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Historical and Philosophical Background

In the present chapter we provide the building blocks that will be needed in our analysis of the debate on uncertainty in AI. First of all, we focus on the origins of the issue of uncertainty. In Section 2.1, we point out that uncertainty became a subject of scientific interest only in the 17th century and that it was modeled within the new born framework of probability. In Section 2.2, we focus on scientific modelling. We address the issue of how the notion of model is used in science. We clarify what we mean by a scientific model and by a theory, which are key concepts in our analysis. We make a distinction between probability as a mathematical theory, on the one hand; and probabilistic models as empirical and thus testable models, on the other one. Finally, we elaborate on the status of empirical models by referring to the 20th century debate that followed the crisis of classical mechanics and the consequent paradigm shift. This debate is topical for our analysis because, as we will see in Chapter 5, the introduction of the alternative framework has been presented by the alternative school as a paradigm shift.

2.1 Uncertainty as a Scientific Concern

Uncertainty is an issue that has been discussed for centuries in both philosophy and science. Philosophers have proposed epistemological theories to explain what knowledge is, how it is acquired, and how human beings use it to make decisions. These epistemological theories differ much one from the other, but they all eventually deal with the same issue: uncertainty. Epistemological investigations start indeed from the observation that humans typically have only partial and imperfect information about reality and therefore their knowledge is always affected by uncertainty.

One of the first elaborated account of uncertainty can be found in the allegory of the cave that is presented by Plato in the Republic (Plato, Republic, Book VII, 514a–517a). This allegory is a portrayal of the ancients’ view on uncertainty. The prisoners of Plato’s cave represent the human beings: their
knowledge of reality, like the one of all humans, is uncertain because the prisoners cannot see reality as it is but only its shadowy appearances. From this portrayal, one of the most distinctive themes of the Greek epistemology emerges: the dichotomy doxa/episteme, opinion and knowledge respectively. For the ancient Greek epistemology, what in modern terms we call empirical knowledge was not knowledge but rather opinion. Empirical knowledge derives from the contingent and changing world of sensations. As such, empirical knowledge is uncertain. It is therefore not genuine knowledge but mere opinion. Genuine knowledge is only the intellectual one, as it refers to what is eternal and unchangeable. Knowledge arises, indeed, from the abstract, eternal, and unchanging ideas of the intellect. In the prologue of the Timaeus, Plato illustrates the dichotomy doxa/episteme as follows:

As I see it, then, we must begin by making the following distinction: What is that which always is and has no becoming; and what is that which becomes but never is? The former is grasped by understanding, which involves a reasoned account. It is unchanging. The latter is grasped by opinion, which involves unreasoning sense perception. It comes to be and passes away but never really is. (Plato, Timaeus, 27d–28a)

According to Donald Zeyl,

[... ] Plato wants to think us back to the Republic, where the being/becoming distinction was used to refer to the contrast between Forms and sensibles. In that case, the answer to ‘What is that which always is and has no becoming?’ is simply ‘Forms’ or a ‘Form’, and the answer to ‘What is that which becomes but never is?’ is ‘sensibles’ or ‘a sensible’ [... ] Plato then gives the answer: the former is such that it is grasped by understanding, the latter such that it is grasped by opinion. In favor of this way of reading the question is that it posits a conceptual connection between being and being grasped by opinion based on sense perception. It is just such a conceptual connection that is needed for Timaeus’ subsequent argument that the world, being visible, can only be grasped by opinion and is therefore something that has come to be, and not something that always is [... ] (Zeyl, 2000, p. xxxi)

The ancient Greeks’ assumption that empirical knowledge is not genuine knowledge had a significant impact on the Western thought and, for centuries, it played a major role in preventing uncertainty from being considered a subject of scientific merit. Indeed, though games of chance were known since the antiquity, no systematic study of chance arose before the 17th century. Only then, the sharp opposition between doxa and episteme was overcome and uncertainty began to be considered as a scientific matter. In modern science, dealing with uncertainty is indeed a primary concern. As science is essentially the procedure of acquiring and modelling empirical knowledge,