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The physical world and the Ionian miracle
A philosophical linguistic perspective

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Abstract
The concept of our physical world, as we understand it today, goes back further than the 17th century, the beginning of modern science. It is rooted in ancient Greek philosophy. The Ionian philosophers of the 6th-4th century BC had the revolutionary idea of asking the question "*what is the cause of observed natural phenomena?*" They supposed that the world could be understood in terms of its constituent parts and with human reasoning. It was their curiosity and systematic observation of natural phenomena that led to the material perception of the world that gave birth to the astonishing idea of the smallest, indivisible, indestructible and internal "seeds" of matter, the atoms (*ἄτομα*). It was the dilemma between the "*one*" and the "*many*" that led to the assumption that ever changing natural phenomena are governed by "*one natural principle*", a reoccurring question in modern physics. The antithesis (*ἀντί-θεσις*) of Parmenides' "*Being*" (*ἔστιν, ἐόν*) and "*Not-being*" (*οὐκ ἔστιν, μή ἐόν*) was replaced by the concept of "*Full*" (τό οὖλον, *ἄτομα ἄπειρα τῶ πλήθει*) and "*Void*" (*τό κενόν ἄπειρον τῶ μεγέθει*) in the philosophy of Leucippus and his student Democritus and "*motion*" (*κίνησις*) was made possible through the existence of empty space (*τό κενόν)*. In modern scientific language "The atom is an empty space (*κενόν)* containing a positively charged nucleus and negative electrons orbiting around it (Ernest Rutherford)", and interestingly "*τό κενόν*" is the "carrier for

geometry and kinematics" as expressed in general relativity: "geometry is produced by matter or matter by geometry". This material motion according to Leucippus does not occur by chance (*χρῆμα μάτην*) but for a reason (*ἐκ λόγου καί ὑπ'ἀνάγκη*) and it is the first ever "*deterministic view*" of the world. In the views of Democritus, the *ἄτομα* are indestructible and internal units of matter. Modern physics considers atoms not to be "internal and indestructible"; they can be transformed into each other. This happens when particles move in a vacuum against each other at high kinetic energies and "*new elementary particles*" are formed from the available "*energy*" and the old particles cease to exist, thus indicating that all things are made of the same *primordial substance*, called *energy*. This concept of the world reminds us, on the one hand, of the idealistic philosophy of Plato, in which the structure of the world is not based on material "*objects*", but on geometrical "*forms*", "*ideas*" (ἰδέα) and, on the other, of the mystical philosophy of the Pythagoreans, in which the harmony of the world is inherent in numbers (ἀριθμός) and their mathematical formalism; "*all things are numbers*". This view, according to Werner Heisenberg, could be realised "in modern quantum theory, in which the elementary particles will finally be given by mathematical forms, of a much more complicated nature", as compared to the views of the Greek philosophers familiar with static geometrical Euclidian forms, the first harmonious and rational structure of the world. Heisenberg's complex mathematical forms, the "*eigensolutions*" of complex sets of integral equations pose a number of deontological (δεοντολογία) questions: Are these smallest units in nature, called *elementary particles*, as described by quantum theory, ordinary physical objects in the same way in which we perceive and express, in "ordinary language", the world around us? In "ordinary language", one understands a medium consisting of words placed in a logical order to form sentences to be used to express our ways of thinking and to describe the observable world. The mathematical laws of quantum physics indicate that our "ordinary linguistic concepts" cannot be applied "*unambiguously*" to describe the probabilistic behaviour of elementary particles. Will we ever be able to develop the elements needed in ordinary language to translate "*unambiguously*" the language of mathematics, which, we say, is perfectly adequate to "describe" quantum phenomena and, thus, the doings of nature at its smallest scale? Will we ever be able to create a "unified language" to reconcile our physics concepts with the problem of the "*observer*", the *subject*, and the "*observable*", the *object*, in an "*unambiguous*" way?

Recommended Literature

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10. Albert Einstein and Leopold Infeld (1938). The evolution of science. Cambridge University Press.