How and why did European science and medicine change between 1500 and 1700?

The profound transformation of science and medicine in this period is attributed to a number of factors. The increase in scientific interest away from conventional urban disciplines such as alchemy ushered in a new change for the practice of science as an academic topic, with the development of Academies and Societies whose aim was to advance this newly emerging form of thought. Whereas original scientific thought and medical knowledge was based on classical texts, this 'Scientific Revolution' attempted to move away from this archaic illustration by forming new theories or building on established knowledge – for example, the findings of scholars such as Copernicus. Medicine was profoundly affected with the rise in knowledge of anatomy and physiology pioneered by those such as William Harvey who built on Aristotle's research from ancient texts. Moving towards a more humanist society is the likely reason for such knowledge finding its way into European theories with the logical becoming almost as important as the theological. Three examples of radical change will be utilised to express how science and medicine morphed during the period and arguments of why this occurred will be used from a range of historians and primary evidence.

During the period 1500-1700, a large decline in occult sciences allowed new scientific theories to become popularised in European societies. Therefore, astronomy became developed by newer academics taking ancient knowledge and furthering its practice. One such scholar was Nicolaus Copernicus who challenged the idea of an earth-centred universe.[1] He developed the idea of heliocentricity – in other words the idea that the Sun was at the centre of the universe. This came into direct conflict with the geocentric theory of Ptolemy, who believed that the Earth was the centre of the universe and this was religiously factual

[1] Hoyle, p.58.

when compared against Bible passages.[2] As viewed in appendix 1.1, the idea of the earth being the centre was clearly religiously motivated as most science had been during the Middle Ages. The string of religious symbolism along the outside of the image clearly shows the motivation for this thought. Compare this to Copernicus's drawings on the heliocentric theory,[3] and we see a stark difference with Copernicus' drawing resembling the modern view of the universe more than Ptolemy's theory. This connotes a break in the referring to ancient theory as fact, using a more logical factual base rather than a religious one – clearly a massive change from the fifteenth century and reflecting the change to modernity of this period.[4]

This theory shook the foundations and beliefs of the everyman in the 16th century. Most scholars considered this work an affront to the already firmly established religious teachings and so Copernicus's theory was largely ignored until after his death.[5] The reason Copernicus was key in leading the way for scientific change was due to his challenging of the already established theological perspective. Challenging and revising theories is a modern day norm, with theories being disproven daily. Copernicus was arguably one of the first to do this and so he revolutionised the way we looked at science then and do so now – comparing and contrasting what we hope to understand. He paved the way for further developments in terms of astronomy with the likes of Kepler following in his footsteps. As Turner expresses, 'Copernicus gave men a fresh standpoint'[6] and therefore mathematicians and astronomers could develop from his research, as he developed from older research. It is argued therefore, that this is why science changed during this period – because of the challenge to conventional theories and the dissipation of theology as the groundwork for scientific investigation.[7]

[2] Hoyle, p.60.
[3] See appendix 1.2.
[4] Turner, p.32.
[5] Turner, p.33.
[6] Turner, p.36.
[7] Ibid.

In terms of medicine there is a similar series of events, linking towards the overarching theme of thought progression. The original trust in the work of Galen deprived those in the medical profession of important discoveries, such as those that could have been made from animal dissection and the like.[8] The first to break this archaic notion was Leonardo Da Vinci, with his drawings of the dissected human heart and challenging of the workings of the lung.[9] However the first to challenge on a literary level was Andreas Vesalius with his book *On the Fabric of the Human Body.* This researcher is the basis for the argument of medical change, as he revolutionised the way we view the internal body – with current drawings of human dissections included in fine detail on most pages.[10] For example, appendix 1.3 illustrates the level of detail ascertained from basic dissection, allowing muscle, bone and internal organs to be shown in great detail – something not conceived by followers of Ancient practitioners like Galen. He effectively revolutionised the way we observe anatomy – by utilising first hand evidence as the sole tutorial of modern medicine.[11]

Vesalius effectively picked apart the workings of those ancient practitioners such as Galen and tested each and every theory. Similarly to Copernicus, Vesalius challenged a widely accepted theory and gained results – showing even further than the reason for the rapid change in science and medicine during the period was due to a modern approach. Rapid testing of theories and actually setting out to disprove older views ushered the change that carries through to today. In other words, a look to a more humanist society was achieved with many others taking up the mantle of scientific discovery and challenging work before them, something that was not observed in medieval society.[12] Contrasting popular ancient texts such as Aristotle's writing, new scientific material produced by these pioneers wanted to be disproven and challenged, not accepted as the truth. Ancient texts merely wanted you to

[8] Turner, p.30.
[9] Turner, p.30.
[10] Turner, p.32.
[11] Turner, p.32.
[12] Cowie, p.78.

accept their interpretation of the world rather than achieve discovery in yourself.[13] This links back to thought progression – the challenge to the established was finally approached by these revolutionaries. Copernicus and Vesalius both published their work in the same year, 1543, and as such it was a lot to accept for a deeply religious society. The idea that society could possibly be wrong prevented both Copernicus' work and Vesalius' from being recognised as fact until many years after their deaths.[14] This illustrates perfectly that although this was a period of scientific change and revolution, it was not accepted immediately nor with elation.

The one new philosophy that marked this period as a stage in scientific discovery was the practice of humanism. Humanist scholars were different to those originally studying classical texts in the medieval period, as they challenged and tested everything about their theories. Individual experience was becoming more and more important in this new society, a massive shy away from just accepting what was previously written as fact.[15] They attempted to move away from the interpretations by Islamic and Christian writers – as they believed they wrote with either an agenda or without full praise to the facts.[16] Although many of the pioneers of this philosophy were religious, as most of society was, they separated the aspects of religion and science to prevent confliction of facts. This rang true with Copernicus, who challenged the philosophy that the sun revolves around the earth with his own theory which rang to be true. Therefore, the scientific revolution marked the point in history where we stopped accepting, and started to challenge established theories and assumptions. One such set of assumptions that slowly went away with the emergence of rational science, was alchemy.[17]

[13] Cowie, p.79.
[14] Turner, p.32.
[15] Shaplin, p.75.
[16] Ibid.
[17] Moran, p.1.

Alchemy began as the creation of medicines using the natural world. Creation of remedies and potions to cure ailments was a common practice in the medieval world but began to die out with the emergence of 'rational and ordered' science.[18] Due to pulling strongly from 'magic' and the 'occult', alchemy had no place in modernity with its advancing theories and constant fact-checking. The idea that a substance could be transformed into another, such as gold, sounded bizarre and unproven in the eyes of new humanists who were hugely sceptical about the occult and 'magic'.[19] However, the research gained from the natural investigation of alchemists paved the way for rational science, and eventually evolved into what we refer to as Chemistry.[20] This transformation was ushered in with the revolutionary book *Alchemy* by Libavius in 1597 – which included a large amount of diagrams and information regarding the construction of a chemical workshop and how to utilise it effectively.[21] The combination of different substances and the results of such combinations were also printed in detail – similar to our understanding of chemistry today. The book's title seems to mislead as the book is more chemistry than alchemy, but nonetheless the confusion between the two practices would have been a common occurrence due to the concept of combining substances having its roots in alchemy.[22] This early form of chemistry was still very basic however, as it was similar to alchemy in the sense that there was no explanation for why these combinations worked; it was just accepted that they did work much like the older belief in classical work, where it was just accepted and not challenged.[23] By the end of the sixteenth century, and the beginning of the seventeenth, alchemy was in a steady decline – being almost forced away by the discovery of chemistry as

[18] Ibid.
[19] Moran, p.9.
[20] Ibid.
[21] Ibid.
[22] Moran, p.10.
[23] Moran, p.11.

a more legitimate and sound practice. Although there were still practisers of this archaic art, it never really gained as much ground following its decline.

Therefore, it could be argued that the decline of pseudo-sciences like alchemy and astrology directly aided the scientific revolution. People had relied on the idea of help from magic and the occult throughout most of the medieval period, but with the scientific revolution, change was ushered in. Much like astronomy and medicine, chemistry changed the way alchemy was viewed – as a lesser practice and also a heavily ancient practice. As mentioned earlier, the move towards a more humanist perspective cast huge doubt upon fringe-sciences like this, as scepticism became the new norm amongst scientific communities and the general public. Alchemy was outlawed in England in the latter part of the sixteenth century, reflecting the advancement in the field of science and the huge scepticism of magic that came with it.[24] The reason for alchemy solidifying itself for so long in society was the mind-set of acceptance – alchemy made sense to those who read into it and even saw it, hence there was no need to question it much like the acceptance of classical scholars such as Hippocrates without challenge.[25] Therefore, much like the other mentioned facts, the main reason for the change during this period was challenge to the established.

In this essay, three examples of scientific and medical change have been explored: the change in the study of astronomy, anatomy and the decline of the pseudo-science. All three examples have reached the same conclusion: that the reason for their emergence or decline was due to the newly formed philosophy of humanism – in other words, rational and sceptical thought. The idea that religion was a separate entity to science shocked many contemporaries during the period, preventing acceptance of these new theories until after their creators had died. The work performed during the period changed the view on science and medicine – that it had to

[24] Moran, p.14.
[25] Moran, p.25.

be challenged and disproven for it to be the most effective, something which was not done with classical texts such as the work of Galen and Hippocrates. This change in the way science was observed allowed further researchers such as Galileo to build on theories proposed and effectively challenge or disprove them. All in all, science and medicine changed because of this scepticism, but it also changed due to the decline of the mass theology of the medieval period. Most researchers were still religious, but understood that the separation of theology and rationality was important in order to advance science as a discipline. The decline of pseudo-science reflects this perfectly, removing ideas of superstition and magic in favour of rationality and a scientific basis we recognise today.

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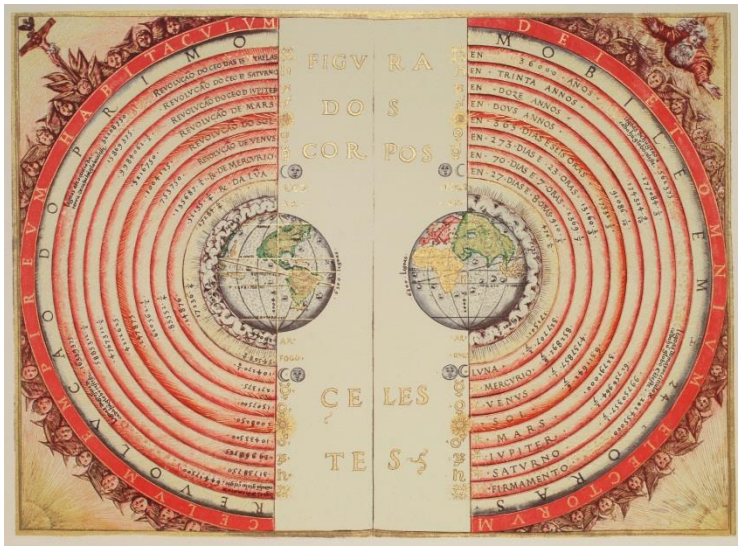
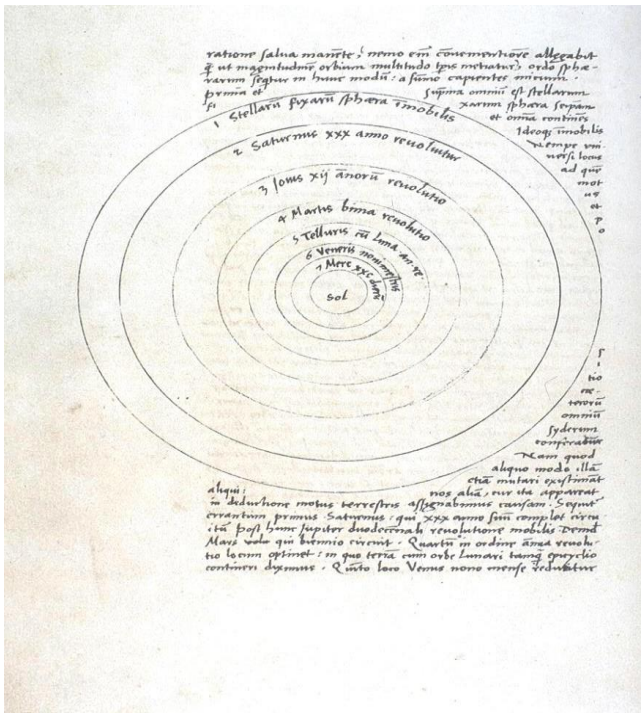
Appendix

1.1 Bartolomeu Velho, *Figure of the Heavenly Bodies* (1568), from his work *Cosmographia*, Bibliotèque nationale de France, Paris. <http://www.fulcrumgallery.com/product-images/P696566-10/bartolomeu-velho-1568.jpg> [accessed 23/03/2014].



1.2 Nicolaus Copernicus, *De Revolutionibus* (1543), ink on paper. Jagiellonian Library, Krakow.

<http://upload.wikimedia.org/wikipedia/commons/e/e8/De_Revolutionibus_manuscript_p9b.jpg> [accessed 23/03/2014].



1.3 Andreas Vesalius, *On the Fabric of the Human Body* (1543), <http://upload.wikimedia.org/wikipedia/commons/a/ad/Vesalius_Fabrica_p184.jpg> [accessed 23/03/2014].