Historical Roots of Gottfried Wilhelm Leibniz's Universal Science

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This paper analyses different retrospective links between the scientia generalis by Leibniz and the three key traditions of the Renaissance and Early Modern Europe – the philosophical, the rhetorical and the encyclopaedic one. The issue demonstrates the insufficient charachter of the two influential interpretations of the idea of scientia generalis by Leibniz – as a project of elaborating a a method of mathematical calculations for non-mathematical subjects (L. Couturat, J. Mittelstraß, V. Peckhaus etc.) and as a project of an encyclopaedic synthesis combining ideas of the Lull's Ars magna and humanistic rhetoric by M. Nizolius with the philosophical-theological encyclopaedism of J. Alsted and B. Keckermann (P. Rossi, W. Schmidt-Biggemann, T. Leinkauf etc.). The author presents the thesis that the formation of Leibniz's idea of scientia generalis as well as some other concepts of the universal science in 17th century philosophy are the result of rethinking and expanding of the concept of the "first philosophy" delivered by Aristotle in his "Metaphysics".

Keywords: Leibniz, universal science, encyclopaedism, history of science

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В статье рассматриваются различные ретроспективные связи между scientia generalis Лейбница и тремя ключевыми традициями Возрождения и раннего Нового времени – философской, риторической и энциклопедической. В статье показана недостаточность двух влиятельных интерпретаций идеи всеобщей науки Лейбница: как проекта разработки математического исчисления для нематематических предметов, продолжающего традиции картезианского рационализма (Л. Кутюра, Ю. Миттельштрас, Ф. Пекхаус и др.), и как проекта энциклопедического синтеза, соединяющего идеи «великого искусства» Р. Луллия и гуманистической риторики М. Низолия с философско-теологическим энциклопедизмом И. Альстеда и Б. Кекермана (П. Росси, В. Шмидт-Биггеман, Т. Лейнкауф и др.). Автор предлагает обоснование тезиса, согласно которому формирование идеи scientia generalis Лейбница, а также некоторых других концепций универсальной науки в XVII в., связано прежде всего с переосмыслением и расширением концепции «первой философии», развитой в «Метафизике» Аристотеля.

Ключевые слова: Лейбниц, универсальная наука, энциклопедизм, история науки

The philosophy of Leibniz had the project of universal science as one of its central motives. The philosopher worked actively on it from 1676-1686. The abundance of archival materials on the problem of universal science (published and unpublished) notwithstanding, the experts in Leibniz cannot agree either on the meaning of this notion, or to what philosophical tradition it should be attributed. There are two trends in contemporary studies of the project of universal science by Leibniz. One could be traced back to Louis Couturat, where universal science is interpreted as a method of mathematical calculations for non-mathematical subjects that laid foundations for all reliable knowledge [Couturat, 1901; Mittelstraß, 1979; Duchesneau, 1993; Krüger, 1969; Mittelstraß, Schröder-Heister, 1986; Peckhaus, 1997]. This interpretation of universal science places it within the context of the history of Modern European rationalism in general and Cartesian philosophy in particular. Another trend implies searching for and tracing retrospective links between Leibniz's scientia generalis and the rhetorical and encyclopaedic tradition of the Renaissance and Early Modern Europe, so that Leibniz's universal science is viewed as an analogy to the mathesis universalis by Descartes, and to the traditions of Lull's Ars magna (Lull, Alsted, Comenius), humanistic rhetoric (Nizolius), logical and methodological reforms (Petrus Ramus, Zabarella, Keckermann) and encyclopaedism [Rossi, 1983; Schmidt-Biggemann, 1983; Leinkauf, 1993; Meier-Kunz, 1996; Moll, 2002]. In this study we shall try to demonstrate that the most important reference for Leibniz's project of the universal science which makes it possible to connect both trends of interpretation and to clarify the significance of both traditions for the formation of Leibniz' scientia generalis is the concept of metaphysics delivered by Aristotle.

1. The unity of knowledge in the project of 'Ars magna' by Raymond Lull

The desire to unify the laws of knowledge and to build a united system of knowledge that would reflect the structure of the universe and lead men to the knowledge of God was characteristic of Early Modern European philosophy and science. This desire found its reflection in a number of cultural phenomena, but first of all – in the tendency towards encyclopaedism and in the search for one method of knowledge. The number of projects that were based on universalist principles of this type included the search for universal science and universal language. These were linked genetically and rooted in the tradition of the *ars magna* by Raymond Lull and natural theology of his followers.

Raimond Lull (p. 1235–1315) was the first European philosopher to attempt to create a universal science of all existing things[1]. In the spirit of medieval realism that had interpreted universals as having independent existence, Lull thought it possible to view the world as a total of various intelligible combinations formed according to the laws of logic. In order to find these laws, that is, to reveal the true nature of and connections between things, Lull developed a method that he called *ars generalis*, *ars universalis*, or *ars magna*. The main point of the method was to reduce all possible human knowledge to a certain set of primary truths, to the 'alphabet of human thoughts'. The combination of the primary terms should provide, according to Lull, the establishing of all possible derivative truths, for example, the definitions of space, etc. The fundamental difference between Lull's universal science and other models of knowledge lays in the fact that it is not based on a hierarchical division of knowledge into particular disciplines, but rather on a combinatory method that provides a logical connection between all things and all knowledge. In his 'Liber de ascensu et descensu intellectus' (1305) Lull described the ascent of human intellect to the knowledge of divine archetypes, on the ladder of creation, from the lowest (stones) to the highest (angels) and further to God [Rossi, 2001, p. 35].

The ideas of Lull enjoyed great popularity in the Late Middle Ages, and in the Renaissance when the school of Lullists was established. Renaissance encyclopaedists and pansophists viewed the art of Lull as the *clavis universalis*: they thought it possible to draw a direct analogy between cosmological hierarchy and the hierarchy of knowledge. At the same time, neither Lull nor his enthusiastic followers had ever thought metaphysics to be an object of their specific interest. The attractiveness in Lull's system was its underlying universal symbolism, or 'natural semiotics', oriented towards symbolic interpretation of divine signs written in the 'book of nature'; it had the idea of universal language as a direct result of its development. Lull's universal symbolism found its continuation in the metaphysics and ideas of natural language by Nicholas of Cusa, and in the concept of natural theology by a Catalan Lullist Ramon Sibiuda. The latter attempted to develop a science of creation based on the reading of *liber naturae*, rather than the studying of the Scripture [Rossi, 2001, p. 34]. The direct influence of Lullism, or, rather, the attempts to reform it, helped create numerous versions of universal knowledge, for instance, the programme of universal science by Bernard de Lavinheta and Heinrich Cornelius Agrippa. Lull's image of the tree of sciences was also adopted by Francis Bacon and Rene Descartes [Johnson, 1981, p. 37].

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[1] On philosophy of Raimond Lull, Lullism and its influence on Leibniz's combinatorics see: [Yates, 1954; Doucet-Rosenstein, 1981; Rossi, 1983; Schmidt-Biggemann, 1983; Bonner, 2007].

2. Encyclopaedism and universal science: the context of Humanism

A number of intellectual movements oriented towards encyclopaedic scope and the systematization of knowledge emerged in Europe in the 16-17th century. The term 'encyclopaedia' was invented by Humanists in the late 15th century. The term was derived from the Greek word κυκλοπαιδεία[2], which Humanists saw as analogous to the Latin terms orbis disciplinarum, orbis doctrinae, encyclios disciplina. By the mid-sixteenth century, this word was widely used, but often meant a mutually ordered account of sciences, not an all-embracing compendium of knowledge [Dierse, 1977, p. 9]. Humanists were the most passionate advocates of encyclopaedism as they aimed at a combination of logic and eloquence modelled on the Ciceronian image of the perfect speaker. Thus, an Italian Humanist, Marius Nizolius, connected the notion of encyclopaedia directly with 'the one science' by Cicero[3], that is, a synthesis of eloquence and philosophy [Nizolius, 1553][4]. Nizolius presented his own model of encyclopaedia, made of three parts – 'physics, or natural philosophy', 'politics, or civil philosophy', and 'eloquence' (or logic and rhetoric).

Another example of the way the encyclopaedic ideal was linked to the notion of universal science in humanistic circles was the book, 'Dello speccio di scientia universale', published by a medical doctor, Leonardo Fioranti, in Venice in 1603 [Fioravanti, 1603], where one of the first uses of the term was to be found. This work was a compilation and consisted of three parts, where the author described the origin and destiny of all possible arts, sciences, and crafts that could ever be useful to the humankind. The author certainly did not desire to build an original genetic model of the described sciences but rather saw a science as wisdom necessary in everyday life. The works of an English philosopher, Walter Warner (1562-1643), also persuades us that the seventeenth-century notion of universal science did not mean a method but rather an

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[2] The notion of κυκλοπαιδεία goes back to the Greek words εγκυκλιωσ παιδεια, which in Ancient Greece meant the subjects to be studied by the children of citizens [Dierse, 1977, p. 6].

[3] When presenting an image of an ideal rhetorician in Book 3 of his 'Orator', Cicero gave him 'a miraculous unity of speech and thought'. Cicero insisted it was necessary to return to the practice of ancient thinkers before Socrates who did not divide the science of speech from studies and knowledge of all human life. In Cicero's opinion, philosophy and eloquence shared a source, so that eloquence together with philosophy could become the one science that was the source of all possible knowledge; cf. [Cicero, 1995, p. 316].

[4] This work was also published by Leibniz in 1670 in Frankfurt with his extensive critical introduction. It was re-printed in 1674, also in Frankfurt, under a title "Antibarbarus Philosophicus". The citations here are from the first edition. See also [Dierse, 1977, p. 13–15].

exhaustive corpus of knowledge where particular sciences represented the strictly ordered whole[5]. A similar meaning of the expression scientia universalis was to be found in 'Universal Science' by Charles Sorel [Sorel, 1641], where the author insisted that it was necessary to create a new system of sciences "based on reason and experiment" and corresponding to the natural order of things.

3. Universal science as first philosophy

In contrast to humanistic circles where the term 'universal science' was blurred and ambiguous, the only field where it could be viewed as *terminus technicus* was in Protestant theological tradition that presented a consistent re-interpretation of Aristotelian and scholastic traditions. It was theologians who debated the delineation between the science of things and the science of God in the 16-17[th]c. This differentiation is genetically linked to the ambiguous definition of Aristotle's 'first philosophy': in his 'Metaphysics' it meant both the science of things (and in this case it embraced theology, mathematics and physics), and the science of God (in that case it only included theology).

What had been defined as the differentiation between *metaphysica generalis* (the 'first philosophy' by Aristotle, which studied existing things) and *metaphysica specialis* (the doctrine of God and immaterial things) in the scholastic tradition, Protestant theology transformed into the doctrine of the two types of sciences – the science of God, as much as He could be perceived by men, and the universal science (*scientia universalis*) that provided foundations for all particular sciences. A clear example of intensive theological and terminological search of the period was provided in 'Isagoge in Isagoge in Peripateticorum et Scholasticorum Primam Philosophiam primam philosophiam', (1598) written by a Marburg professor, Rudolph Goclenius, who defined the 'first philosophy' as 'universal science' (*scientia universalis*) that dealt with the first foundations of all existing things as well as the first divine substance. Goclenius used synonyms for the 'first philosophy': the notion of wisdom (philosophy, as such), theology, and metaphysics that dealt with transcendental things [Lohr, 1999, p. 290–291]. Thus, Goclenius identified the notion of 'general knowledge' with Aristotle's 'first philosophy', or metaphysics.

Another allusion to Aristotle's 'Metaphysics' is represented by the notion of 'universal science' by Francis Bacon. In the third book of the 'Great Instauration', Bacon set forth a doctrine of one foundation for all sciences, that is, a 'universal science' [Bacon, 1829, p. 151]. Bacon identified it with the 'first philosophy' and with 'wisdom', which was a

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5   See: [Rossi, 2001, p. VIII].

direct reference to Aristotle's definition of 'sought science' as the 'first science' and 'wisdom'. The fact that the immediate prototype for the Baconian concept of 'universal science' was 'Metaphysics' by Aristotle is proved, strangely as it is, by Bacon's demonstrative break with all previous tradition that had falsely identified, in his own words, the notions of the 'first philosophy' and 'metaphysics' [Bacon, 1829, p. 163]. He placed metaphysics within the realm of natural philosophy that, according to him, should not only have its subject in 'external existence, movement and natural necessity but also ... reason and idea' [Bacon, 1829, p. 164]. Bacon placed this kind of metaphysics among innovative disciplines, that is, the ones that were still to be created.

As it was the case with Bacon, it was the 'innovative' context where the notion of universal science was commonly used by Descartes, and it seems to have confused some scholars of early Modern philosophy who have failed to recognize traditional allusions of the term. For instance, the work by Jurgen Mittelstrass [Mittelstraß, 1979] studied specifically the differences between the notion of universal science by Descartes and his *mathesis universalis*, and it has been established that the first notion was wider than the second. Mittelstraß based his analysis of the two main methodological works by Descartes: the 'Discourse of the method' that had initially been called the 'Project of universal science that could raise our nature to the highest level of perfection'; and the 'Rules for the Direction of the Mind' where universal science was called universal wisdom. The aim of Mittelstraß was to show that Descartes thought the unity of the mind (common sense) to be the foundation of the possibility of universal science as it was a basis for all sciences (including empirical ones). Unlike the universal science, the notion of *mathesis universalis* by Descartes had been better defined and applied exclusively to quantitative disciplines such as astronomy, music (theory of harmony), optics, and mechanics. These sciences thus were *a priori*, or formal, and their unity was not explained from their contents, but from method, that is, through their subjection to the theory of computation and proportions.

The differentiation between the notion of universal science by Descartes and his *mathesis universalis* was reinforced by the ambiguous historical and philosophical context that shaped new philosophical theories of Modernity – that is, their polemics with tradition. Thus, Descartes identified universal science with the notion of universal wisdom and it clearly pointed towards the 'sought science' or the 'first philosophy' by Aristotle. The concept of *mathesis universalis*, in its turn, had Neo-Platonic sources and went back to the concept of 'one science'; Descartes knew its programme through Proclus' commentary to the 'Elements of Geometry' by Euclid. The terminological line between the two notions was rather uncertain since they both went back to Aristotle's 'sought science' and reflected its ambiguous nature, so that Descartes viewed universal science

as a science of existing things, and *mathesis universalis* as a science of intelligible things. The difficulty that contemporary scholars face: how to evaluate the correlation between the two aspects of the same science, in my opinion, reflects the fundamental problem in the construction of the new models of metaphysics that intend to overcome the breach between ideal and real, Creator and creature. It seems that here lays the problem of 'complete metaphysical computation of existing things' that Leibniz later tried to solve with his project of universal science through creating his projects of the logic of contingency.

4. 'Universal Encyclopaedia' by Johann Heinrich Alsted and 'Pansophia' by John Amos Comenius

While Descartes made his project of universal science dependant on the success of the new metaphysics, his contemporaries – Protestant philosophers of the first half and the middle of the 17th c. who were affiliated with the German university of Herborn – strived to implement a version of universal science rooted in Lullism.

Johann Heinrich Alsted[6] was the central figure of this circle, a fine example of Protestant encyclopaedism. In his early work, 'A key to the art of Lull' ('Clavis artis Lullianae', 1609), Alsted advocated the science of 'all that could be known' (*de omnium scibili*) [Alsted, 1609, p. 20]. Having rejected Keckermann's criticism of Lullism, namely that Lull's art was tangled and incomplete, Alsted insisted that, outward heterodoxy notwithstanding, the first principles of Lull presented a highly articulate system. Alsted stated that all first notions set forth by Lull were logical notions; their difference from all others was that as *primae notiones* they had a special ontological status, i.e., they existed outside of a cognitive mind. Bearing on this statement, Alsted then found it possible to borrow Lull's alphabet of human thoughts, where logical categories, or the *topoi* of invention, were simultaneously divine attributes, or metaphysical principles. It is remarkable that in 'Clavis artis Lullianae', and in his later work 'Trigae Canonicae' (1612) Alsted added Aristotelian categories to the absolute notions of Lull. On the base of this alphabet, Alsted created his own 'general philosophical Lexicon' that was to lay foundations for all sciences [Schmidt-Biggemann, 1983, p. 112].

Early works by Alsted also included his 'Philosophia dignè restituta' [Alsted, 1612], where gnoseological and metaphysical grounds for universal science were presented in their fully developed form. In the spirit of Neo-Platonic doctrine of the connection of human mind to the divine, Alsted defined the philosophy and wisdom as a pre-condition for the

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[6] On Alsted see: [Close, 1969].

possibility to cognize God. Alsted made a special section of philosophy – 'Archaeology' – as the foundation of 'universal science'. 'Archaeology' was the science of beginnings, the 'basis of all sciences'. Together with 'Hexilogy' (the science of human cognitive ability), 'Technology' (the science of encyclopaedia and the specialities of particular sciences), and 'Canonica' or 'Dialectics' (the science of method), Archaeologia formed the field of premonitory knowledge that Alsted called Praecognita.

Theoretical and methodical rules of universal encyclopaedia, presented in the 'Philosophia dignè restituta', were implemented in the two encyclopaedias by Alsted, published in 1620, although in different gnoseological and theological context. Alsted embraced orthodox Calvinism in the mid-1610s and rejected the doctrine of human mind partaking of divine Mind. His interest in Lullism was also pushed into the background. Yet even at the 'post-Lullist' stage, Alsted continued to develop the concept of universal science although in a rather different form. The 'Encyclopaedia in seven volumes' [Alsted, 1630], the second, revised edition of an earlier work of 1620, is the best known and the most important work by Alsted. It influenced the encyclopaedic projects of Leibniz directly: in late 1660s Leibniz saw that Alsted's work of 1630 was a possible basis for his own encyclopedia[7]. At the very beginning of his work, pointing out the Greek origin of the term encyclopaedia, Alsted, however, remarked that, unlike the Ancient system of seven liberal arts, his encyclopaedia was 'absolute', i.e., the 'system of systems', the 'circle of all disciplines used in this life' [Alsted, 1630, p. 49].

Alsted explained the unity of disciplines both in the spirit of natural theology and on the grounds of logical relations: the accord between the true elements of various subjects (the relations of family members, a father and a son), a shared goal (glory of God and relative rise of man above his smallness), and finally, the unity of disciplines in their implementation [ibid., p. 63]. In other words, Alsted explained the unity of sciences by the shared first principles, the same subject of cognition (intellect and the art of will), the same object of cognition (truth and good) and finally, the same aim of cognition (human perfection) [ibid., p. 75].

In accordance to the main aim of the encyclopaedia, which consisted in the restoration of the original perfection of the man, Alsted developed the doctrine of human thinking that went up to cognition influenced by natural light and divine grace. The foundation of 'internal science' was natural light (*lumen naturae*), that was given to man at the moment of Creation and was preserved after the Fall as an impression of his original condition. This natural light was the 'radiance of divine wisdom' through which "light is recognized, that is, the obviousness and firmness of the first principles and conclusions derived from them" [ibid., p. 53]. Natural light influenced three

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[7]   See: [Leibniz, 1990, p. 394–397], also see: [Dierse, 1977, p. 26].

main intellectual abilities of man – intelligence (*intellegentia*), syntheresis (*synteresis*), and conscience (*conscientia*) [ibid., p. 51]. Alsted called these qualities the sources of "all that could be taught and studied in sciences" [ibid., p. 51]. Intelligence, which Alsted identified with the Greek νοῦζ, was a contemplative ability to perceive the first theoretical principles. Syntheresis was a practical ability to perceive the first practical premises in theory, while conscience was an ability to perceive practical premises in application to itself. Alsted called the divine light that influenced practical qualities, the law of nature (*lex naturae*). Moreover, he includes the so-called poetic intelligence (*intellegentia poetica*), also called organic, to the number of fundamental abilities responsible for the perception of the first principles [ibid., p. 53]. Thus, according to the unity of human nature, natural light influenced both theoretical and practical spheres of human activity and revealed its foundations.

Alsted's encyclopaedism served as a starting point for the doctrine of Pansophia, developed by his student, John Amos Comenius[8]. The best known work by Comenius, the 'Pansophiae Prodromus' [Comenius, 1644], was nothing else but an expanded theological justification of the possibility of all-encompassing knowledge of the world. For all evident similarities in the theological presumptions of universal science by Alsted and Pansophia by Comenius, there are considerable methodological and philosophical differences between the two projects. First of all, it concerns the problem of the first elements. Alsted thought that first *a priori* foundations of all knowledge had initially been intelligible entities (as in Lull's alphabet and in substantiated Aristotelian categories), and then were transformed into the functions of intellect (*habitus intellectuales*). Comenius, however, defined the field of knowledge as including both intelligible notions and 'things themselves' in their sensuality, "we warn against the neglect of them" [Comenius, 1644, p. 95]. The comparison of the descriptions of things with things themselves was indispensable for Comenius' Pansophian method, so that in his doctrine things themselves were adequate representations of the first elements: "since things, ideas of things and images of these ideas (words) are parallel to each other, so I thought that these basic elements could be rendered similarly by things, ideas and words" [Comenius, 1644, p. 86]. Here, one could glimpse the two philosophical problems that would preoccupy young Leibniz: the problem of the combination of rationalism with sensualism, and the problem of sign, which reflected the debates on universal philosophical language started by the very first generation of Lullists.

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[8] The term 'Pansophia' was introduced in a Rosicrucian work of 1616, later it could be found in Alsted's Encyclopedia of 1630, and in 1633 an analogous appeared in the title of a work by one Laurenberg, a physician from Rostock, 'Pansophia, or philosophical Paideia'. On Pansophia by Comenius see: [Schmidt-Biggemann, 1983]; also see: [Schmidt-Biggemann, 1989, p. 56–58].

It has been stated above the view of the world as a reflection of the Creator was commonplace in humanist thought, and its expression could be found both in encyclopaedic works and in such forms of activity as the systematization of knowledge and forming of scientific collections[9]. Led by a desire to represent all things of the world systematically, the museology of the late 16th – early 17th c. developed its own forms of an encyclopaedic list of things based either exclusively on visual images, or on a combination of verbal catalogue, where notions were represented, with some visual images, where particular things were represented. Both Francis Bacon and Leibniz paid attention to the art of creation collections that reflected the Universe[10]. So the fact that Comenius included 'things themselves' in his Pansophian book should not be viewed as a departure from the programme of Encyclopaedia, but rather as its extension. It is not surprising that this approach to the problem of representation found its continuation in the deliberations of a moderate nominalist Leibniz on the ways to organize a perfect encyclopaedia.

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[9]   On this see [Osminskaya, 2004].
[10] On Leibniz and collecting of the Baroque period see [Bredekamp, 2004]. See also an article on Leibniz: [Bredekamp, 2005].

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