Theory and experiment in early modern chymistry

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In this paper I argue that the development of speculative matter theory was necessary for the progress of experimental chymistry in the second half of the seventeenth century and the early decades of the eighteenth century.

The paper takes as its point of departure recent claims by Alan Chalmers and Ursula Klein that experimental chymistry advanced in the late seventeenth century and early eighteenth century independently and in spite of speculative theories concerning the nature of matter. I bring five arguments against the 'Independence Thesis' of Chalmers (and to a lesser extent Klein) and for the positive thesis that speculative matter theory was indispensable for the advance of early modern chymistry. But before outlining these arguments I set the scene by describing the terms of reference by which the methodology of much natural philosophy of second half of the seventeenth century was understood.

The salient distinction here is between the experimental philosophy and the speculative philosophy. From the 1660s the experimental philosophy came to predominate over the speculative philosophy and much of the methodological rhetoric in natural philosophy was opposed to vain speculation and the use of hypotheses. Robert Boyle was an advocate of the experimental philosophy and this may suggest that he too was opposed to appeals to speculative theory in the practice of natural philosophy and in particular chymistry. However, this is not the case, for Boyle had well-developed views on the positive relation between experiment and theory and an elaboration of these views must inform any interpretation of the relation between his corpuscular matter theory and his experimental chymistry.

Turning to the arguments against the Independence Thesis, first I argue that the particular method which Boyle advocated for the practice of experimental chymistry was the Baconian method of natural history. This method ensured an important place for the consideration of speculative hypotheses during the compilation of the natural history and was designed so that a speculative theory could be developed as the history neared completion. Boyle's mechanical or corpuscular matter theory was conceived within the context of the Baconian method of natural history as being the sort of theory that would be confirmed and extended as a result of the production of natural histories in chymistry and allied disciplines. Thus Boyle's speculative matter theory was an integral component of his overall neo-Baconian conception of how natural philosophy, including the study of chymistry, should advance.

Second, and complementing the first argument, I repeat and extend claims published in 2002 about the heuristic value of Boyle's mechanical philosophy. In a paper entitled 'Robert Boyle and the heuristic value of mechanism' I argued that Boyle's mechanical philosophy has an heuristic structure such that as natural philosophy advances it is able to ascend the scale of causes and eventually, well beyond Boyle's

own generation, to penetrate to the ultimate material causes of natural phenomena. I argued that Boyle had reasonable grounds for confidence that progress was being made in ascending the scale of causes on the basis of results he had obtained in pneumatics and his ability to generalise some of them to solve a problem in the physiology of respiration. Boyle's results were just the sort of thing one might expect if natural phenomena are to be explained on the basis of the functioning of machines and with intermediate causes such as the spring of the air. I now argue that on the basis of his results in pneumatics and animal physiology Boyle had reasonable grounds to expect that similar intermediate causes might be discovered in chymistry. That is, the inference to the best explanation from Boyle's success in pneumatics was that similar intermediate causes consistent with the mechanical philosophy would be found in chymistry.

Third, I argue that the explanatory principles which underlie Boyle's corpuscularian hypothesis, and in particular his argument for intelligibility, perform an important function in ruling out certain speculative theories thus narrowing the range of possible 'intelligible' theories, particularly those theories that might have a deleterious effect on the advance of experimental chymistry. The claim here is that the explanatory principles associated with the mechanical philosophy performed an important function of 'epistemic hygiene' in the marketplace of ideas in early modern natural philosophy. Intelligibility arguments are, on the whole, of limited philosophical value. However, it is a contingent fact that in the latter half of the seventeenth century such arguments performed a valuable role of 'ground-clearing' by delimiting the range of speculative matter theories that were to be considered potentially empirically tractable.

Fourth, I argue that as a matter of historical fact chymists such as Boyle and Wilhelm Homberg did test speculative matter theories using chymical experiments. I discuss Boyle's repetition of van Helmont's Willow Tree Experiment and Homberg's later experiment to test the Helmontian claim that the ultimate principle of matter is water.

Fifth and finally, I argue that Chalmers' and Klein's emphasis on and evaluation of the significance of the affinity tables published by Etienne Geoffroy in 1718 is open to the charge of being a case of Whiggish history. The singling out of the table chemical affinities as a significant advance can only be done with hindsight and serves to elide a host of other sites for the interaction between experiment and matter theory in the early decades of the eighteenth century.

I conclude by claiming that early modern chymistry and in particular the chymistry of Robert Boyle provides a good example of the manner in which experiment and speculative theory can be in an intimate relation even though the experimental science does not bear any direct *evidential* relation to the theory: lack of empirical tractability of a theory does not imply independence from experimental practice.

This paper forms part of a three-way symposium on early modern chymistry including papers by William R. Newman and Alan Chalmers.