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Poeta Calculans: Harsdörffer, Leibniz, and the *mathesis universalis*

Jan C. Westerhoff

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*.[1]

Because such a work, especially when attempted within the scope of a paper, needs a clearly determined focal point, I shall concentrate on the works of two baroque savants, Gottfried Wilhelm Leibniz and Georg Philipp Harsdörffer. The reason for the choice of Leibniz is obvious: there is no single philosopher whose entire intellectual career, from his earliest youth to his death-bed, was so deeply connected with the idea of a *mathesis universalis*. Harsdörffer has the advantage of being not only a poet but also a language-theorist and scientist, and this informs the conceptual background of his poetry. In order to explain that background I shall also rely to some extent on the works of Justus Georg Schottel, a fellow language theorist and personal acquaintance of Harsdörffer's.

Three of Harsdörffer's works will be at the center of our attention, the *Frauenzimmer Gesprächsspiele*,[2] an eight-volume series of dialogues about social, poetic, and scientific matters, which incorporates much of Harsdörffer's

[1] And see John Neubauer, *Symbolismus und symbolische Logik: Die Idee der Ars Combinatoria in der Entwicklung der modernen Dichtung* (Munich, 1978), 40-178.

[2] Georg Philipp Harsdörffer, *Frauenzimmer Gesprächsspiele* (8 vols.; Nürnberg, 1641-49; repr. Tübingen, 1968); see Rosemarie Zeller, *Spiel und Konversation im Barock. Untersuchungen zu Harsdörffers "Gesprächsspielen"* (New York, 1974); and Kenneth G. Knight, "Harsdörffers 'Gesprächsspiele' und ihre Nachwirkung," *Georg Philipp Harsdörffer: Ein deutscher Dichter und europäischer Gelehrter*, ed. Italo Michele Battafarano (Frankfurt am Main, 1991), 181-94.

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own poetry and even entire plays; the *Delitiae Mathematicae et Physicae*,[3] a three-volume scientific work, of which Harsdörffer edited the last two volumes and which deal with a number of sciences in question-and-answer form; and the *Poetischer Trichter*, Harsdörffer's *magnum opus* on the theory of poetry.[4]

The Idea of the *mathesis universalis*

The Leibnizian project of the *mathesis universalis* took off from the idea of finding a method of deciding all questions, whether they belonged to physics,[5] to metaphysics,[6] or to any other science,[7] with mathematical certainty. This should be brought about by inventing a universal system of notation, which would allow the detection of errors of thinking as purely grammatical or syntactical errors.[8] This system should consist of two parts, the *lingua characteristica* and the *calculus ratiocinator*.[9]

The *lingua characteristica*[10] was supposed to act as a system of notation for "the alphabet of human thoughts,"[11] i.e., for the primitive concepts.[12] For Leibniz all conceptual complexity arises as the result of a combination of simple concepts.[13] By combining the primitive concepts one can produce more complex ones and thus gain new knowledge. Similarly, every concept can be resolved into

[3] Georg Philipp Harsdörffer, *Delitiae Mathematicae et Physicae* ... (Nürnberg, 1651-53), II and III, especially the chapters "Von der Schreibkunst."

[4] Georg Philipp Harsdörffer, *Poetischer Trichter: Die Teutsche Dicht- und Reimkunst/ ohne Behuf der Lateinischen Sprache/ in VI. Stunden einzugiessen* (Nürnberg, 1648-53; repr. Darmstadt, 1969); Jörg-Ulrich Fechner, "Harsdörffers 'Poetischer Trichter' als Poetik geistlicher Dichtung," *Harsdörffer*, ed. Battafarano, 143-62.

[5] Louis Couturat (ed.), *Opuscules et fragments inédits de Leibniz: Extraits des manuscrits de la Bibliothèque royale de Hanovre* (Paris, 1903), 94.

[6] Carl Immanuel Gerhardt (ed.), *Die philosophischen Schriften von Gottfried Wilhelm Leibniz* (Berlin, 1875-90), I, 119.

[7] Eduard Bodemann, *Der Briefwechsel des Gottfried Wilhelm Leibniz in der Königlichen öffentlichen Bibliothek zu Hannover* (Hannover, 1889), 16.

[8] Gerhard, *Leibniz*, VII, 205.

[9] Leibniz's terminology for these matters varies; sometimes (e.g., Wilhelm Risse, "Die Characteristica Universalis bei Leibniz," [*Studi Internazionali di Filosofia*, 1, 107-16], 107) the whole project is called "characteristica universalis," sometimes (e.g., Volker Peckhaus, *Logik, Mathesis Universalis und allgemeine Wissenschaft: Leibniz und die Wiederentdeckung der formalen Logik im 19. Jahrhundert* [Berlin, 1997], 31) this is taken to denote what we have called *lingua characteristica*. The above terminology is chosen merely for the sake of uniformity and does not imply that Leibniz used these terms most often or in the most important contexts. See Günther Patzig, "Leibniz, Frege und die sogenannte 'lingua characteristica universalis,' " *Studia Leibnitiana*, 3 (1969), 107-8.

[10] Cf. Peckhaus, *Logik*, 31-32.

[11] E.g., Gerhardt, *Leibniz*, VII, 198-99; Couturat, *Opuscules*, 430.

[12] Bodemann, *Briefwechsel*, 80-81; cf. Wilhelm Schmidt-Biggemann, *Topica Universalis: Eine Modellgeschichte humanistischer und barocker Wissenschaft* (Hamburg, 1983), 195.

[13] See Albert Heinekamp, "Ars Characteristica und natürliche Sprache bei Leibniz," *Tijdschrift voor Filosofie*, 34 (1972), 459-63; also William Kneale and Martha Kneale, *The Development of Logic* (Oxford, 1962), 326.

the most simple concepts that constitute it in a unique way.[14] The *lingua characteristica* was supposed to make this conceptual constitution obvious, so that there could not possibly be any doubt left about what a given concept entailed. Furthermore, it should be a means of visualizing proofs, to enable people to check the correctness of a derivation at a glance.[15]

The aim of the *calculus ratiocinator*[16] was to provide a means of systematic work with the notational system of the *lingua universalis*, i.e., the recombination of the primitive signs according to specific rules.[17] The latter was intended as a means of obtaining a clear *expression* of concepts, the former as an auxiliary for their transformation, i.e., the process of reasoning and thinking. The idea of the *calculus ratiocinator* thus comes quite close to the modern idea of formal logic.

Leibniz tried to design this calculus similar to those of arithmetic so that it would literally be possible to "calculate" the correctness of an inference in a purely mechanical way without needing any ingenuity.[18] His most famous design was based on the idea of assigning prime numbers to the simple concepts and to represent complex concepts as products of these. Because every number can be uniquely reduced to its prime factors, the "characteristic number" of each concept could be uniquely resolved into the primitive concepts which compose it.[19] Leibniz also discussed some extensions of this basic idea[20] and was finally able to represent syllogistic rules of inference in his arithmetical system.[21]

It thus becomes clear that there are two crucial notions that determine Leibniz's account of the *mathesis universalis*. The first is the idea of the *combinatorial nature* of his system of notation: the primitive concepts in the *lingua characteristica*, which provide the foundation for the whole system, are conceived as being the basis of a combinatorial process of the development of this language. The second idea is that the whole system is open to a *mechanical treatment*, which is guaranteed by the arithmetical nature of the *calculus ratiocinator*. The whole process of generation, transformation, and decision in this language could be in principle performed by a machine.

[14] Gerhardt, *Leibniz*, IV, 4; VII, 293.

[15] Peckhaus, *Logik*, 31.

[16] Cf. *ibid.*, 33-34.

[17] Gerhardt, *Leibniz*, VII, 206.

[18] Cf. Peckhaus, *Logik*, 41.

[19] See Couturat, *Opuscules*, 42-70; also Wolfgang Lenzen, *Das System der Leibnizschen Logik* (New York, 1990), 21-27; Jürgen Mittelstrass and Peter Schroeder-Heister, "Zeichen, Kalkül, Wahrscheinlichkeit. Elemente einer mathesis universalis bei Leibniz," *Pragmatik. Handbuch pragmatischen Denkens*, I: *Pragmatisches Denken von den Ursprüngen bis zum 18. Jahrhundert*, ed. Herbert Stachowiak (Hamburg 1986), 392-414, 400-406; Jan Lukasiewicz, *Aristotle's Syllogistic from the Standpoint of Modern Formal Logic* (Oxford, 1951), 126-29; and Hans Aarsleff, "Leibniz and Locke on Language," *From Locke to Saussure: Essays on the Study of Language and Intellectual History*, ed. Aarsleff (London, 1982), 43.

[20] Assigning *two* numbers, one positive and one negative, to each primitive concept; see Couturat, *Opuscules*, 71-92.

[21] See also Peckhaus, *Logik*, 43.

I shall show in the following how these two conceptions of "language" are also present in Harsdörffer's practice of poetry as well as in his theoretical remarks. It will also become clear that the *reasons* for holding these views are similar, since both the philosopher and the poet try to develop a fundamentally adequate picture of the nature of things.

Combination

The conception of the *mathesis universalis*, particularly that of the *lingua characteristica*, rests on a fundamentally combinatorial basis. Thus it is not surprising that Leibniz gives his first detailed account of it in a mathematical treatise written as a young man, the *Dissertatio de Arte Combinatoria* of 1666.[22] The *mathesis universalis* was not just conceived as a system to which combinatorial methods could be applied but was thought to intrinsically embody combinatorial notions.

At least *prima facie* the case seems somewhat different when considering natural language. Applying the combinatorial method to it appears to be something alien, coming from the outside. However, baroque authors, and particularly Harsdörffer, did not see it this way: for them combinatorial principles could be fruitfully and indeed naturally applied in constructing poetry. If this opinion is held, there are at least three different possible ways in which to proceed: one can start at the level of individual letters and generate words and sentences as combinations of these, one can take the words themselves as the primitive entities and generate sentences in a combinatorial way, or one can use a more complex procedure by taking *two* kinds of entities as primitives, namely, word stems and grammatical endings, creating words out of combinations of these two and complete sentences out of the combinations of the words produced.

There are examples of all three forms in baroque poetry and language theory. I shall discuss some of those from Harsdörffer's works and show the connection with the combinatorial conception of systems of notation in Leibniz's project of the *mathesis universalis*.

If a poet takes individual letters as primitive elements of language, he is naturally led to the study of anagrams. The anagrams of a word are all those words which are elements of the set of permutations of the first word, e.g., the anagrams of the German "Leib" are "lieb," "Beil," and "Blei."[23] This method can be extended by not forming the anagrams of a word but of a sentence or a short text, e.g., "Die fruchtbringende Gesellschaft" gives "Deutscher Gegend

[22] Leibniz, *Dissertatio de Arte Combinatoria. In qua Ex Arithmeticae fundamentis Complicationum ac Transpositionum Doctrina novis praeceptis exstruitur* ... (Leipzig, 1666), esp. 70-73 (all page numbers refer to Gerhardt, *Leibniz*, IV, 27-104).

[23] Harsdörffer's example, *Trichter*, II, 20, also *Gesprächsspiele*, III, 327.

lieblicher Safft."[24] Needless to say that the longer the text is, the more difficult it becomes to find some or all of its anagrams.[25] Harsdörffer frequently discusses anagrams in his major literary and scientific works,[26] first and foremost as means of poetical invention:

> The permutation of letters is part of the Hebrew cabala and produces valuable thoughts, increases the faculty of invention, generates pleasantness and a particular proportion of poems, and it produces witty and instructive ideas.... This kind of invention is more pleasant than any other, for it can be common to no one than him whose name has been used [in anagrammatic invention].[27]

Thus the baroque poet would use an anagram in order to invent a witty and sophisticated topic for a poem. This was especially useful in constructing poems for particular occasions or particular persons.

What is most interesting in the context of our discussion, however, is the idea of using a combinatorial process to assist invention. This appears certainly strange from a modern point of view, where we tend to regard invention, wit, and originality as something inherently non-formal which is not open to systematic, rule-governed treatment. Nevertheless, this was not the view of the seventeenth century. Leibniz in particular was convinced that all rational thinking amounted to nothing more than an immensely complex combinatorial manipulation of symbols: "All our thinking is nothing but the connection or substitution of signs, whether these are words or marks or images."[28] The initial awkwardness of taking a mechanical, combinatorial process as a means for poetical invention immediately disappears if we take this view of thinking into account. Furthermore, it makes clear why Leibniz placed such high hopes in his project of the

[24] Harsdörffer, *Trichter,* II, 18. The "Fruchtbringende Gesellschaft," founded in 1617 in Köthen, was the most famous of the German language societies, of which Harsdörffer, together with many other German baroque poets, was a member.

[25] See Justus Georg Schottel, *Ausführliche Arbeit von der Teutschen HaubtSprache/ Worin enthalten dieser HaubtSprache Uhrankunft/ Uhraltertuhm/ Reinlichkeit/ Eigenschaft/ Vermögen/ Unvergleichlichkeit/ Grundrichtigkeit ... Abgetheilet in Fünf Bücher* ... (Braunschweig, 1663; repr. Tübingen, 1967), 971.

[26] E.g., Harsdörffer, *Trichter,* II, 17-24; *Gesprächsspiele,* III, 322-31, 451-52, IV, 182-89; *Delitiae,* II, 513, III, 59-60, 78-79.

[27] "Die versetzung der Buchstaben ist Theil von der Ebreer Cabala und veranlaßt zu feinen Gedanken/ vermehret die Erfindung/ bringet eine Lieblichkeit und sondere Schicklichkeit in den Gedichten/ und fliessen daher Schertz- und Lehrreiche Einfälle. ... Diese Art der poetischen Erfindung ist deswegen angenehmer/ als keine andere/ weil sie keinem/ als von dessen Namen sie ausgesuchet ist/ gemein seyn kann." Harsdörffer, *Delitiae,* II, 513-16; see also *Trichter*, II, 17-22.

[28] "Omnis Ratiocinatio nostra nihil aliud est quam characterum connexio et substitutio, sive ille characteres sint verba, sive notae, sive denique imagines," in Gerhardt, *Leibniz*, III, 605; also VII, 31; 1903: 15; and see Peckhaus, *Logik*, 31-32.

mathesis universalis as a means of providing an *ars inveniendi* and called the art of combination the *mater aller inventionen*:[29] if every rational knowledge of the world that could be gained at all could be gained by systematic recombination of the "alphabet of human thoughts," it was perfectly possible to reconstruct and assist this by permutating the representations of the simple concepts, the primitive signs of the *characteristica universalis*,[30] like the letters in an anagram. In fact the baroque poets constructing anagrams and the Leibnizian inventor faced exactly similar tasks: one tried to find the words amongst the letter combinations that would form anagrams and the other searched the combinations of the simple concepts for useful inventions.

A second interesting feature is that Harsdörffer places the anagram in the tradition of the cabbala.[31] Of course he has in mind particularly the *temurah*, in which recombinations of the letters of parts of the scripture are studied in order to discover their "hidden" meaning. There is little doubt that Harsdörffer was aware of the heavy metaphysical background this particular form of anagrammatics involved, and endorsed it to some extent.[32] For the cabbalist the *temurah* was a valid form of interpretation because he assumed a structural isomorphism between the anagrammatic creation of language and the divine act of creation: combination of a fixed number of elements was "the very method by which God created the world."[33] This view was by no means exclusive to the cabbalists, but was relatively popular with baroque thinkers.[34]

Most interesting in the context of our discussion is the way in which Leibniz discussed these matters in his *Dissertatio de Arte Combinatoria*. When considering some of Harsdörffer's works from the standpoint of combinatorics, Leibniz turns to a generalized discussion of anagrams. After giving an account of the "universal anagram"—i.e., the permutation of all the letters of the alphabet "in quo omnia scripta scribendaque inveniantur,"[35] anticipating Borges's vision of the universal library in which every possible book was contained—Leibniz discusses the parallel between atoms as the primitive particles of matter and letters as the primitive particles of speech: the world is produced in a combinatorial manner from the former and language in the same way from the latter.

[29] Gerhardt, *Leibniz*, IV, 4.

[30] Gerhardt, *Leibniz*, VII, 185.

[31] Compare Harsdörffer, *Gesprächsspiele*, III, 328-29; also Gerhardt, *Leibniz*, VII, 199; Ruth Tatlow, *Bach and the Riddle of the Number Alphabet* (Cambridge, 1991), 41-57.

[32] See, e.g., his remarks in *Delitiae*, III, 76-78; also II, 31-36; III, 66-70; *Gesprächsspiele*, III, 332-35; *Trichter*, II, 17, 28.

[33] Umberto Eco, *The Search for the Perfect Language* (Cambridge, Mass., 1995), 28; see also chap. 2, 25-33.

[34] See, e.g., Quirinus Kuhlmann's discussion of his fifty-first sonnet in his *Himmlische Libes-Küsse* of 1671, or Kircher's remarks in the *Ars Magna Sciendi* of 1669, 115; also Gerhardt, *Leibniz*, VII, 191; Zeller, *Spiel*, 139-43, 159.

[35] Leibniz, *Dissertatio*, 89; also Harsdörffer, *Delitiae*, III, 59-60.

This analogy is also stressed in an interesting passage from Lucretius's *De rerum natura* which Leibniz quotes:

Quin etiam refert nostris in versibus ipsis
Cum quibus et quali sint ordine quaeque locata.
Namque eadem coelum, mare, terras, flumina, Solem
Significant: eadem fruges, arbusta, animantes:
Si non omnia sint, at multo maxima pars est
Consimilis; verum positura discrepitant haec.
Sic ipsis in rebus item jam materiai
Intervalla, viae, connexus, pondera, plagae,
Concursus, motus, ordo, positura, figurae
Cum permutantur, mutari res quoque debent.[36]

It is of importance even in our verses with what and in what order the letters are placed, for the same signify the sky, the sea, the earth, the rivers and the sun, the same fruits, trees and living beings. Not all of them but the greatest part of them is similar, but they differ through their position. In the same way, when the matter in the things changes regarding distance, ways, connections, weight, blows, clashes, motion, order, position and figure the things themselves are bound to change.[37]

This conception is taken one step further by Schottel, who argues for the perfection of the German language by claiming that in German the objects denoted by anagrams of a word stand in close connection with the object denoted by the original word:

Amongst the many peculiarities and abilities of the German words, there is one which makes it the case that those words which are of equal or of similar sound, or are anagrams of them, are nearly always pleasant, in accordance with the nature of the thing denoted, and the source of many useful inventions, as in the following:

[36] Leibniz, *Dissertatio*, 89, and quoting a passage about Epicurus: "Vario, inquit [Epicurus], ordine ac positione conveniunt atomi sicut literae, quae cum sint paucae, varie tamen collocatae innumerabilia verba conficiunt." (The atoms, like the letters, says Epicurus, come together in various orders and positions; although there is only a small number of them, by forming different combinations they can still produce an inumerable amount of words.)

[37] See Cyril Bailey (ed.), *Titi Lucreti Cari De Rerum Natura Libri Sex*, II (Oxford, 1947), ll. 1013-22. The original text reads instead of "animantes" "animantis" in l. 1016, similarly instead of "sint" "sunt" in l. 1017, instead of "haec" "res" in l. 1018, instead of "viae" and "plagae" "vias" and "plagas" in l. 1020, and instead of "figura" "figurae" in l. 1021.

to advise/ to act (for advice must be followed by acting &c.)
sense/ direction (for one thinks into the direction of the sense &c.).[38]

Despite the fact that all the examples quoted by Schottel are not anagrams but simple rhymes and that his thesis is most probably not true, this passage makes clear what baroque thinkers considered as an excellence of a language, namely, that words and things were so intimately connected that the recombination of the elements of the former leads to a result which stands in close connection to the latter. For Schottel there is not just a general similarity between the atoms of matter and the atoms of words (i.e., the letters), as in the case of Leibniz, but a very specific connection: the relation of a word to its anagrams, which are produced by a combinatorial rearrangement of its letters, is mirrored by the similarity of the nature of things denoted by the anagrams. In a perfect language (which Schottel sees realized in German and which Leibniz strives to attain in the *lingua characteristica*) anagrammatic recombination opens up the way for the knowledge of the nature of things.

So it becomes clear that Harsdörffer's short passage on anagrams quoted above contains two fundamental features baroque thinkers associated with the combinatorial method: that it possessed an *epistemological* foundation, being the fundamental way in which all rational and inventive thinking was accomplished, and a *metaphysical* foundation, being the underlying structure of being, the way in which God created the world.

Of course it was the very same view about this foundation which also justified the intrinsically combinatorial project of the *mathesis universalis*: if the world itself was constructed according to combinatorial principles, then the perfect language, the system of notation envisaged to give access to all rational knowledge, must also work in a combinatorial way. The order of the perfect system of notation must be isomorphic to the order of the world.

This metaphysical point of view is also of special interest with respect to the next level of combinatorial complexity in poetry: the combination of whole words. If the poetical equivalent of letter-combinations is the anagram, those of word-combinations must be the proteus verse. A proteus verse is a couplet or a longer poem which is constructed in such a way that the order of words can be changed without destroying its meter or rhyme.[39] By transposing the words the proteus verse gives rise to a great number of "new" poems. Obviously proteus verses can be constructed in various degrees of sophistication. The smaller the number

[38] "Man kann unter vielen Kunststükken und mancherley Füglichkeiten der Teutschen Wörter auch dieses beobachten/ daß die Zustimmung/ Gleichlautung/ *Letterwechslung* &c.derselben fast angenehm/ *der Natur des Dinges zustimmig* und freygebig an artlichen Erfindungen seyn mag/ als: Rahten/ Tahten/ (auf *Rath* muß folgen die *That* &c.) Sinn/ hin/ (wo ist der *Sinn*/ da denke ich *hin* &c)." [my italics]. Schottel, *HaubtSprache*, 784-85.

[39] Leibniz, *Dissertatio*, 86.

of words which have to remain "fixed," i.e., whose place cannot be changed without turning the poem into nonsense, the better the poem. As a rule of thumb, the smaller the number of syllables in the words used[40] and the greater the degree of flexibility of word-order the respective language allows, the easier it is to construct a good proteus verse.

It is thus much easier to construct a proteus verse in Latin than in German, as apparent from the numbers of Latin and German proteus verses constructed by baroque poets. The most famous German example, and, to the best of my knowledge the earliest one, was constructed by Harsdörffer:

> Ehr/ Kunst/ Geld/ Guth/ Lob/ Weib und Kind
> Man hat/ sucht/ fehlt/ hofft/ und verschwind.

> Honor, art, money, wealth, praise, wife and children; having, searching, failing, hoping, disappearing.[41]

It is of some interest to note that this verse was discussed by Leibniz in his *De Arte Combinatoria* as part of his general discussion of monosyllabic proteus verses. Obviously, proteus verses are of the similar combinatorial interest as anagrams, in both cases the aim being to calculate the number of the "variationes utiles"[42] of the number of permutations of elements. However, in the case of the proteus verses there is the additional complication that some elements remain fixed or can only be interchanged with certain other words, a feature not present in the study of anagrams. In the above example four of the fifteen words must remain fixed, so that it can act as the basis of construction of 39,916,800 "new" verses.[43]

In considering the content of this proteus verse and its variations (as well as those of another one given by Harsdörffer in his *Poetischer Trichter*[44] and even Kuhlmann's monstrous 156-word proteus verse in the *Himmlische Libes-Küsse*[45]), one realizes that all variations keep their sense, no "new" verse with a new message is produced.[46] All stress the futility of striving for honor, money, and

[40] *Ibid.*, 86-88, 97-102.

[41] Quoted in *ibid.*, 88; originally in Harsdörffer, *Delitiae*, III, 59-60.

[42] Leibniz, *Dissertatio*, 88.

[43] *Ibid.*, 88.

[44] Harsdörffer, *Trichter*, I, 51-52.

[45] *Quirin Kuhlmanns Breßlauers Himmlische Libes-Küsse/ über die fürnemsten Oerter Der Hochgeheiligten Schrifft/ vornemlich des Salomonischen Hohelides* (Jena, 1671), 53-60; see also Zeller, *Spiel*, 174-77.

[46] Zeller (*ibid.*, 174) is wrong in arguing about the proteus verse by Harsdörffer quoted above that the combination of different nouns with different verbs generates different meanings. This would be true if the nouns in the first line could be paired one-to-one with the verbs in the last line, but obviously this cannot be done. This is even more clear in the case of the verse given in Harsdörffer, *Trichter*, I, 51-52.

fame; and each ends with *verschwinden*, disappearance, death. On one level of interpretation this emphasizes the ubiquity of *vanitas* throughout all permutations of letters and things. However, the fact that the meaning stays constant has a somewhat deeper metaphysical significance in the context of our comparison with the project of the *mathesis universalis*.

It is not always the case that the variations of a proteus verse have the same meaning,[47] nor is a proteus verse always defined in this way.[48] Leibniz, nevertheless, considers it part of the meaning of "proteus verse" that its variations have the same sense.[49] Regardless of the way the elements of a proteus verse are recombined, the meaning will be left unchanged. This is particularly interesting because this feature of a *synthesis* of elements is mirrored in one of Leibniz's ideas on *analysis*. In constructing the *lingua characteristica* as a part of the *mathesis universalis*, Leibniz considers it as necessary to analyze concepts into their most simple components, the primitive concepts or "alphabet of human thoughts." In doing this one can start with any definitions (analyses of concepts) whatsoever and will eventually be led to the unique set of simple concepts, regardless of the way of analysis one chooses.[50] Thus the parallel between this conception and the Leibnizian idea of the proteus verse is obvious: regarding the proteus verse we can choose whatever recombination of words we like, the variation of the verse will always have the same sense, and so we will always arrive at the same meaning, independent of the particular word order. Similarly, independent of the way of conceptual analysis we choose, we will always arrive at the same set of primitive concepts, regardless of the analytical vocabulary it is expressed in. Thus there is not just a similarity between the baroque views of the elements of language and the elements of the world but also a particular conceptual resemblance between the combinatorial constitution of a part of poetry and a part of the idea of the *mathesis universalis*.

In considering the last of our three possibilities for the combinatorial generation of language mentioned above, namely, that taking *several* different linguistic entities e.g., word stems, auxiliary words, and grammatical endings as primitive, the focus will be not on works of Harsdörffer's but on the most impor-

[47] See, e.g., Eberhard Knobloch, *Die mathematischen Studien von G. W. Leibniz zur Kombinatorik, auf Grund fast ausschließlich handschriftlicher Aufzeichnungen dargelegt und kommentiert* (Wiesbaden, 1973), 52, discussing a Latin proteus verse by Bauhausius.

[48] See, e.g., Scaliger's definition in Zeller, *Spiel*, 174.

[49] Leibniz, *Dissertatio*, 86.

[50] See the letter to Tschirnhaus from May 1678: "qui Characteristicam seu analyticam universalem constituere velit, initio quibuscunque uti potest definitionibus, quia omnes continuata resolutione tandem in idem desinunt" (if one wants to construct the characteristic or universal analysis, one can in the beginning use any definitions whatsoever, for after complete resolution they all come to the same result). Leibniz, *Sämtliche Schriften und Briefe*, ed. Deutsche Akademie der Wissenschaften zu Berlin (Berlin, 1923-), II, 1, 414.

tant baroque German grammar and seventeenth-century work on language theory, Justus Georg Schottel's *Ausführliche Arbeit von der Teutschen HaubtSprache* of 1663. Although not published until five years after Harsdörffer's death, it is of interest in our discussion because Harsdörffer considerably influenced the first edition, called *Teutsche Sprachkunst*, published in 1641.[51] Leibniz also knew this work and frequently drew upon it.[52] That Harsdörffer agreed with Schottel's basic ideas becomes clear when considering the amount to which Harsdörffer quotes him, especially in the *Gesprächsspiele*.[53]

For Schottel the foundation of the German language is not to be found in the letters or in just any words but in a particular class of them, the monosyllabic *Stammwörter* (root words).[54] These basic words are combined with *Nebenwörter* (auxiliary words), which might be either grammatical endings as in *Klug-e,Klug-es, Klug-en &c.* or the main endings of derived words, as in *Mann-lich, Freund-lich, Fremd-lich &c.*[55] This process serves as the foundation of the entire German language.

It is now especially interesting to note that this combinatorial conception of language held by Schottel[56] (and Harsdörffer[57]) can be regarded as a simple model of fundamental features of the *mathesis universalis*. The notion of root words is equivalent to the primitive concepts of the *lingua characteristica*, whose recombination, perhaps together with logical symbols, forms the basis for all complex concepts. The primitive concepts and the root words share important features:

[1.] The absolute perfection of the root words of any language consists without doubt in the following: ...
2. That they have a pleasant sound, and express the nature of the thing denoted in a correct way;
3. That there is a sufficient amount of them;
4. That everything necessary can be derived from them;

[51] This later formed the first three of the five books of Schottel's *HaubtSprache*. See also Zeller, *Spiel*, 163.

[52] Cf. Aarsleff, *From Locke to Saussure*, 47, 63.

[53] E.g., Harsdörffer, *Gesprächsspiele*, III, 314-22; IV, 94-104. See also Zeller, *Spiel*, n. 345, and Schottel's praise of Harsdörffer, Schottel, *HaubtSprache*, 1175-76; also Tatlow, *Bach*, 79-81.

[54] Schottel, *HaubtSprache*, 61, Manfred Faust, "Schottelius' Concept of Word Formation," Horst Geckeler, Brigitte Schlieben-Lange, Jürgen Trabant, Harald Weydt (eds.), *Logos Semantikos 1, Studia Linguistica in honorem Eugenio Coseriu 1921-1981* (New York, 1981), 359-70, 363, 366.

[55] Schottel, *HaubtSprache*, 70-71.

[56] See Tatlow, *Bach*, 80.

[57] See Zeller, *Spiel*, 180.

5. That multiple combinations and compound words can be derived from them.[58]

Thus Schottel demands three fundamental qualities from root words: that they express their denotation precisely and directly, that there are enough of them, and that they can be recombined among themselves.

The first requirement was, according to Schottel, admirably met by German words; indeed they express their meaning better than any other language: *Wasser* perfectly depicts the sound of flowing water,[59] *Blitz* suggests the brilliance of lightning, and *Donner* the roaring of a thunderclap.[60] In fact this perfect match between word and denotation is so striking that it must be the result of a superhuman, divine construction.[61] In German word and reality meet in an extraordinary way.[62]

This (alleged) extraordinary feature of the German root words,[63] which for Schottel was already realized in this particular natural language,[64] was what Leibniz tried to achieve in formulating the primitive concepts. They should constitute the building-blocks of all knowledge, and the signs expressing them should

[58] "Der Stammwörter untadelhafte Vollkommenheit in einer jeden Sprache wird zweiffels ohn diese seyn: ... 2. Daß sie wollauten/ und ihr Ding eigentlich ausdrükken: 3. Daß ihre Anzahl völlig und gnugsam sey: 4. Daß sie von sich reichlich auswachsen und herleiten lassen/ was nötig ist: 5. Daß sie allerley Bindungen/ Doppelungen und artige Zusammenfügungen leiten." Schottel, *HaubtSprache*, 50-51.

[59] *Ibid.*, 59.

[60] *Ibid.*, 63. Harsdörffer held the same idea; see Elmar Locher, "Harsdörffers Deutkunst," *Harsdörffer*, ed. Battafarano, 243-65, 247. Although "Wasser" and "Donner" are not monosyllabic, they are, according to Schottel (*HaubtSprache*, 61-62), root words, for the letter "e" in them is a relatively modern addition. The original pronunciation must have sounded somewhat like "Wassr" and "Donnr."

[61] Schottel, *HaubtSprache*, 64, 58, 402. See also Zeller, *Spiel*; Aarsleff, *Locke*, 47; Faust, *Schottelius*, 360; Arno Borst, *Der Turmbau von Babel. Geschichte der Meinungen über den Ursprung der Sprachen und Völker* (4 vols.; Stuttgart, 1957-63), III, 1357.

[62] *Ibid.*, III, 1357.

[63] Cf. Harsdörffer, *Gesprächsspiele*, III, 288-95, giving a number of examples for Schottel's observation, all of which are onomatopoeic. However, I do not think that either Schottel or Harsdörffer restricted the connection between German words and things to onomatopoeia and sounds produced by the things. For Harsdörffer, see the quotation by Luther he gives in this context "Ich weiß nicht/ ob man auch das Wort Liebe/ so hertzlich und genugsam in Lateinischer/ oder in einiger andern Sprache reden möchte/ daß also dringe und klinge in das Hertze/ und durch alle Sinne/ wie es thut in Teutscher Sprache." "I do not know whether one can express the word 'love' in such a heartmoving way which affects all the senses (as is possible in German), either in Latin or in any other language" (*ibid.*, III, 291). See also Hans Aarsleff, "The Study and Use of Etymology in Leibniz," *Locke*, ed. Aarsleff, 89, 92.

[64] See Leibniz, "Unvorgreiffliche Gedancken, betreffend die Ausübung und Verbesserung der Teutschen Sprache," *Wisssenschaftliche Beihefte zur Zeitschrift des Allgemeinen Deutschen Sprachvereins*, ed. Paul Pietsch, 4. ser., vol. 30 (1902-8, repr. Stuttgart 1983), 327-56; § 9; also Aarsleff, *From Locke to Saussure*, 46-47.

directly and unambiguously represent them.[65] The signs of the primitive concepts should become what the Schottel's root words only purported to be but of course were not: true *figures significantes par elles mêmes*[66] which could immediately be understood.[67]

Secondly, there must be enough root words in a language to express everything that can be said. Schottel and Harsdörffer agreed that the fact that there were things which could not be said in a language (that it was expressibly incomplete) would be a serious defect and imperfection of it. Fortunately, this is not the case with German, which can express everything necessary "although it might seem difficult to translate some expressions into German, this is not a defect of the language itself, which has a sufficient amount of words, but of the ignorance of the teacher, or of the inability of the pupil, or of the laziness we have shown up to now in developing the German language."[68]

However, there remained a problem: How can the German language be expressively complete, if there is only a finite number of root words while the number of things to be named is "nearly infinite"?[69] The solution consists in the combinatorial nature of language and the fact that its primitive elements can be mutually recombined.[70] In fact Schottel's demands 4 and 5 mentioned above support the third: because of the combinatorial nature of the German language, even a relatively confined set of root words is sufficient for securing expressive completeness. If there is no root word for signifying a particular thing, it can be constucted from a combination of basic words.[71]

> Every language has only a finite and small number of basic words, in contrast to the great number of things that need a name, for it is based on the nature of things that there are more things than words. Therefore, and because only a small part of speech can be constructed from the root words, they must rely on the help from derived words or those constructed by repetition.[72]

[65] See Aarsleff, *From Locke to Saussure*, 88.

[66] Gerhardt, *Leibniz*, V: 379. Note that already in his *Dissertatio*, 73, Leibniz demanded "notas quam maxime naturales," which would serve as the basis of language which could be read without a dictionary. See also Heinekamp, *Ars*, 449-54.

[67] Cf. Couturat, *Opuscules*, 29.

[68] "... wiewol etliche Sachen zu teutschen fast schwer scheinen; doch ist solches nicht der Sprache/ welche genugsame Wort hat/ sonndern der Unwissenheit deß Lehrers/ oder der Ungeschicklichkeit deß Zuhörers/ oder dem Unfleiß/ in dem wir bißhero verharret/ beyzumessen." Harsdörffer, *Trichter*, I, 17.

[69] Schottel, *HaubtSprache*, 65.

[70] *Ibid.*, 74, 99, 1247.

[71] This is, because it is constructed from root words, also "grundrichtig" (Zeller, *Spiel*, 164-66).

[72] "Denn dieses muß gestanden werden/ daß eine jede Sprache eine gewisse/ und nur eine wenige Anzahl Stammwörter habe/gegen der grossen Menge der Dinge/ so da unterschiedlich zubenahmen seyn *Naturâ enim rerum conditum est, ut plura sint negotia, quam vocabula.* Zu

This is also a fundamental idea of the *mathesis universalis*.[73] It relies on the thought that the enormous variety of concepts is due to the recombination of a fixed amount of primitive concepts. This presupposition makes the *mathesis universalis* a worthwhile undertaking because it ensures that only those concepts which are constructed from primitive concepts can even be expressed in the *lingua characteristica*. Furthermore, by inspecting a complex concept so constructed, one can immediately see which primitives compose it.

In a similar way its combinatorial nature is the source of the perfection of the German language, surpassing even Hebrew,[74] Greek,[75] and Latin:[76]

> In the same way as the noble art of music arises not from uncertain principles or from the opinions of the vulgar but from the most certain proportions of numbers and their demonstrations; in the same way the German language is based on the most certain principles, according to which God and nature constructed it. And it possesses a different kind of certainty from those of Hebrew, Greek, or Latin, and has to be considered in a different way.[77]

Thus our consideration of combinatorial elements in baroque poetry has shown three things: first that the combinatorial method is treated as a means for facilitating invention, both in poetry and in Leibniz's conception of the *mathesis universalis*. Secondly, both regard it as metaphysically founded in the nature of the world, which gives the poet applying it a further conceptual backing and provides the philosopher with reasons why the universal characteristic, as a fundamentally combinatorial enterprise, is a correct method of inquiry. Furthermore, we observed certain similarities between philosophical conceptual analysis necessary for the *mathesis universalis* and a certain kind of poetical synthesis. Finally, we considered Schottel's view of the German language and noticed to what extent he assumes qualities of the artificial universal characteristic to be present in a particular natural language.

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dem/ weil die Stammwörter durch sich und in sich allein fast keine/ oder gar eine gering Rede machen können/ als muß jhnen die hülfliche Hand stets gebohten werden von jhren abgeleiteten und verdoppelten Wörtern." Schottel, *HaubtSprache*, 74. Compare Harsdörffer, *Gesprächsspiele*, III, 295-98.

[73] Cf. Schmidt-Biggemann, *Topica*, 189.

[74] See Aarsleff, *From Locke to Saussure*, 87; also Borst, *Turmbau*, III, 1477.

[75] Schottel, *HaubtSprache*, 408

[76] *Ibid.*, 77, see also Faust, *Schottelius*, 366.

[77] "Gleich wie aber die edle Kunst der Music nicht aus den ungewissen Gründen/ oder dem Geläute des Pöbels/sonderen *ex certissimis numerorum musicalium proportionibus, earumque demonstrationibus* entstehet; Also erhebet sich absonderlich die Teutsche Sprache aus den gewissesten Gründen/ welche GOtt und die Natur darin ausgewirket haben/ empor: Und helt eine andere Art der Gewisheit in sich/ und erfordert andere Augen sich beschauen zulassen/ als mit welchen man das Hebraische/ Grichische oder Lateinische durchsehen hat." Schottel, *HaubtSprache*, 67.

Mechanization

As mentioned above, Leibniz tried to use arithmetic as a model for the *mathesis universalis* in a double way, on the level of the *lingua characteristica* as a means for representing concepts by prime numbers and on the level of the *calculus ratiocinator* by trying to invent a calculus in which conceptual questions could be "solved" in a way that was up to then only possible for problems of arithmetic. This is understandable since he regarded the *ars combinatoria* as comprising algebra as well as arithmetic.[78] Thus if the universal characteristic is a fundamentally combinatorial project, it is not surprising that he considers algebraic and arithmetical methods for developing it.[79]

This conceptual link with arithmetic and algebra also establishes a connection with the idea of mechanization. After all, Leibniz invented a calculating machine for performing basic arithmetical operations[80] as well as an algebraic machine.[81] If he had thus succeeded in completely embedding the system of notation of his *mathesis universalis* in arithmetic and had been able to perfect his calculating machine to deal with very complex arithmetical operations, his system would have been able to decide all sorts of questions in a completely mechanical way. In fact both "ifs" were impossible to fulfil for Leibniz, and yet it is important to note that at least the possibility of a mechanized universal characteristic was envisaged by him.[82]

The idea of mechanizing systems of notation was also quite popular with baroque poets and scientists. What exactly is meant by the term "mechanization"? Since the "mechanisms" employed by baroque poets were mostly primitive devices, it might seem somewhat exaggerated to speak of "mechanizations" of language in this context. However, it is evident that they fulfil the following definition of "mechanization," as do a number of other machines which do not at all appear to be trivial or unimportant.

For present purposes a system of notation is "mechanized" if at least three operations can be performed with it, namely, input, manipulation and output. The *input* consists of inscribing elements of the system of notation onto the physical parts of the system. In the *manipulation* these physical parts are set into action in accordance with the physical laws governing it. The *output* involves reading off the characters inscribed onto the mechanism.

[78] Knobloch, *Kombinatorik*, 57; also Peckhaus, *Logik*, 33.

[79] See *ibid.*, 42-44, 44-55.

[80] In 1673 according to Sibylle Krämer, *Symbolische Maschinen. Die Idee der Formalisierung im historischen Abriß* (Darmstadt, 1988), 98; in 1674 according to Louis Couturat, *La logique de Leibniz d'après des documents inédits* (Paris, 1901; repr. Hildesheim, 1961), 115, n. 3; see also 294-96.

[81] In 1674; *ibid.*, 115, n. 4, see also the references given there.

[82] *Ibid.*, 115-16. See also Gerhardt, *Leibniz*, VII, 10.

It is obvious that this describes in the most general way how, for example, a mechanical calculating machine works; but it can also be applied to the earliest "hard wired" computers, in which the operating instructions were part of the mechanism and not part of the non-physical, symbolic input. All the "language machines" discussed here are "mechanical" according to this definition.

The mechanizations of language discussed by Harsdörffer fall into two groups, one consisting of very simple combinatorial devices and the other one containing his famous *Denckring*. The first of the simple mechanisms consists of a set of six dice, on which the letters of the German alphabet, together with the umlauts and some frequent two-letter combinations are inscribed. When throwing several or all of these, words or word-parts are produced in a mechanical way. Harsdörffer intends these as a pedagogical device for teaching children to read: "After the child knows the letters of one die, one takes the first die containing the vowels and a second one, and constructs a simple syllable, subsequently one plays with syllables of three or four letters."[83] Thus the child first of all had to learn the alphabet, by playing with a single die at a time, in order subsequently to learn to read random syllables or parts of words, by playing with several dice.

The fact that Harsdörffer considered this as a sensible procedure for learning to read gives us a further indication of how obvious and manifest he considered the idea of the combinatorial foundation of language to be. In fact he regards it as so natural and essential a fact that small children should be immediately confronted with it as soon as they start to deal with reading and writing.

His second primitive mechanical device is again discussed with a specific poetical aim in mind. It is supposed to facilitate the construction of anagrams and is not unlike his idea mentioned above: "Anagrams can be easily found by writing the letters of the respective word on small pieces of wood, which are moved around until a whole or partial anagram is found."[84] In this simple mechanization we see how the ideas of the combinatorial nature of the world on the one hand and language on the other hand meet: letters are inscribed onto material elements, so that a permutation of these *out of itself* generates an anagram without requiring any ingenuity. For the baroque poet this structural isomorphism between language and matter explains why this method of anagram production

[83] "Wann nun das Kind eines Würffels Buchstaben nach dem andern hat kennen/ aussprechen/ und wol mit den Kreiden nachmahlen lernen so gibt man ihm den andern für/ alsdann wann es die Buchstaben kennet/ nimmet man den ersten Würffel mit den Stimmern und noch einen darzu/ und bringet eine leichte Sylben zuwegen: alsdann spielet man dreybuchstabige Sylben und alsdann mit vier Buchstaben/ darunter der V. Würffel mit den Dopplauten oder *Diphtongis*." Harsdörffer, *Delitiae*, II, 513. The same method is also described in Harsdörffer, *Gesprächsspiele*, V, 72, and in Leibniz, *Dissertatio*, 90.

[84] "Der Letterwechsel ist leichtlich zu finden/ wann man die Buchstaben des Namens auff kleine Höltzlein schreibet und solang verrucket/ bis eine halbe oder ganze Meinung herauskommet." Harsdörffer, *Trichter*, II, 18.

works, while this fact itself serves as a further manifestation of the very same isomorphism. Because language and matter both follow combinatorial principles, it is possible to mechanize the former by inscribing it onto the latter. In the "language machine" the combinatorial features of language and the world which are generally distinct are unified into a single artifact.

In fact Harsdörffer considers this conjunction of linguistic and material combination in the mechanized production of anagrams as sufficiently interesting in itself to be made a subject of an artistic performance. This is Harsdörffer's third simple mechanization of language: he hit upon the certainly very baroque and ingenious conception of combining anagrams with ballet.[85] The basic idea is this: several dancers of a ballet carry huge pieces of cardboard on which letters of the alphabet are written. As the ballet goes on, the dancers change their positions and generate anagrams (i.e., recombinations) of the set of letters they carry. This constitutes an animated construction of anagrams, which makes the similarity between the combinatorial configurations of matter and of letters visible. This kind of ballet makes it possible to observe (as Leibniz, quoting Epicurus, put it) how "the atoms, like the letters, were together in various orders and positions."[86]

The most complex mechanization of language developed by Harsdörffer is his *Fünffacher Denckring der Teutschen Sprache*,[87] which consists of five concentric circles made of cardboard, each one movable against all the others, on which are inscribed

> I. the 48 prefixes; II. the 50 initial letters; III. the 12 medial letters; IV. the 120 final letters; V. the 24 suffixes.[88]

By moving the circles against each other, German words can be generated in a mechanical way. For Harsdörffer the *Denckring* should fulfil three main purposes. First of all, it is supposed to be yet another means for helping poetical invention, in particular the invention of rhymes. How this is going to work is obvious: the third and fourth ring kept fixed, while the second is moved against it.[89] In this way a number of rhymes can be found. Here, however, Harsdörffer faces a problem which also confronts the combinatorial foundations of the *lin-*

[85] *Ibid.*, III, 54-56.

[86] "... vario ordine ac positione conveniunt atomi sicut litterae." Leibniz, *Dissertatio*, 89.

[87] Harsdörffer, *Trichter*, II, 516-19, illustration on p. 517, also in Zeller, *Spiel*, V. Discussed in Leibniz, *Dissertatio*, 74.

[88] "I. die 48 Vorsylben, II. die 50 Anfangsbuchstab und Reimbuchstaben, III. die 12 Mittelbuchstaben, IV. die 20 Endbuchstaben, V. die 24 Nachsylben." Harsdörffer, *Trichter*, II, 517.

[89] *Ibid.*, II, 518. If, e.g., the baroque poet is looking for rhymes on "Traum," he keeps the third (-au-) and fourth (-m-) wheel fixed and moves the second to get "Schaum," "Raum," "Flaum," "Baum," "Zaum" etc. The "Denckring" can act as a mechanized dictionary of rhymes.

gua characteristica,[90] namely, that of selecting the words out of all letter-strings combinatorially generated (or the useful concepts out of all those produced, respectively). Both the perfection of Harsdörffer's *Denckring* and the full system of the universal characteristic would need a *mechanical* procedure for accomplishing this task.

Secondly, the *Denckring* should be a means for generating in a combinatorial way new correct German words: "all the words generated in this way which denote are correct German, they are especially useful in poetry, though not often used outside poetry."[91] These are, because of their combinatorial way of generation, as "grundrichtig" as all other German words.[92]

Finally his mechanism was supposed to be complete; i.e., it should be able to generate all German words: "one hopes that there will not be any German word, which can not be generated by using this ring."[93] In fact this does not hold, for there are some German words Harsdörffers's mechanism cannot generate.[94] Yet again, more important than what this device *can* actually accomplish is what its inventor *supposed* it to accomplish, for this will give us some information regarding his conception of language and mechanization. (Of course Harsdörffer's mechanism can trivially be extended so that it will be able to produce all German words, simply by increasing the number of wheels and syllables inscribed on them.) Both Harsdörffer's *Denckring* and the system of the *mathesis universalis* were attempts to construct infinite systems (natural language and the language of humans thoughts, the faculty of invention, respectively) from a definite well-defined number of primitive elements in a combinatorial way. Both were supposed to be complete, being able to reconstruct the respective infinity in its entirety; and both were supposed to be finally completely mechanical, requiring no ingenuity for their operation.

The reader will notice some difference between Harsdörffer's construction and Schottel's theories: Harsdörffer's device does not take the basic words as primitive but starts with letters and letter combinations.[95] It is interesting to note in the context of this discussion that a mechanical apparatus of incorporating Schottel's idea to a greater extent has also been devised, though not by Harsdörffer. This was the so called "cylindrical grammar," envisaged by a contemporary of

[90] Cf. Schmidt-Biggemann, *Topica*, 197.

[91] "... und beharren wir in der Meinung/ daß alle solche zusammen gesetzte Wörter/ welche ihre Deutung würcken für gut Teutsch zulässig/ sonderlich in den Gedichten/ ob sie gleich sonsten nicht gebräuchlich...." Harsdörffer, *Trichter*, II, 518.

[92] Zeller, *Spiel*, 167.

[93] "... und wird sich verhoffentlich kein Wort in unserer gantzen Sprache finden/ welches nicht auf diesen Ring zu weisen sein sollte." Harsdörffer, *Trichter*, II, 519 Cf. also the inscription on the "Denckring" "Die gantze Teutsche Sprache auf einem Blättlein zu weisen" ("writing the entire German language on a single sheet of paper") (*ibid.*, II, 517).

[94] Zeller, *Spiel*, 167.

[95] *Ibid.*, 167, n. 357.

Leibniz, Albert von Holten. It appears as if his discussion of the *Denckring* in the *Dissertatio de Arte Combinatoria* suggested the idea to von Holten.[96] As its name suggests, it was supposed to have the form of a cylinder and looked somewhat like a combination lock. The basic words, the suffixes, prefixes and the necessary endings for declentions and conjugations were written on the different movable parts, so that they could be moved against each other in order to produce grammatically complex expressions.[97]

It should be noted that Harsdörffer and Leibniz were not alone with their ideas of the mechanization of language.[98] This is not very surprising if one considers the widespread distribution of combinatorial concepts in baroque culture.[99] However the works of these two show very nicely how conceptions of the combinatorial nature of the world and the combinatorial nature of language came together in the project of the mechanisation of language: because language and the material world were both fundamentally combinatorial, one could be fruitfully implemented on the other. The result of this union could produce both, a metaphysically well founded poetry and the perfection of the Leibnizian dream, the *mathesis universalis*.

In conclusion it is evident that that the fundamental elements of the *mathesis universalis*, i.e., the ideas of the combinatorial and mechanizable nature of language, are strongly present in Harsdörffer's poetry. I would like to consider this as part of an argument for the dependence of the project of the universal characteristic on baroque culture, in particular its dependence on the baroque conception of systems of notation. Making this suggestion plausible, however, would require taking into account many different forms of baroque culture and not just the works of a single poet, and moreover considering more views on the idea of a universal science, not just those of Leibniz. Obviously this is an undertaking quite beyond the scope of a single paper. Nevertheless, I hope that apart from this, the preceding discussion will have been of some interest in itself, by showing that the strong contemporary division between the "two cultures" of the arts and the sciences has not always existed, particularly not in the seventeenth century, a time which was extraordinarily fruitful regarding both scientific and artistic achievements.

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[96] Couturat, *Logique*, 115.

[97] *Ibid.*, 115.

[98] See especially Kircher (in particular Thomas Leinkauf, *Mundus Combinatus. Studien zur Struktur der barocken Universalwissenschaft am Beispiel Athanasius Kirchers SJ 1602-1608* [Berlin, 1993]) and Quirinus Kuhlmann (see Walter Dietze, *Quirinus Kuhlmann, Ketzer und Poet*, [Berlin, 1963]).

[99] Cf. Neubauer, *Symbolismus*, 27-39.