Guest-Editorial

Gottfried Wilhelm LEIBNIZ
on the occasion of his 350th birthday
1 July 1646-14 Nov. 1716

The wise man always acts according to principles
(Theodicee, §337)

LEIBNIZ passes for the last universal scholar who worked productively in nearly all fields of his time. He stimulated numerous contemporary scientists in their work, as documented by more than 15,000 preserved letters from him directed to about 1,100 addressees, and many of his discoveries form today an integral part of scientific knowledge. Nevertheless he leads a shadowy existence in German philosophy and elsewhere: much praised and often quoted, but little read. There are several circumstances which have hindered a full appreciation of his achievements: (1) He wrote in three languages: Latin, French, and German. (2) He expressed his ideas mainly in letters or fragments that remained unpublished during his lifetime and have so remained to this day. (3) Although he left us a near-complete heritage of some 50,000 items - a unique stroke of luck - his work was published only at a late date and incompletely and is scattered over a variety of editions; the historico-critical complete edition started only in 1923 with the appearance of volume 1. Roughly 30 volumes have appeared so far, but publishing is still going on and will take several more decades to be finished. And (4), his work, the work of a generalist, has been handled by specialists. This has led to misleading and one-sided interpretations, given rise to incorrect translations, and influenced edition practice. Thus many an idea of his has fallen into oblivion to be re-discovered only later, with other discoveries possibly still remaining to be made or understood, while in some fields he has preserved his superiority unchallenged so far.

Thus, e.g., our time of over-specialization has seen the complete loss of the art of thinking in large dimensions, the reason for this being no doubt the loss of visions from which philosophizing can start making sense. LEIBNIZ's vision was his optimistic view that our world is the best of all possible worlds and that nothing contributes more to the public welfare of all people than the knowledge, perfecting as it does reason (1, p.157); for the highest felicity of human beings consists in their greatest possible completeness. In promoting the human abilities, completeness is a higher degree of health. The most powerful human ability is the power of thinking, and the best remedy for the mind are a few elementary thoughts by which an infinite number of other thoughts can be produced according to rules (1, p.429). Some of his aims typically concern knowledge organization, i.e. the search for an order of the most significant known human knowledge already serving life (1, p.42). These thoughts reflect very clearly LEIBNIZ's unshakeable trust in the power of knowledge, and from this follows directly his esteem for the sciences: Felicity consists in contentment, he said, and since durable contentment depends on the confidence we put in the future, sciences are necessary for true felicity (1, p.153). But in order to fulfil their tasks, the sciences need a reliable foundation.

Knowledge depends on proofs, and the invention of them again depends on the right method. But what is the right method leading to founded knowledge? According to LEIBNIZ it is the art of proving practised in mathematics, where mistakes can be discovered with smallest effort by calculation requiring no more things than ink and paper. It is fundamental in this consideration that the proofs are not meant for the matter itself; rather, they are executed in manipulating symbols which take up the function of things they represent. If it were possible to test non-mathematical knowledge by calculation as well, then there would be no such a variety of opinions, and disputes could be solved by a *calculemus*! His idea might be summarized in the catchword: Founded knowledge by means of proofs, reliable proofs by means of calculations. But while this method is inherent in mathematics from its very nature, special precautions must be taken to use it in other disciplines, too (1, p.153-157; 2, p.200). Many of LEIBNIZ's fragments deal with this problem (3). He took up this idea very early already in his *dissertatio de arte combinatoria*, and it kept occupying him during his lifetime for a period of about 50 years.

His approach is very similar to what is now called 'symbol processing' in artificial intelligence, and from this point of view the subject proved to be of a surprising relevance, worth, therefore, of devoting a special issue to its philosophical fundamentals. Symbol processing includes three main aspects: algorithmization, reasoning, and knowledge representation, all of which are represented in the four contributions to this issue:

In the first article, Erhard SCHEIBE (*Calculemus! The problem of applying logic and mathematics*) investigates the performance of mathematics in a qualitative sense. He distinguishes between its algorithmical, its demonstrative and its descriptive capacity. The close relationship between proofs in mathematics, conclusions in logic and computation is shown. The descriptive power is ascribed to the fact that in mathematics general structures are considered. Finally, the amazing phenomenon is discussed that a great many mathematical structures have their counterparts in physics.

Witold MARCISZEWSKI (*LEIBNIZ's two legacies and their implications regarding knowledge engineering*) starts with the assumption that Leibniz on the one hand believed in the possibility of automating the processes of knowledge production, but that on the other hand he implicitly questioned this view with respect to his conception about perception. Both positions are reflected in the logical antiphysicalism held by TURING, and the

physicalism held by von NEUMANN, respectively. They are synthesized in the hypothesis that there is a mutual dependence between perception and reasoning; perception is of non-digital nature supporting von NEUMANN's point of view, whereas the digital nature of reasoning corresponds to TURING's assumption. According to MARCISZEWSKI, LEIBNIZ failed to see the connection between perception and reasoning.

In investigating similarities and differences between LEIBNIZ's program and the goals which Artificial Intelligence research pursues, Sybille KRÄMER (*Mind, symbolism, formalism: Is Leibniz a precursor of Artificial Intelligence*?) takes up again the theme dealt with by MARCISZEWSKI. But in contrast to him, she comes to the conclusion that LEIBNIZ's statements about reasoning and symbolic operations do not describe what actually happens within the mind, rather, they have to be understood as epistemological arguments.

Whereas the previous authors follow the traditional way of interpreting LEIBNIZ's ideas as an undertaking in logic, Peter JAENECKE (*Elementary principles for representing knowledge*) attempts to show that they deal in fact with knowledge representation. Seven principles are suggested; their function is illustrated by means of the features of a formal language and by means of the tasks typically done in syntactic pattern recognition. He comes to the conclusion that LEIBNIZ knew all principles except one, and that his *characteristica universalis* is an early form of a formal language.

We do not know where we will go from here, but where we come from we can explore to a certain degree. The issue contains also a list of LEIBNIZ's ancestors and his binary pedigree as compiled and updated by Arndt RICHTER and Weert MEYER.

The above synopsis reveals that there are different accesses to LEIBNIZ's work, and, as a consequence, controversial views cannot fail to appear, thus illustrating the actuality of the topics dealt with.

May this issue contribute to promoting the discussion and to widening the understanding of the interesting subject matter, remembering LEIBNIZ's assertion (in a note to Van HELMONT): "We will regress if we do not progress, because there is no standstill".

Peter Jaenecke

1   Leibniz, G.W.: Opuscules et fragments inédits. Extraits des manuscrits de la Bibliothèque Royale de Hanovre par Luis Couturat. Paris 1903.
2   Gerhardt, C.I. (Ed.): Die philosophischen Schriften von Gottfried Wilhelm Leibniz, Bd:VII: Berlin 1890: Reprint: Hildeshcim/New York: Georg Olms Verlag 1978.
3   To be published completely in the historico-critical edition in Series VI, Vol. 4 in four subvolumes, announced for the end of 1997 by Akademie Verlag, Berlin.