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Hobbes' Calculus of Words

1. Hobbes' (1588-1679) philosophy of language transpires from his much quoted adage: "Words are wise men's counters". (Leviathan ch. IV, p. 25, in the edition of 1885) His ideas meant the rather revolutionary initiation of the preliminaries of computational linguistics.

2. Hobbes' pioneering work underwent two influences, namely:
A) a doctrinary influence from Nominalism (e.g. Occam 1300-1350), which was overlapped by
B) the disciplinary impact of contemporary Physics, more precisely of the newly established Mechanics (Galileo 1564-1641).

3. Leibniz (1646-1715) is Hobbes' main heir; he develops Hobbes' ideas, together with questions of artificial languages and symbolic systems, into the conception of Representation, which became the nuclear theorem of his philosophy.

(4. Frege (1848-1925) and Russell (born 1872) are the main participants in the last relay that took Hobbes' initiative to our day.)

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HOBBES' CALCULUS OF WORDS

1. Hobbes' philosophy of language transpires from his much quoted adage: Words are wise men's counters. The context gives more evidence of his deeper intentions; the subsequent text runs as follows: "..... , they do but reckon by them; but they are the money of fools, that value them by the authority of an Aristotle, a Cicero, or a Thomas, or any other doctor whatsoever, if but a man. - 'Subject to names', is whatsoever can enter into or be considered in an account, and be added one to another to make a sum, or subtracted one from another and leave a remainder. The Latins called account of money rationes, and accounting ratiocinatio; and that which we in bills or books of account call 'items', they call nomina, that is 'names'; and thence it seems to proceed, that they extended the word 'ratio' to the faculty of reckoning in all other things. The Greeks have but one word, λόγος for both 'speech' and 'reason'; not that they thought there was no speech without reason, but no reasoning without speech: and the act of reasoning they called 'syllogism', which signifieth summing up of the consequences of one saying to another."
Hobbes' philosophy allows for the functioning of natural words as counters - or, as he more often calls it: as marks (in his Latin works: notae) - only in one respect, namely in the cognition of reality. The opposition 'cognitive versus communicative use of words' is maintained consistently; the following diagram may serve to make this clear:

DIAGRAM I: Hobbes (1588-1679)

Invention			Demonstration	
Reality ⟵	(Words as Notae/Marks ((cognitive))	⟵ (Reason or Mind) ⟶	(Words as Signa/Signs ((communicative))	⟶ Others

The inventive application of natural words puts them to an enno-etical - i.e. intelligence-integrated - and instrumental use, which accurately handled turns out to be a reliable procedure for attaining rational truth. In so doing Hobbes posited the most striking and consequential linguistic theory of his time.
The sign-use of natural language is allowed to be weaker; the interhuman communicative application is not a philosopher's privilege, but the everyday practice of ordinary people. They operate with prudence, which is the common mind as it consists of memory, perception and imagination. Philosophers, on the other hand, operate with their calculative reason, which is the counting and reckoning mind.
Hobbes elaborates on his calculus of words in the sense that he demonstrates that the syntactic procedure is of an arithmetical nature in so far as we add or subtract the notions of which the common words are urged to become the bearers.

2. Regarding influences Hobbes underwent from earlier theories and philosophies, we must first remember that he was an excellent classicist, who had acquired a thorough knowledge of all the outstanding authors of Antiquity. We suspect that Hobbes' opposition 'inventio versus demonstratio', is related to Plato's concept of the dual function of language, namely diakrinein towards things, didaskein towards fellow men.
There is little basis for thinking of Hobbes as an Aristotelian. In the domain of language-theory and philosophical grammar, the Middle Ages had yielded a realist grammar, largely under the influence of Aristotle's theories. The so-called Grammatica Speculativa did not appeal to Hobbes and only the fact that Leibniz, who continued and improved on Hobbes' work, reintroduced this theory, makes it worth mentioning at all.

The main trends Hobbes' linguistic philosophy had to cope with, were more topical. We can distinguish a doctrinary and a disciplinary trend.

A. Nominalism had been strong and dominating since Ockham (1300-1350). Nominalist epistemology had taken the following basic form:

DIAGRAM II: Nominalism

Reality (only individua) ⟵ Words, *nomina* ⟵ (*Intellectus*, *conceptus*, *intentio*)

To the nominalist, the direct intellectual or conceptual approach to reality is primary. From this approach he learns that reality consists of individua. This immediate inventive intellection is fundamental and the insertion of words into it is in a way redundant and possibly even misleading since many words stand for nonexistent generalities; reliable *nomina* only refer to individua. What Hobbes evidently learned from nominalist doctrine, was the intermediary role language could play as a means, as a tool in inventive thought - an epistemological model, which, however, he did not take over along with the critical and suspicious attitude towards language inherent in the nominalist view. For that matter, a critical attitude towards common language also characterized the politician and philosopher whom Hobbes served as a secretary, namely Francis Bacon (1561-1626). Well-known are the latter's warnings against the pitfalls forming a constant danger for those who make too negligent a use of words. His '*idola fori*' especially, focused attention on lingual errors and inconsistencies.

B. A much stronger impact on Hobbes' philosophy came from Mechanics, the newly established sub-discipline of Physics, founded by Galileo and closely related to the new ideas on motion of contemporary astronomers like Kepler. The scientific nature of Mechanics is in this case of great importance.

Inventors and designers of all kinds of machines were numerous in the Quattrocento and Cinquecento - one of them the great artist Leonardo da Vinci (1452-1519). Some published their works, though in the vernacular, and Galileo was acquainted with such writings. In Galileo this tradition of practical craftmanship and technical skill merges with the academic tradition of the Aristotelian philosophy of nature. In other words: The practical manipulation of arithmetical and geometrical knowledge as acquired in the scholastic quadrivium on the one hand, and theories about natural motion that were radically non-mathematical and linked up with the pseudo-explanation of a transition from potentiality to actuality on the other hand, united in Galileo. His great achievement, which in his era places him in the category of outstanding scholars and inventive minds like Planck, de Broglie, Einstein and Heisenberg in our era, was his application of mathematics to physical research, more precisely, his analysis of macrophysical motion by means of counting and measuring (As a very simple but most significant example we point to the so-called parallelogram of forces).

Galileo himself was highly conscious of the importance of his innovation and the perspectives it opened up. This is evidenced by statements like the following: "The book of nature is written in an alphabet of triangles, squares, parallelograms, circles, etc." Kepler had already said that the 'caelestic machina' was not 'instar divini animalis, sed instar horologii' and Galileo often expressed himself in similar terms, especially in his famous adage: 'universum horologium est'.

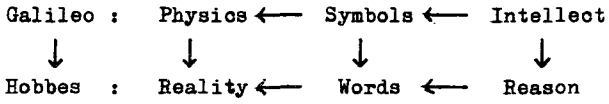
The following diagram represents Galileo's position:

DIAGRAM III: Galileo (1564-1641)

Physics (Motion in Astronomy and Mechanics)	⟵	Means: (Mathematical Symbols	⟵	'intelletto, raggio' (Reason)

The transition to a philosophical theory like that of Hobbes was facilitated because Galileo himself led the way by talking about the Universe as a whole instead of about Physics as the object of his science.
The transition from artificial mathematical symbolism to a more general concept of natural language was also expedited by Galileo himself already comparing cyphers and figures to an alphabet.
Hobbes' extrapolation from Physics to Universe and the Substitution of natural language words for mathematical symbols can be represented as follows:

Diagram IV: from Galileo to Hobbes



This part of Hobbes' conception then is the left half (Invention) of Diagram I.
The inventive use of words takes the form of a calculus. In itself the embedding of words as tools in the cognitive process corresponds to the nominalist 'ennoesis', i.e. inclusion into thinking, of nomina. Yet there is a decisive difference in evaluation: for the nominalist the use of words is firstly optional and secondly unreliable and full of uncertainty. For Hobbes, however, the computational use of natural words is firstly necessary to obtain rational, i.e. true insights, and secondly, provided the calculation is performed accurately, fully certain and reliable. The calculation can only succeed if performed by philosophers, i.e. rationalist philosophers, - the "wise men" of his above quoted adage.
For the calculative use of words Hobbes introduces the Latin term ratiocinari, i.e. reasoning and reckoning in one! In his view it consists of addition and subtraction, in short, of

arithmetical operations. He adduces all manner of evidence, for example that the Lation ratio - and come to that the Greek logos too - had always properly signified reckoning, counting, calculating, etc.; further, that 'syllogism' properly means addition, summing up, etc.
So Hobbes' calculus with words corresponds to grammar or syntax in natural language, conceived of as an operation with words; it may be mentioned that in this view the dynamic and functional character of syntax as a kind of technical procedure is retained - this in contradistinction to its fate in Leibniz' philosophy. Natural words are, for philosophers, usable as counters, i.e. as premeditated artificial symbols. There is more to this mark/nota role imparted to natural signs. As a matter of fact, their symbolic character is, in Hobbes' opinion, their essential nature, right from the beginning of creation. Adam invented words ex arbitrio! This theorem subsumes the concept of natural language and its units under that of artificial symbolism. We must hold against this thesis that the drawing up of any artificial symbolism is only possible because of our human endowedness with a lingual faculty. Any system of symbols is a posteriori to natural "linguality" and only possible because of the a priori and innate human language faculty. Hobbes' subsumption is like the statement: Look how that mother resembles her daughter!

3. LEIBNIZ - and not Spinoza or Locke - accepted and digested the inheritance of Hobbes' philosophy of language. Leibniz was a character averse to any sort of quarrel, dispute, controversy, contrast, opposition, and conflict in any form.

In religion, politics, science and philosophy he endeavoured to achieve harmony by stressing mutualities, agreements, similarities, gradualities, shading transition and so on. Let me examine the circumstances in which Leibniz conceived of his mathematical philosophy of representation.

A. Hobbes began publishing as early as 1642 and continued until the year of his death, 1679. In 1668 "An essay towards a real character and a philosophical language" by J.Wilkins appeared in London. It is not fortuitous that the seventeenth century in particular was very fertile with regard to artificial language projects. The vital point is that these artefacts are not intended to be learned as an easier means of interhuman communication - Hobbes' demonstrative use of language! - but, quite positively, as "the distinct expression of all things and notions" - i.e. as an inventive language "which may likewise be styled philosophical, rational and universal" as well. For Leibniz the numerous artificial language projects bridged the gap - see Diagram IV - between Hobbes' exact, symbolic-notative, computational calculative and artificial application of a natural but unfit material, namely natural words of a natural vernacular, and the establishment of an a priori, purely artificial system of symbols, i.e. mostly written characters or figures. In the inventory of problems which Leibniz encountered in the second half of the century, the numerous newly-constructed artificial languages proved to be very important for his elaboration of Hobbes' initiatives.

B. Leibniz found that on the side of the demonstrative natural signs in interhuman discourse it was possible to operate calculatively as well. This insight rendered Hobbes'

functional opposition of inventive mark versus demonstrative sign essentially invalid. We see this where Leibniz expects in the case of interhuman disputes about matters of ethics or religion to bring about a solution through mathematically strict and rationally convincing arguments; in such cases, claims Leibniz, we can say: Calculons!
The fact that Invention and Demonstration coincide is also significant in that the "others", i.e. fellow-men, (right hand side of Diagram I) now also belong to reality (left hand side of Diagram I). If with Leibniz we further assume that non-human plus human reality together form a huge collection of units - in his terminology 'monads' - it is clear that each human, rational monad emits spontaneous signals to other monads. Consequently this process must be reciprocal and any human monad must operate at once as a transmitter and a receiver. This means that Leibniz mingles the originally nominalist active mind theory with a passive mind concept (tabula rasa) similar to that of the realist grammatica speculativa, which, indeed, he reintroduces.

C. And he does not even stop here. Towards the end of his life Leibniz taught that there is no question of any impact on the monads from outside, for this would interfere with the pre-established progress of world history. Monads have no windows. Their existence is representation. The following image, naturally not Leibniz' own, may serve to illustrate this point. The monads resemble a number of cinemas, completely shut off from outside, where day and night the same endless film is being shown with perfect synchronization. The only variation possible is when the monad is asleep and the light being, as it were, somewhat weaker, illumination and clarity are reduced. The Leibnizian idea of representation reaches Von Humboldt via Wolff.

D. Hobbes based the certainty that he would obtain true and reliable results from his reasoning on the accuracy and correctness of the computational procedure. His calculus with words is analogous to the intralingual operations with words that we call syntactic or grammatical procedure. Hobbes was only an arithmetician, and a poor one at that. Leibniz was a geometer as well, i.e. an all-round mathematician, and a brilliant one too. Hobbes continues to see grammar as a procedure, a computational, an arithmetical procedure, but nevertheless a process. The older Leibniz eventually arrives at a static view of the world and a geometrically conceived model of grammar. Any language, whether natural or artificial, any mathematical symbolism, mirrors in its own system the structure of the universe, the order of the world; and this correspondence is fundamentum veritatis, the very basis of truth. Leibniz' static parallelism replaces Hobbes' dynamic-calculative approach, which strives for the truth. For Leibniz, the truth is present a priori, in the deep structure, the "grammaire rationelle et universelle" of any sign- or symbolsystem, except that in a, rather irrational, natural language it may be somewhat obscured. To demonstrate this he uses a geometrical comparison: if for example, a circle with inscribed figures is viewed from a point not along its vertical axis, it will appear oval, but the inner order and proportions will be preserved in spite of the distortion.
In the latter case there is only less "clarity" because of the shift in "point de vue" but the fundamental adequacy and truth is maintained.

4. We wanted to confine ourselves to describing and historically locating Hobbes' arithmetical philosophy of language. And we must confine ourselves to merely sketching Leibniz' role as Hobbes' heir and successor. Just as it may happen in architecture that the initiator of a new style is outstripped by a successor, so, in language philosophy, Leibniz overshadows Hobbes. In linguistics proper Leibniz influenced the founder of the discipline, Bopp, though indirectly, through Wolff; in mathematics he influenced Frege, who wanted to draft a Leibnizian "Begriffsschrift"; in philosophy and mathematical logic he influenced Russell in the latter's attempt to create an ideal language, which he recommended as the goal of the philosophy of language. "The 'ideal language' would satisfy perfectly the intentions to make the relation of 'picturing' the sole essential basis of symbolism.....Russell.... is unwilling to abandon the notion that language must "correspond" to the "facts", through one-to-one correlation of elements and identity of logical structure." (Black)
It has been said that the failure of Machine Translation was due to the absence of an adequate philosophy of language; I feel inclined to agree. Such a philosophy is still in its infancy and it cannot be successful without scanning the past for its origins.

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