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INTRODUCTION

Abstract. This introduction clarifies the ideas behind the Logic, Reasoning and Rationality congress from which the papers in this issue are selected. These ideas are situated in the history of 20th century philosophy (Vienna Circle, Kuhn, ...). We also give an overview of the papers in this issue.

Keywords: classical logic, rationality, scientific reasoning.

According to the members of the Vienna Circle, there was a strong connection between logic, reasoning, and rationality. They believed that human reasoning (and in particular scientific reasoning) is rational in so far as it is based on logic (which meant for them the classical logic). It was also believed that scientific reasoning (for them the hallmark of human reasoning) was, in general, rational. In the second half of the twentieth century, both beliefs came under attack.

One of the motors for this change was the turn in history of science initiated by Alexandre Koyré. In the 'old history of science' success stories were told, usually on the basis of published papers and even textbooks, and only theories that had survived were considered (Galileo's law of free fall, Kepler's three laws, Newton's gravitation theory, and so on). Moreover, no attention was paid to mistaken paths, nor to the contexts in which the original theories were formulated and accepted. So, what happened was that nice and polished reconstructions of scientific episodes were made, with the classical logic as the underlying logic, and that the results were deemed to be rational. In the 'new history of science', things changed radically. Theories were studied in their historical setting, and explicit attention was directed not only to

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theories that were abandoned (such as the phlogiston theory), but also to flaws, and to elements that played a crucial role in the construction of new theories, but that are today considered as non-rational. Examples are Kepler's work on astrology and on the harmony of the spheres, and Newton's work on alchemy.

In the aftermath of Koyré, philosophers of science, such as Hanson and Kuhn, also followed this new trend and started basing their philosophical analyses on actual examples from the history of science. Two central lessons came out of all this. First, the so-called 'context of justification', which was the sole concern of the members of the Vienna Circle, is less straightforward and less 'logical' than was traditionally accepted. Next, the 'context of discovery' is much more structured and methodical than was believed within the Vienna Circle, even though it is not understandable from the point of view of the classical logic. The conclusion was that logic is inadequate to explicate actual examples of human reasoning, whether in the sciences or in everyday life.

There were several reactions to this situation. Some scholars held on to the link between (classical) logic and rationality, but concluded that scientific reasoning (especially as it occurs in the context of discovery) is inherently non-rational or even irrational. Others gave up the connection between logic and rationality. They looked for tools elsewhere (mainly in psychology and cognitive science) to analyse the rational character of scientific reasoning, often at the expense of rigour and formal accuracy. Times have changed, however. Today, a multiplicity of formal frameworks (ranging from non-classical logics over probability theory to Bayesian networks) is available in addition to the classical logic. Also, historians and philosophers of science as well as psychologists have described a rich variety of patterns in both scientific and common sense reasoning.

The aim of the congress *Logic, Reasoning and Rationality* (Centre for Logic and Philosophy of Science, Gent, 20–22 September 2010) was to stimulate the use of formal frameworks to explicate concrete examples of human reasoning, and conversely, to challenge scholars in formal studies by presenting them with interesting new examples of actual reasoning. This special issue contains a selection of papers presented at the congress.Other papers presented at the congress will be published in a book (*Logic, Reasoning and Rationality*, Springer) and in special issues of the journals *Foundations of Science, Logique* & *Analyse* and *Philosophica*.

Frode Bjørdal presents in *Librationist Closures of the Paradoxes* a semi-formal foundational theory of sorts, akin to sets, named *librationism* because of its way of dealing with paradoxes. Its semantics is related to Herzberger's semi-inductive approach: it is negation complete and free variables (noemata) name sorts. Librationism deals with paradoxes in a novel way related to paraconsistent *dialetheic* approaches, but the author thinks of it as *bialethic* and *parasistent*. Classical logical theorems are retained, and none contradicted.

In *The Theory of Form Logic*, Wolfgang Freitag and Alexandra Zinke investigate a construction schema for first-order logical systems, called "formlogic". Form logic allows us to overcome the dualistic commitment of predicate logic to individual constants and predicates. Dualism is replaced by a pluralism of terms of different "logical forms". Individual form-logical systems are generated by the determination of a range of logical forms and of the form-based syntax rules forcombining terms into formulas. They develop a generic syntax and semantics for such systems and provide a completeness proof for them. To illustrate the idea of form logic, and the possibilities it facilitates, they discuss in their paper three particular systems, one of which is the form-logical reconstruction of standard first-order predicate logic.

Marcello Frixione and Antonio Lieto consider in their paper *Representing Concepts in Formal Ontologies: Compositionality vs. Typicality Effects* the problem of concept representation. Concept representation is relevant for many subfields of cognitive research, including psychology and philosophy, as well as artificial intelligence. In particular, in recent years it has received a great deal of attention within the field of knowledge representation, due to its relevance for both knowledge engineering as well as ontology-based technologies. However, the notion of a concept itself turns out to be highly disputed and problematic. In their opinion, one of the causes of this state of affairs is that the notion of a concept is, to some extent, heterogeneous, and encompasses different cognitive phenomena. This results in a strain between conflicting requirements, such as compositionality, on the one hand and the need to represent prototypical information on the other. In some ways artificial intelligence research shows traces of this situation. In their paper, Marcello Frixione and Antonio Lieto propose an analysis of this current state of affairs.

In *Abstract Logic of Oppositions*, Fabien Schang proposes a general theory of logical oppositions by abstracting them from the Aristotelian background of quantified sentences. Opposition is a relation that goes

beyond incompatibility (not being true together), and a question-answer semantics is devised to investigate the features of oppositions and opposites within a functional calculus. Finally, he considers several theoretical problems about its applicability.

In the last paper, *Interactive Logic in the Middle Ages*, Sara Uckelman shows us that the recent shift towards "interactive logics" is not new. A similar shift from static systems developed for purely theoretical reasons to dynamic systems occurred in the high Middle Ages. She provides a number of different examples of "interactive logic" in the Middle Ages, all species of the disputation game obligatio. These games display a recognition of the importance of interaction in logical contexts and the way that interactive logic differs from single-agent inference.

The congress was organised in honour of Diderik Batens. It served as an opportunity for him—on the verge of his retirement—to look back on his long and distinguished academic career and clarify his personal views to the audience. Among other things, Batens helped shape paraconsistent logic and was the founder of adaptive logics.

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