The Mechanical Philosophy and Robert Boyle
William R. Newman

What was the mechanical philosophy? What role did "mechanism" play in seventeenth century science? The answers to these questions may seem obvious to those raised on such vintage surveys as Marie Boas Hall's influential *Establishment of the Mechanical Philosophy*. Here one finds a triumphalist view of the subject, as though Robert Boyle and his peers really managed to reduce the phenomena of the world to the spatial interactions of tiny primordial corpuscles made up of a "uniform catholic matter" and differentiated from one another only by their size, shape, and motion. But in reality the issue was more complex than this, even in the heyday of the mechanical philosophy. As recent studies by Antonio Clericuzio and Alan Chalmers have revealed, it is even possible to argue that Boyle was engaged in two simultaneous projects, in large measure orthogonal to one another. One of these projects consisted of Boyle's mechanical philosophy, seen strictly as the claim that the world consists of indivisible particles (*prima naturalia*) made up of homogeneous matter and differentiated only by their size, shape, and motion. Boyle's other project, was his experimental science, above all his work in pneumatics and chemistry. According to this viewpoint, Boyle's chemistry was a domain distinct from his mechanical philosophy, which neither contributed to nor benefited in a significant way from Boyle's attempt to mechanize the natural world.

In my recent *Atoms and Alchemy* (Chicago, 2006) I take a very different position from that of Clericuzio and Chalmers. In contradistinction to them, I argue that Boyle's writings on chemistry (or as I prefer, "chymistry") were central to his goal of acquiring empirical data and arguments supporting his mechanical philosophy. In order to make this claim, I analyze several experiments of Boyle's taken from works that he published in the 1660's and 1670's, such as *The Sceptical Chymist*, *Experiments Touching Colours*, *The Origin of Forms and Qualities*, and *Experiments about the Mechanical Origin or Production of Divers Particular Qualities*. In particular, I focus on a type of experiment that was called the "reduction to the pristine state" (*reductio in pristinum statum*), which Boyle took over from the Wittenberg iatrochemist Daniel Sennert and other alchemical authors. The best known example of this experiment consisted of dissolving metallic silver in nitric acid, filtering the solution to show that no macroscopic residue remained, and then adding a base to precipitate the silver in the form of silver carbonate. Since simple heating of the yellow silver carbonate powder would recapture the original silver in metallic form, the experiment was a successful demonstration of the metal's ability to withstand analysis by one of the most powerful solvents known to the seventeenth century. Indeed, it allowed Sennert and Boyle to argue that silver and other metals subjected to the same cycle of dissolution and reduction were "atomic" and "elemental," since the metal was the final point of analysis according to the laboratory technologies of the time.

The reduction to the pristine state therefore provided Sennert, Boyle, and others like them with a warrant for a type of atomism, but this in itself was not the mechanical philosophy. Sennert himself was anything but a mechanical philosopher, since he

accepted the reality of substantial forms inhering in each individual atom and providing it with the characteristics of its species. Nonetheless, I argue that Boyle – under the influence of Bacon, Gassendi, and Descartes – combined the reduction to the pristine state with other experiments to show that much phenomenal change could be explained as the result of the changing spatial relationships between corpuscles. The particles in question were not the primordial entities bearing only the properties of size, shape, and motion, but much larger aggregate corpuscles that had been formed by compounding and recompounding of the tiny primordial *prima naturalia*. The aggregate corpuscles were in effect the chymical atoms of Daniel Sennert, but stripped of their substantial forms. Accepting that these chymical corpuscles were resistant to analysis by laboratory means, Boyle performed experiments to show that mere combination, separation, and transposition of them resulted in a variety of sensible alterations, such as changes in color, taste, and odor. Having shown this to be the case, Boyle then employed a parsimony principle to advance his project. If highly diverse and striking changes across a wide range of phenomena could be introduced by means that were acknowledged to be purely mechanical, then why should anyone think that other agencies of change were operating at a deeper level of matter? Why, above all, should anyone fly to the refuge of substantial forms, whose origin even the scholastics admitted to be obscure?

While Boyle's use of the reduction to the pristine state and other experiments allowed him to argue that many phenomenal changes were due to the combination, separation, and transposition of chymical corpuscles, Chalmers in particular claims that this program did not provide evidence for the correctness of the mechanical philosophy, since Chalmers construes the term "mechanical philosophy" to refer <u>only</u> to explanations in terms of the primordial *prima naturalia*. Chalmers admits that Boyle sometimes used the term "mechanical" when describing the interactions of aggregate corpuscles, but asserts that this was a loose and vernacular usage of the term that had no bearing on the mechanical philosophy as such. In my paper, I will argue the contrary, bringing new evidence to the discussion from additional Boylean works that I did not analyze in *Atoms and Alchemy*. As I will show, Boyle himself argued for a latitudinarian sense of the term "mechanical" explicitly within the context of the mechanical philosophy. Boyle pointedly asserted that mechanisms existing at the level of the *prima naturalia* were not directly verifiable by experiment, but that experimental manipulation of aggregate corpuscles nonetheless provided knowledge within the domain of the mechanical philosophy. My paper will thereby form part of a three-way discussion with Alan Chalmers and Peter Anstey on early modern chymistry in which Boyle plays a central role.