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***Harlequin and the Microscope.
Essay on Leibniz's Philosophy of Nature***

by

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Summary

The main purpose of this work is to investigate in detail the interest shown by Leibniz for the microscope and the amazing discoveries that, through this new instrument, have been made in the second half of the Seventeenth century. If the telescope, in the first half of the century, had provided essential support to modern astronomy (a science which however was already well-structured long before the use of such instrument), the large-scale use of the microscope opened entirely *new* fields of investigation: bacteriology, cytology, cell theory, embryology, etc. Of this fact Leibniz has been perfectly aware and he looked at the new findings concerning the “microcosm” as a treasure of knowledge able to affect both our theories about the physical world and the technical applications (e.g. medicine) directed to the common good.

The theatrical metaphor based on the mask of Harlequin was not planned at the beginning of the work. It slowly emerged during the research as a *Leitmotif* which Leibniz loves to recall, over a considerable number of years: “c'est tout comme ici” - “everything is like here”, says the Italian mask in a famous plot of the Commedia dell'Arte, edited first in Paris in 1695 (*Arlequin, Empereur dans la Lune*). Leibniz frequently uses this motto to stress the fundamental uniformity and analogy of the natural world: a thesis that is in some ways a manifesto of modern physics and cosmology, in which every essential distinction between the terrestrial world and the heavenly one was finally demolished. The reference to Harlequin and his “endless garments” is also present in some passages concerning the thesis of the immortality of organic bodies - a claim that Leibniz tries often to defend by referring to the observation of the first protozoa.

During the work I have tried to show how these two major issues – the discovery of the microscopic world of life and the use of some theatrical images by Leibniz – find a mutual connection. In particular, the use of metaphorical expression by Leibniz often occurs as a device to bridge some linguistic and conceptual gaps, in a period in which embryology was not yet born as a real science and the question of the origin and the end of the living beings lacked completely an explanation in mechanical terms. Thus, according to this view, the use of theatrical metaphors has not in Leibniz a purely rhetorical function, rather it plays in a sense an explanatory role with regard to phenomena for which a technical vocabulary was still missing.

The first chapter of the work deals with questions about methodology and focuses on the origin of the research project. Despite some authors had already pointed out the impact of nascent microbiology on certain aspects of Leibniz's system of nature, no one had yet undertaken a systematic study of the

issue. Further, in recent years the *Akademie-Ausgabe* has provided scholars with a lot of fresh sources, which enable us both to put into a sharper focus old interpretations and to advance new claims. I have chosen to embrace a “micro-historical” approach to the main topic: that is, a research method by which one focuses on a seemingly small detail of a very general issue and deepens such detail until it reveals unseen aspects of the whole topic to which it belongs. Such approach has been particularly fruitful with respect to the philosophical system of Leibniz, in which every aspect (however small it may be) recalls the whole of which it is a part. The outcome was that by deepening Leibniz's concern for microscopy I have been conducted to reconstruct almost the entire building of Leibniz's philosophy of nature.

The second chapter traces the interest showed by Leibniz for the budding microbiology, starting from the early years and coming to maturity. In particular, the frequent textual references made by Leibniz to the huge potential opened up by new observational tool are taken into account as a starting point. In these texts the microscope is often invested with the capacity to let us penetrate the “inside of things” and to reveal us the “infinite worlds” that are hidden in the smallest drop of water. The personal meetings that Leibniz had with the leading microscopists of the time (from Hooke to Swammerdam, from Leeuwenhoek to Malpighi) are also reported and discussed. Beyond the theoretical aspects of the “microcosm” in which Leibniz was interested, I also try to show how he detected the enormous possibilities opened by nascent microbiology in the field of medicine, physiology and anatomy. It is no coincidence that in the numerous projects of scientific societies drafted by Leibniz (including the one for the Prussian Academy of Sciences) the microscope is always called upon to play a leading role. The establishment of a school for young microscopists supervised by Leeuwenhoek himself was a theme on which Leibniz returned several times, until the last years of his life. In such an attitude towards microscopy is possible to realize a strong Baconian inspiration as to the nature and the aim of human knowledge, which is always to be linked to concrete uses addressed to the improvement of the material conditions of life. The cooperation between learned science and technical knowledge, between natural philosophers and craftsmen (the “spiders” and the “ants”, in Baconian jargon) is a constant hope of the *Wissenschaftsorganizador* Leibniz.

The third chapter focuses on Leibniz's thesis of the uniformity of nature (that was a typical claim of the early modern philosophy) and on the related method of search after analogies among different levels of the physical world. This view is analyzed starting from Harlequin' motto “c'est tout comme ici” [everything is like here], often invoked by Leibniz and sometimes joined by him to the Italian verse “per tal variar natura è bella” [for this variety nature is beautiful] by Serafino Aquilano. These two popular sayings summarize, according to Leibniz, his whole view of nature, conceived as an *ordered variety*. The fundamental uniformity and similarity of the different aspects of reality does not rule out the immense variety and richness of its outward manifestations. God, in His omniscience and omnipotence, has created the greatest variety in conjunction with the maximum of possible order: the harmony that characterizes the actual world consists precisely in this “*varietas identitate compensata*”. Of this essential feature of creation, the microscopic observations give us further empirical evidence, showing us unseen shapes and colors, new kinds of movements and living beings, which are however characterized by the same degree of order and complexity of the larger animals.

The fourth chapter focuses on the relationship between Leibniz and the Dutch microscopist Antoni van Leeuwenhoek. Although the names of the other great microscopists of the time (Malpighi, Swammerdam, Hartsoeker) often occur in the writings of Leibniz, he had a very special predilection for the “draper” of Delft, because of his astonishing results and the observational method he employed. On the one hand, the lenses built and used by Leeuwenhoek were at the time the most powerful: they made it possible for the first time the observation of protozoa and bacteria. On the other, he represented to the eyes of Leibniz that “cultural intermediate layer” (merchants, craftsmen, etc.) which was repository of a treasure of technical knowledge waiting to be codified and shared by larger groups of scholars and “curious” about nature. From the theoretical point of view, I try to show the influence

exerted to some extent by Leeuwenhoek's observations on some central theses of Leibniz's metaphysics: the idea that the ultimate constituents of reality are "living atoms" endowed with perception and appetite, the theory of the pre-formation of living organisms (and their subsistence after death), the claim that there are "worlds within worlds" in the smallest particle, the "panorganic" view of matter. It is noteworthy that between Leibniz and Leeuwenhoek a direct correspondence occurred in the years 1715-1716 (forty years after their meeting in Delft), which amounts to ten letters and which was interrupted by the death of Leibniz. Leibniz's letters, which I take here into account, are still unpublished. Among the topics touched on there are issues of physiology, embryology, comparative anatomy which, in the eyes of the philosopher of Leipzig, had a more general (metaphysical) interest.

In the last chapter I focus on the concept of preformation, which was born in the field of biology (as we would call it today) and that in Leibniz eventually plays a much more general role, investing several central aspects of his philosophy, from epistemology to metaphysics. The predicate of every true statement is already contained in the subject; a lot of our knowledge is already preformed, outlined in our mind; and the harmony holding among the infinite individual substances is characterized by Leibniz as a sort of "divine preformation". One could also add – as Leibniz loves to repeat – that "the present is pregnant with the future", i.e. the future is somehow preformed in the present. From this point of view, I argue that the concept of preformation plays in Leibniz the role of a very general category – something like a transcendental idea – by which he looks at the most different aspects of reality and knowledge.

A particular emphasis is given in this context to the work of Malebranche, who first (*Search of Truth*, 1674) gave philosophical dignity to the concept of preformation in the framework of the Cartesian science and with explicit reference to some recent microscopic discoveries by Malpighi and Swammerdam. I also try to show how the Leibniz's concern for the microscopic world of life was connected on one side with his mathematical interests and discoveries (the infinitesimal calculus *in primis*), on the other with his sensibility for the literary imagination (Cyrano, Fontenelle, Godwin, etc.), to which Leibniz often has recourse in order to fill the gaps that seem to threaten the continuity of the "great chain of being". The new instrument of observation seems thus to provide Leibniz with *empirical* evidence of both the infinite actual division of matter (i.e. the refusal of materialistic atomism) and the fundamental continuity and analogy holding between the different natural kinds and kingdoms.

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