1. Historical context: the Emergence of the Modern Paradigm of the Sciences

* The thought of Descartes needs to be assessed, in the first place, within the horizon of the scientific and philosophical revolutions of the 16\textsuperscript{th} and the 17\textsuperscript{th} centuries, which his philosophy both contributes to and provides a founding reflection.

* The modern reinvention of the natural sciences, specifically of physics and astronomy, with thinkers such as Nicholas de Cusa, Nicolaus Copernicus, Johannes Kepler and Galileo Galieli, involves a dramatic overturning of previous conceptions of the physical universe and nature: for instance, a shift, announced as early as 1543 in Copernicus’ *On the Revolution of Heavenly Spheres*, from a geocentric, or Ptolemaic, to a heliocentric, and later a centreless conception of the universe.

* However, the birth of the modern scientific era hereby coincides with a radical questioning not only of the received evidences of the scientific endeavours of the Medieval period, but of the intellectual systems which supported them: in the first place, of Scholastic theology and philosophy, and more generally, of the Aristotelian system of sciences and philosophy. Whereas for the major thinkers of Greek Antiquity as well as for medieval scholastic philosophers, the universe had represented a closed and finite world, a *cosmos* organized hierarchically according to the degrees of perfection and harmony that different beings and things are capable of attaining, the universe that modern physics had conceived represented an infinite and open world, governed by uniform laws attributable universally without considerations of value.

* A new theoretical orientation of modern science: the unity of mathematised sciences, organized according to abstract principles capable of generating general concepts, as against the contemplation and empirical study of the intrinsic ‘natures’ of essences of things (their qualitative or substantial sources of change). The replacement of questions of value and of purpose with explanations of necessity through the study of efficient causes. The establishment of uniform causes, universally applicable, as opposed to the multiform and heterogeneous causes of Aristotelian philosophy.

* A new practical attitude: a shift from the idea of a detached theoretical contemplation of nature (Greek *theoria*) to the active and practical attempt at mastering nature. Science and knowledge become instruments of technological conquest of the natural environment.

“Science should make us masters and possessors of Nature”
(Descartes, *Discourse on Method*, 1537)
2. Descartes and the New Foundation of the Sciences

* The central aim of Descartes philosophical reflection: providing a new, lasting foundation for modern scientific inquiry. Descartes’ monumental philosophical importance is in nothing less than in laying the grounds for a new, specifically modern orientation of thought and in a radical displacement of the principles and procedures of Scholastic and more generally of Aristotelian philosophy which had been a predominant paradigm throughout the Medieval times.

* A new beginning for thinking is to be found neither in things themselves, that is in the colorful world of specific natures or essences, each with its own idiosyncrasy, nor in the preeminence of the idea of God, as a perfect being and an absolute substance; rather, this beginning resides in the thinking subject, that is, in the rational procedure of thought and its own reflection upon itself.

* The supreme mode of rationality, in this sense, is for Descartes provided by mathematics: due to their abstraction, mathematical concepts and truths possess a character of universality and uniformity, being potentially applicable to all contents, irrespective of their qualitative nature; due to their clarity and self-evidence, mathematical operations of thought provide us with rational rules which can immediately ascertained and repeated; furthermore, the elementary mathematical ideas, such as number, figure, space, etc. carry within themselves a potential for constructibility, as they can be combined and linked, forming a chain of necessary relations out of which new concepts and relations can be deduced; finally, such a setting of order, when applied to empirical phenomena, allows for predictability, according to the idea that in an ordered universe the knowledge of one thing necessarily follows the knowledge of another.

* Descartes’ claim in this regard is that mathematics can provide a conceptual and methodical warrant of certainty which can be extended to all domains, whereby the intelligibility of any possible object, whatever its complexity, is due to a consequent and exhaustive application of elementary rational principles. He lists four universal rules of method which can be extracted from mathematical reasoning: 1) never accept as valid anything apart from those ideas which you can entirely ascertain as being clear and distinct, as well as indubitable; 2) always seek a solution to complex problems by decomposing them; 3) always conduct the rational procedure of thought by moving from the most simple elements towards complex and composed ones; 4) make exhaustive lists of elements of problems under consideration.

* A new mode of inquiry: the order of reasons (ratio cognoscendi), which presupposes that thought can grasp any object not starting from its real genesis, either in a substantial or an empirical sense, but by following an analytical and a logical inquiry into the conditions of its representability, starting from the most elementary rational truths. In practice, this implies that the universe can be constructed as an intelligible totality not through an exhaustive study of all its qualitative features, but through the consequent and universal application of elementary rational notions: starting from the most simple rational elements, which, once combined into ever increasing complex operations, can embrace the entirety of the world.

* A new, ascetic, mathematised physics, which can serve as a model for all other sciences: the entirety of physical phenomena in the universe can be reduced to the most simple (and abstract) ideas, such as those found in the elementary geometrical or
mathematical reasoning: extension (to which, for Descartes, matter was equal), figure, movement, etc.

* Consequence: the autonomy of science, which finds in itself its own criteria of truth (and not in theology or in a substantial metaphysical system).

3. Hyperbolic Doubt and the Cogito

* In his major philosophical works, such as The Discourse on Method (1637) and the Meditations on First Philosophy (1641) Descartes attempts to lay the systematic philosophical foundations for such a new approach to the sciences: the elementary set of philosophical categories and problems through which mathematical reasoning can be justified in providing the grounds for physics and all other sciences. In this, however, he first and foremost employs a specifically negative procedure: inviting us to engage in a radically skeptical attitude, a radical doubt towards all previously received evidences.

* Descartes’ hyperbolic doubt as excessive doubt (Greek hyperbolé, exaggeration, excess): rejecting without exceptions everything which is not entirely ascertained – including all possible objects of sense perceptions that we receive or imagine, but also the rational procedures and truths of mathematics or philosophy. Descartes’ aim is to clear the path for his new philosophical system by questioning (and effectively negating) all the possible evidences of previous philosophies and sciences – starting from Aristotelian philosophy, science and logic, as well as the truths of Medieval theology, all the way up to the evidences of common sense. However, the aim of doubt, unlike that of the Skeptics, is not to claim the impossibility of knowing, but to reinstate certainty: to find a new foundation for philosophical and scientific truth, an elementary rational principle out of which all possible scientific operations could be reconstructed.

* The two movements of doubt: a ‘natural doubt’, which involves putting in question all the truths and representations received by the senses, due to the risk of arbitrariness that they carry, while affirming the certainty of simple rational elements, such as those affirmed by mathematics of geometry, which, moreover, provide the very forms for the organisation and intelligibility of all sensible representations; a ‘metaphysical doubt’ is, however, more radical, where the hypothesis of the existence of an ‘evil genius’, a malicious omnipotent God who willingly deceives me by creating a chaotic universe, places in doubt even the existence of self-evident rational and mathematical truths, for example that the number of angles of a triangle is always three; at the end of the second movement of doubt, which has placed in question both the existence of the entire external world and of all elements of rationality, what does appear beyond doubt, however, is the very fact of doubting, the self-conscious reflection of the thinking subject in the act of his thinking.

* Herein lies the discovery of Descartes’ central concept of the Cogito: Descartes expresses the most elementary philosophical truth, that which provides an immediate mode of certainty which can serve as an example for all other truths, through the following formula: cogito, ergo sum (I think, therefore I am). What lies beyond doubt
is the fact of doubting itself – and this act of immediate self-reflection upon my cognitive process provides me with a form of certainty which can be applied as a model and a criterion for all other inquiries into certainty, for all other truths about the world. The Cogito, the pure certainty of the self-reflexive act of thought, an act without content provides a model for assessing the certainty of all the possible contents of my thought. This is because in the act of self-reflection the idea that I hold does not seek a confirmation in an outside thing – which can arouse all kinds of doubt – but is the very thing which it represents, and this immediate presence leads to the most elementary form of certainty. In short, the Cogito provides me with a certainty of the very formal conditions of thinking, regardless of the contents of my thought, but necessary for all the possible contents of my thought.

* an Archimedean point: starting from the Cogito, from the certainty of the interiority of the thinking subject, Descartes is able to reconstruct the entirety of the ‘outside’ universe on new rational grounds – by ascertaining the validity of abstract rational elements an operations such as those provided by geometry, and furthermore, of the application of these elements to all possible empirical representations. The Cogito, in this sense, is not the personal “I”, even if it is first and foremost ascertained in the act of the empirical “I”, but is rather the general idea of “self” necessary for each and every rational act, and therefore shared by all rational beings.

Quotes:

“While we thus reject all of which we can entertain the smallest doubt, and even imagine that it is false, we easily indeed suppose that there is neither God, nor sky, nor bodies, and that we ourselves even have neither hands nor feet, nor, finally, a body; but we cannot in the same way suppose that we are not while we doubt of the truth of these things; for there is a repugnance in conceiving that what thinks does not exist at the very time when it thinks. Accordingly, the knowledge, I THINK, THEREFORE I AM, is the first and most certain that occurs to one who philosophizes orderly.”
(Descartes, Discourse on Method)

“But I was persuaded that there was nothing in all the world, that there was no heaven, no earth, that there were no minds, nor any bodies: was I not then likewise persuaded that I did not exist? Not at all; of a surety I myself did exist since I persuaded myself of something [or merely because I thought of something]. But there is some deceiver or other, very powerful and very cunning, who ever employs his ingenuity in deceiving me. Then without doubt I exist also if he deceives me, and let him deceive me as much as he will, he can never cause me to be nothing so long as I think that I am something. So that after having reflected well and carefully examined all things, we must come to the definite conclusion that this proposition: I am, I exist, is necessarily true each time that I pronounce it, or that I mentally conceive it.”
(Descartes, Meditations on First Philosophy, Meditation 2)