Modern Mathematical Science and Technology: Formalisation of the Life World

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I, Ciaran Summerton declare that this dissertation is my own account of my research and contains as its main content work which has not previously been submitted for a degree at any University.

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Abstract

In this dissertation, I offer a critical examination of modern science with a particular stress on the changes that the modern scientific project inaugurated. The focus is how modern science has radically changed the way we think about the world. I draw upon several phenomenological thinkers who have considered the changing nature of modern science and its relation to our present day thinking.

I begin by exploring the key differences between the Ancient Greek and modern scientific understanding of mathematics, geometry, and idealisation. Specifically, I discuss the reversal of Platonic geometry carried out by Galileo Galilei and the formalisation of Galilean physics achieved by Isaac Newton. In addition, I outline the key methodological features of modern science, which include indirect mathematisation and perfect causality, as well as the role of experimentation in the modern scientific project. Theory is central to modern science in its function of opening certain regions of things, while delimiting others. Thereby, I discuss how theory prescribes what counts as facts for science and experimentation, in advance.

Finally, I consider the pervasiveness of instrumental reasoning in modern science and technology. I conclude with a discussion of the institutional setting of modern science and its participation in business, governance, and power relations in these domains.

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Introduction

In this dissertation, I will argue that modern mathematical science has radically changed the way we think about the world. We live in an age in which we understand the world in techno-scientific terms. Those modes of understanding that do not follow the fundamental conceptions of modern science are rejected as illusory. To substantiate my overall thesis, I will draw on the insights of phenomenologists that continue in the tradition of Edmund Husserl and Martin Heidegger, such as Jan Patočka, Theodore J. Kisiel, Joseph J. Kockelmans, Alexandre Koyré and Hannah Arendt. I also consider and use the thought of scientists who have expressed similar ideas about modern science and its dominant role in the contemporary world.

In what follows, I will use the term modern science to refer to the classical physics that started with Galileo Galilei and Isaac Newton up until the work of Albert Einstein. It is important to acknowledge that at the latter end of the nineteenth century and throughout the twentieth century, certain aspects of the theoretical position of Newtonian physics have been questioned, but not abandoned, from within the discipline of physics. Physicists consider Newtonian physics a borderline case in a much broader domain. Hence, my contention is that the metaphysical presuppositions and methodological approaches of the modern scientific outlook have not changed from its inception through to the present day. Therefore, I suggest that much of the critique offered by the thinkers I will use is relevant to present day science.

To support my overall thesis that modern science has radically changed the way we think about the world, I will follow a phenomenological method by presenting different ways of considering how we might think about the world in which we live and how it is influenced by the modern scientific project. The aim is to show how we take scientific presuppositions for granted.

In chapter one, I discuss a number of the key methodological changes in modern mathematical science and its development, while paying attention to the way it differs from both the Ancient Greek and medieval conception of the world. In this

short dissertation, I cannot do justice to this rich history, so I will sketch it in very broad outlines.[1]

I start by outlining the transition from scientific thinking in Ancient Greece through to the formalisation of Newtonian physics. I will consider the way early modern scientists such as Galileo understand the ideal formulations of geometry inherited from Ancient Greek and medieval[2] thinking. I draw attention to the following key difference: For Plato, the abstract shapes of geometry are immaterial, ideal beings. In contrast, according to the postulates of early modern science, geometrical shapes are no longer in the sphere of ideal forms; rather, we now understand them as constituting the material world. With the advent of formalisation in modern science – in which geometrical space is described purely in mathematical terms – there evolves an understanding of the world in which the two Platonic realms (one of ideal, unchanging beings and the other of the everyday world of becoming) are collapsed into an extensive formal manifold.

Then, I will survey Husserl's (1970) account of two key assumptions in the methodology of modern science, to elucidate further the change from idealisation in Ancient Greece to the formalisation in modern science. These are the assumptions of universal causality (in which all events and objects are situated within vast chains of cause and effect, each effect becoming a cause for further effects) and indirect mathematisation (the process by which qualitative experiences are correlated with quantitative determinations).[3]

In the second chapter, I extend my account of the new scientific methodology by unpacking the modern process of experimentation. The modern experiment, I argue, is not based simply on observation and a recording of facts (as is commonly claimed) but, rather, science and the modern experiment would not be possible without an *a priori* conception that posits the world as an aggregate of forces and processes in

[1] I acknowledge that there was a large amount of thinking during the medieval period. However, in this dissertation I am interested in the fundamental changes that took place in Galilean/Newtonian physics and how these changes influenced the modern outlook. A theological reading of Aristotelian physics would be an interesting project, but I do not have the space here to go into more detail. It would require a more detailed account of the differences between Greek and Christian thinking, as well as those aspects of medieval science (for instance, Nominalism) that paved the way for the Galilean/Newtonian revolution.

[2] Medieval thought is in many ways an extension of Ancient Greek thinking, transformed through the prism of Christianity and a conception of the world with God as the ground of knowledge.

[3] See Husserl, *The Crisis of European Science and Transcendental Phenomenology*, Evanston: Northwestern University Press, 1970.

geometrical space following mathematical laws. The formal scientific system demarcates *in advance* what are scientific facts. A theoretical position is necessary in order to organise facts and observations into a science. The formal mathematical system constitutes this theoretical position for modern science.

In chapter three, following the observations about the modern experiment, I will examine Heidegger's (1978) thought on the spirit of technological thinking that permeates the modern age.[4] Heidegger's reflections on the spirit of technology highlight another aspect of my central thesis that scientific thinking in conjunction with technological advances has significantly changed the modern understanding of the world. Viewing the world technologically, nature appears as a collection of processes and forces that are open to prediction and control. Therefore, as predictable and controllable, nature is used for our innumerable projects of material expansion. By thinking about the world techno-scientifically, we encourage a relation to the world in which we believe we have the right to organise, manipulate and exploit nature for our own benefit.

Finally, in the fourth chapter I will make connections between the description of modern science (chapters one and two) and the techno-scientific understanding of the world (chapter three). This will include an account of the institutional setting of science and its relationship with business, governance, and the power relations within these domains. In addition, I suggest a more direct link between the methodological aspects of modern science and the techno-scientific understanding of the world. I will contend that the methodology of modern science presupposes a natural world of calculable, measurable and predictable processes. Thus, as calculable, measurable and predictable, natural processes become useful and can be located within the techno-scientific scheme of utility maximisation.[5]

The different emphasis and focus of each chapter provides different aspects that are necessary to substantiate my claim that modern science has radically changed the way we think about the world in the manner I illustrate throughout my dissertation.

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[4] Heidegger, 'The Question Concerning Technology', *Basic Writings*, Ed. David Farrell Krell. London: Routledge, 1978a, pp. 217-238.

[5] A more nuanced and detailed discussion is required to differentiate between scientific, technological, instrumental and utilitarian reasoning. These different kinds of reasoning are not necessarily synonymous, though they do in many ways coincide and overlap each other. Unfortunately, I do not have the space to go into these distinctions. Therefore, it may seem that I am not clearly enough distinguishing between different aspects of modern thinking.