The Modelling Attitude and its Roots in 19th Century Science

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In this talk I shall defend three interrelated claims: i) The historical roots of the ‘modelling attitude’ that is at present dominant in the physical sciences is to be found in late 19th century science; ii) this genealogical foundation suggests some philosophical foundations of the modelling attitude in what I shall refer to as the ‘relativity of knowledge’ thesis; and iii) this thesis in turn both grounds and lends credibility to current deflationary accounts of scientific representation.

The birth of science as a social institution in the 19th century coincided with the heyday of what I call the modelling attitude. Of course natural philosophers had employed models before, and had reflected upon the nature of those models. In fact, before science and philosophy parted ways, decisively at some point in the late 19th century, the building of the model and the philosophical reflection upon its nature often went hand- in- hand. But it is only, I argue, in the 19th century that a ‘modelling attitude’ emerges, as a systematic attempt to articulate and defend model building as the appropriate methodology for science.

The 19th century modellers introduce at least two novel elements. There is first a self-conscious emphasis on the hypothetical and even fictitious nature of the models; and, second, modelling became very sophisticated mathematically, particularly in the hands of what I call the German speaking school – spreading from 3-d geometry into complex versions of the calculus, and the algebra of equations. None of these elements are present in pre-19th century modelling, yet they are all central to contemporary modelling practice. Thus systematic reflection upon models begins in earnest with the electro-dynamical models of the ether, and there are in particular two sources or schools.

There is first an ‘English speaking’ school led by James Clerk Maxwell and William Thomson (Lord Kelvin), but encompassing also many of the other celebrated British physicists of the 19th century, such as Oliver Lodge, George F. Fitzgerald, Oliver Heaviside, John Poyinting or Joseph Larmor. Maxwell and Kelvin advanced a number of methodological considerations in their many attempts over the years to model the ether as a concrete physical medium of vortexes. These considerations mainly bear on the importance of the modelling attitude to their ongoing development and understanding of electric and magnetic phenomena. There is then a somewhat later ‘German speaking’ school represented mainly by Heinrich Hertz and Ludwig Boltzmann and heavily indebted to Helmholtz’s methodology of physics. Partly under the influence of the English speaking school, but mainly as a result of an ongoing process that begins with Helmholtz’s research into the nature of perception, the German theoretical physicists gradually develop a more abstract and theoretical sort of modelling and provide a cogent philosophical defence for it. The defenders of the bildtheorie have a philosophical agenda – nuanced and sophisticated, even in contemporary terms (an agenda that in Botzmann’s case, at least, was linked to a defence of the tenability of the atomic hypothesis). Thus the modelling attitude is born in Britain but it grows of age and acquires the mature form that launches it into the 20th century – and that in essence endures to the present day – in the hands of the skilful ‘German speaking’ school.

My second claim is that the origin of the modelling attitude is historically and conceptually linked to a thesis that I refer to as ‘the relativity of knowledge’, and which has origins in the Scottish enlightenment and philosophy of common sense. According to this thesis scientific knowledge is never atomistic in the sense that it is never absolutely and exclusively of its own object. On the contrary, knowledge can only emerge out of a comparison of the object with something else.

Comparison, likeness, resemblance and analogy are therefore all means to achieve knowledge, and in fact the only means through which genuine empirical knowledge of the world can possibly come about. This ‘relativity of knowledge’ thesis (not to be confused with any form of contemporary ‘relativism’) is in turn the result of applying to the objects of empirical science the method of abstraction that had been developed in connection with mathematical knowledge by distinguished Scottish mathematicians (such as Simson and McLaurin) as early as the first half of the 18th century. For Simson, for instance, ‘surface’ is an abstract concept that results of a comparison of a real solid with an imaginary model of the solid split in two perfect halves, none of which can possibly contain the intermediate surface on pain of contradiction (since if the surface was contained in one of the halves it would the necessarily be missing in the other half, contrary to what is the case in the real solid once one half is in fact removed).

Finally, I sketch the argument that takes from the ‘relativity of knowledge’ to deflationary conceptions of representation. The claim is not that deflationary theories are a consequence of the relativity of knowledge thesis, but rather the opposite: deflationary conceptions of representation entail that analogical (or, more generally, surrogative) inference is essential to scientific representation. This makes the ‘relativity of knowledge’ thesis plausible, since it is a natural corollary of surrogative or analogical inference that all knowledge is comparative in the way required by the thesis. By contrast, substantive theories of representation do not support the relativity of knowledge thesis, but instead render it a mystery that modelling should essentially depend on comparative knowledge. On these views, instead, the comparison between a real and an imaginary case can only provide knowledge to the extent that it rides upon some pre-existent relation between two real entities or objects, and there is nothing in the process of abstraction per se that yields additional knowledge. Thus, to the extent that the modelling attitude is historically dependant upon the relativity of knowledge thesis, scientific representation via models makes is likely to be a deflationary concept.