathematical or logical knowing. The problems Husserl takes on in FTL according to these terms are particularly, (i) the relation between formal logic and mathematics (their co-extension and distinguishability), and (ii) the inner structure of the mathesis universalis. Both problems will be briefly addressed in what follows." p. 105

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2. Kuster, Frederike. 2008. *Wege der Verantwortung. Husserls Phänomenologie als Gang durch die Faktizität*. Dodrecht: Kluwer.
   Erste Kapitel: Eine *mathesis* der Geist und der Humanität.
3. Wiegand, Olav K. 1998. *Interpretationen der Modallogik. Ein Beitrag zur phaenomenologischen Wissenschaftstheorie*. Dordrecht: Kluwer.
   "The author's aim is to point out interpretations of modal logic which are compatible with the phenomenological approach to mathematics. The book consists of three parts with ten chapters. In the first part (pp. 19-77) the author presents E. Husserl's conception of a "mathesis universalis". For Husserl, the mathesis universalis contains both, formal mathematics and formal (symbolic) logic. It has a hierarchical structure consisting of a pure logical grammar, a logic of consequences and a logic of truths. The author pays special attention to the differences between formal logic and formal mathematics which can be observed despite their extensional identity.\par In the second part (pp. 81--143) the author presents what he calls "phenomenological semantics", i.e. the phenomenological theory of modalization being a general analysis of intentions. The author distinguishes three levels of modalization, the level of protological passive synthesis, the level of protological active synthesis, and the level of (logical) predication.\par The third part (pp. 147--194) combines the results of the preceding parts in a phenomenological criticism of modern modal logic, especially its interpretation as possible worlds semantics. The problems of applying this semantics to natural language are seen as anchor points of phenomenological criticism. The provability interpretation of modal logic is proposed as a genetic interpretation, notwithstanding the problems which Hilbert's program and Husserl's closely related idea of definite manifolds had with Gödel's and Church's results. (Volker Peckhaus)".

Ludwig Wittgenstein

Études en Français

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