

MIT Student

Professor David Jones & Professor David Kaiser

STS.003 The Rise of Modern Science

Paper 1

Alchemy & Chemistry; A Rose by Any Other Name.

Most people today consider alchemy to be some sort of archaic black art; sorcerers working in secret chambers to transmute lead into gold. Chemistry, on the other hand, is regarded as one of the most important branches of experimental science. Is this discrepancy historically accurate or has the classic portrayal given us a distorted view of the past? Evidence from primary sources seems to paint a slightly different picture. Alchemy and chemistry are two terms currently used to describe the nearly identical activities of various experimenters in the 16<sup>th</sup> and 17<sup>th</sup> centuries who were later separated into two groups based on assessments of their alleged motives.

When one begins to examine the similarities and differences between the excerpts from George Starkey's *Alchemical Laboratory Notebooks and Correspondence*, and Robert Boyle's *New Experiments Physico-Mechanicall* it becomes immediately apparent that the comparison will be (in some respects) fundamentally flawed. Starkey's writings were taken mostly from a notebook he used in the laboratory for recording the results of his daily experiments;<sup>1</sup> Boyle's *New Experiments* was a document he prepared intentionally for publication and circulation.<sup>2</sup>

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<sup>1</sup> George Starkey, "A Laboratory Notebook," in *Alchemical Laboratory Notebooks and Correspondence*, ed. William R. Newman and Lawrence M. Principe (Chicago: The University of Chicago Press, 2005), 127-129 & 170-175, on 127.

<sup>2</sup> Boyle, Robert, "New Experiments: Physico-Mechanicall, preface and pp. 20-37."

Starkey's and Boyles works represent two entirely different classes of writing so attempting to directly compare these two documents is not a reasonable proposition. However, one can glean a great deal about the authors from their respective writings and use that knowledge to make an indirect comparison of their attitudes and methods.

It may be argued from Starkey's notes that he was not terribly concerned about the precision of his measurements. He continually used phrases such as "perhaps seven gallons", "I rectified the spirit three or four times", and "about nine pints".<sup>3</sup> These statements do not seem to match up to the careful measurements employed in modern labs, carried out to three or more significant figures. However, the context in this case is very important. Starkey was not attempting to determine how much of each ingredient was needed to result in a predetermined amount of end product. He was in the process of discerning *what* that end product would be. This intent is clearly demonstrated by his detailed description of the 'spirit' at each stage of the process. In contrast he mentions the volume in passing, perhaps for the sake of completeness. It is also worth noting that he disposes of the unwanted by-products of each distillation and observed at times that some portion of the vapors escaped through the joints of the apparatus, further lowering the significance of the volume of the original ingredients.<sup>4</sup> Any accusation that accurate measurements were not important to Starkey can be definitively invalidated by the emphasis he places on exactness in his other writings. His concern with final and initial weights, his quantitative analysis (borrowed from an influential mentor, Van Helmont), and his gravimetric technique all demonstrate that he was closer to an obsession with precision than an indifference towards it.<sup>5</sup>

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<sup>3</sup> Starkey, "A Laboratory Notebook," 170-171.

<sup>4</sup> Starkey, "A Laboratory Notebook," 172

<sup>5</sup> William R. Newman and Lawrence M. Principe, *Alchemy Tried in the Fire: Starkey, Boyle, and the Fate of Helmontian Chymistry*, (Chicago: The University of Chicago Press, 2002), 121

Starkey's focused lab notes are starkly contrasted by the preface to Boyle's *New Experiments*. Boyle introduces his work with broad rhetoric—speaking of the spread of “Experimental and Useful Philosophy” and the hope that “ingenious men” would use his discoveries to benefit humanity.<sup>6</sup>

Boyle goes to great length to convince his reader that the experiments he conducted with a ‘new pneumatical engine’ (essentially an early vacuum pump) are rigorous, repeatable and trustworthy. Based on these experiments he poses two alternate hypotheses to explain the nature of air pressure.<sup>7</sup>

The first hypothesis he presents consists mainly of the notion that the air consists of fibers similar to those of wool. They can bend and be compressed but always seek to regain their original size and shape. However, he does not seem to favor this approach to dealing with the problem.

Boyle's second hypothesis is one that he borrowed from Des Cartes; that air consists of small particles (corpuscles) which continually spin and push off of one another and any solid object they encounter. The force of them jostling with one another accounts for air pressure. Of course this second proposition is much closer to our current understanding of how atoms in a gaseous state behave.

Boyle presented two opposing ideas and offered both support and counter-arguments for each of them. This approach allowed him to earn a reputation for open-mindedness and honesty. In addition, the methods employed by Boyle in his experiments are consistent with modern ideas of how such tests should be carried out. He used clearly explained equipment and procedures

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<sup>6</sup> Boyle, Robert, “New Experiments,” preface

<sup>7</sup> Boyle, Robert, “New Experiments,” 22-25

which could be reproduced by other natural philosophers or even a resourceful lay-person.<sup>8</sup> This openness has been heralded by many as ushering in the era of modern, collaborative science and is seen as an anti-type of secretive alchemy.

Alchemists have often been condemned for their strict adherence to secrecy. Modern investigators live in a culture where academia is marked by a free exchange of information. This makes them automatically suspicious of the methods and motives of anyone who works (or worked) secretly. However, once again context can provide us with a clearer understanding of the intention of early alchemists. These men truly believed that while simultaneously working to solve more practical problems, they were striving towards a comprehensive understanding of matter itself along with the ability to manipulate it. This knowledge was therefore something which had to be guarded at all costs, lest it be revealed to an individual who would use such knowledge to cause great harm. Their purpose in silence may have been the same as the purpose of those who kept the Manhattan Project a secret. Indeed the two groups had the same ultimate goal: absolute control over matter.

An important point to remember is that the terminology ‘alchemy’ and ‘chemistry’ are more recent than the pursuits they describe. Both words are thought to have originally been derived from the Greek word *khymeia* which was used mostly to refer to what we now call pharmaceutical chemistry.<sup>9</sup> The more recent terms *alchemia* and *chemia* (Latin) were used interchangeably by most authors in the 17<sup>th</sup> century.<sup>10</sup> There seems to be no historically accurate and consistent distinction between chemistry and alchemy. Contemporaries George Starkey (now

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<sup>8</sup> Boyle, Robert, “New Experiments,” preface

<sup>9</sup> Douglas Harper, “Online Etymology Dictionary,” available at <http://www.etymonline.com/index.php?term=alchemy> (accessed 20 September 2010)

<sup>10</sup> William R. Newman and Lawrence M. Principe, “Alchemy vs. Chemistry: The etymological origins of a historiographical mistake,” *Early Science and Medicine* 3 (1998): 32-65, on 32

considered an alchemist) and Robert Boyle (known as the father of modern chemistry) both used precise measurements and experimental methods to gather useful data about the chemical realm, and even collaborated on several projects.<sup>11</sup> More astounding yet, Sir Isaac Newton and Robert Boyle, both considered founders of modern scientific methods, have recently been identified as practicing alchemists,<sup>12</sup> irreversibly blurring the lines between two terms held to be radical opposites for over two hundred years.

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<sup>11</sup> Newman and Principe, *Alchemy Tried in the Fire*, 9

<sup>12</sup> Mordechai Feingold, "Boyle Reborn," available at <http://www.americanscientist.org/bookshelf/pub/boyle-reborn> (accessed 20 September 2010)

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