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The Formation of a Language of Science: Vitalism in 18th-century Scotland

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Abstract: Vitalism was a scientific theory that prevailed in 18th-century Scotland. Due to the influence of Boerhaave and the teaching of native scholars, vitalism appeared in Scotland in the first half of the 18th century. Its prosperity was closely related to the personal activities of William Cullen and marked by the acceptance and use of vitalism by other new disciplines, especially chemistry. Due to the continuous progress of experiments and the update of experimental instruments, vitalism was gradually replaced by experimental conclusions. Analyzed by social network analysis, the influencing factors affecting the spread of vitalism in Scotland in the 18th century are obtained. Officially, the University of Edinburgh and the teacher-student relationship were the main influencing factors; unofficially, William Cullen's influence was the main influencing factor. As a scientific theory, vitalism experienced a limited rise and fall process; as a language of science, vitalism was borrowed by literature and other disciplines and has an influence even in biology today.

Keywords: Vitalism, Scotland, William Cullen, Language of Science.

1. Introduction

The 18th century in Europe was a time of new ideas and disciplines, which included vitalism. This theory is the product of a reconciliation of the two opposing theories of mechanism and Animism, both of which simplify life to a series of principles. Scholars represented by Reill analyze the causes and characteristics of the rise of vitalism in Europe in detail, but vitalism in Scotland has not attracted much attention. As a scientific theory, the formation, prevalence and fall of vitalism in Scotland in the 18th century were influenced by multiple factors, these factors, in turn, were influenced by the uniqueness of the Scottish scientific scene. Besides, as a language of science, vitalism has exerted an important influence beyond scientific theories. Thus, rewriting vitalism in 18th-century Scotland helps to complement the insufficiency of research in this field and provides a more comprehensive analysis.

2. The Formation, Prevalence and Fall of Vitalism in Scotland in the 18th Century

2.1. The Formation of Vitalism

The formation of vitalism in 18th-century Scotland was tracked in two lines. Firstly, Boerhaave had a clear influence on early vitalism in Scotland, he directly guided Scottish vitalists William

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Porterfield(1696-1771), John Pringle(1707-1782) and Robert Whytt(1714-1766), and mechanists Andrew Plummer(1697-1756) and Alexander Monro *Primus*(1697-1767), who had the most direct impact by teaching vitalists such as William Cullen(1710-1790), Robert Whytt, William Hunter (1718-1783), and Alexander Monro *Secundus*(1733-1817). In addition, native mechanics also played a role, specifically, Colin Maclaurin(1698-1746), as a professor of mathematics recommended by Isaac Newton (1642-1726/27) directly mentored vitalists James Hutton(1726-1797) and John Walker(1731-1803). As the major vitalists developed their interpretations of vitalism in the mid-18th century, vitalism gained a foothold in Scotland and began to enact its influence.

2.2. The Prevalence of Vitalism in Scotland

The prevalence of vitalism in Scotland can be seen in the activities of vitalists. The most iconic event was undoubtedly when William Cullen took over the chair of medicine and chemistry in the ailing Plummer in 1755 at the University of Edinburgh. By 1786, with Daniel Rutherford (1749-1819) succeeding John Hope, throughout the last 14 years of the 18th century, all the other professors in the Medical School at the University of Edinburgh were vitalists except Alexander Hamilton (1739-1802). At the same time, vitalists Benjamin Rush (1746-1813) went to the New World, William Falconer (1744-1824) in Bath, and the activities of David Macbride (1745-1820) in Dublin illustrate the prevalence of vitalism in the mid-18th century not only in Scotland but throughout the English-speaking world. Another phenomenon is that other Scottish universities were consciously imitating the vitalists of the University of Edinburgh. Robert Eden Scott (1769–1811), professor of natural philosophy at the University of Aberdeen, completely followed vitalist John Walker's lectures in Edinburgh in his teaching at the University of Aberdeen [1]. The prevalence of vitalism was reinforced by the reputation of the University of Edinburgh Medical School. After William Cullen went to London, John Hunter (1728-1793) joined him and became his assistant, becoming another famous vitalist[2].

The prevalence of vitalism in Scotland also reflected that vitalism as a new language of science, was applied to various new subjects. In natural philosophy, John Walker evolved a unique explanatory and methodological language related to vitalism[3]. The same phenomenon also appeared in the exploration of chemistry by William Cullen and Joseph Black(1728-1799) and the study of geology by James Hutton, the establishment of the language of these subjects preceded the independence and began to organize discourse systems. Another subject worth noting is Botany. Although Scottish Botany was more based on Linnaeus's (1707-1778) mechanistic approach, James Edward Smith(1759-1828) developed the new classificatory studies of morbid anatomy and nosology with the usage of the language of vitalism.

2.3. The Decline of Vitalism

However, under the prevalence trend, Scottish vitalism showed signs of decline in the second half of the 18th century. New instruments and experimental methods were as important as a new language for a new discipline, this caused vitalism as a scientific theory was replaced by more specific experimental conclusions. Black's proteges and followers such as Thomas Thomson (1773-1852) and William Henry (1774-1836) were not directly opposed to latent heat theory in vitalism, but their attention was on the chemical experiments instead of elaboration of vitalism. By the end of the 18th century, scholars such as George Hoggart Toulmin(1754-1817), and Thomas Charles Hope(1766-1844), even though they were deeply influenced by vitalist Joseph Black, also favoured empirical and experimental chemistry rather than refined vitalism to include experimental chemical conclusions and physiological knowledge. Compared with Lavoisier's Revolution, vitalism in the chemical field could not provide more convincing explanations, nor could it incorporate endless experimental conclusions

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into its explanatory framework. Therefore, in the 19th century, science shifted to a more experimental dimension, and the emerging phrenology and biology became new carriers of vitalism. However, this does not mean that vitalism has disappeared. In the 19th century, life theory and vitalism still caused a famous debate[4]. The mechanism and the debate of the successors of vitalism have always existed in biology, but the forms have evolved and are specific to molecular biology and evolutionary biology[5].

3. Exploration of Different Influences in the Prevalence of Vitalism in Scotland in the 18th Century

3.1. Official Influences of the Prevalence of Vitalism

In Scotland in the 18th century, universities had become the main place of knowledge dissemination, and vitalism was no exception. The University of Edinburgh, the center of medical education in Europe in the 18th century, became the most influential official institution on vitalism. Figure 1 by Gephi can directly reflect this phenomenon. Red nodes indicate vitalists who have been educated or held positions at the University of Edinburgh, while red edges indicate student-student relationships that take place at the University. Black nodes and edges indicate vitalists and teacher-student relationships unrelated to the University of Edinburgh.

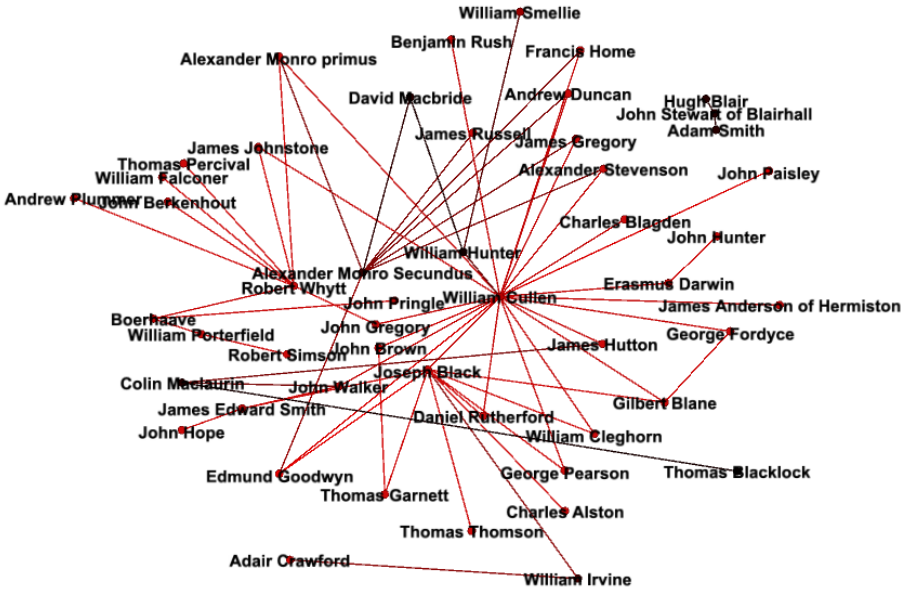

Figure 1: Social Network of the Vitalists at the University of Edinburgh in the 18th century

The dominance of the University of Edinburgh is reflected in Figure 1, 14.6% (6/41) of vitalists are neither educated nor employed at the University of Edinburgh. Besides, the modern curriculum set by the Medical School of the University of Edinburgh imitating Leiden University and the free internal course selection also contributed to the rapid spread of this new theory[6], making the University of Edinburgh become the center of vitalism. The importance of the teacher-student relationship to vitalism communication can also be seen from the social network. To more clearly represent the clustering of nodes, the ForceAtlas 2 layout in Gephi is used, resulting in Figure 2.

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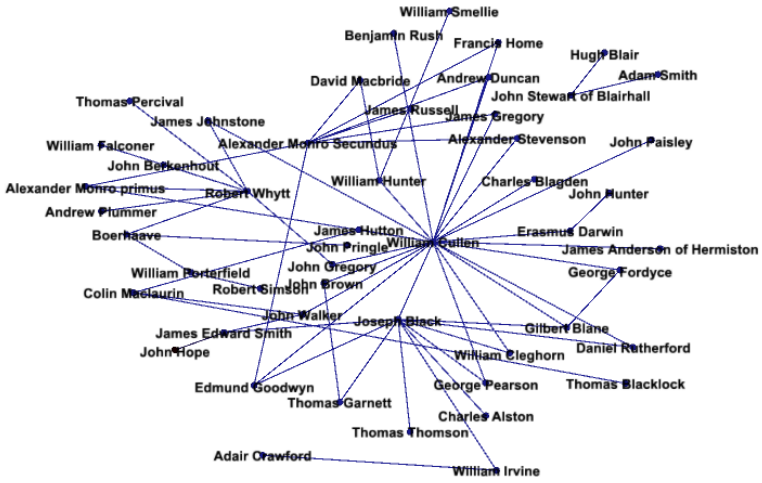

Figure 2: Social Network of Scottish Vitalists in the 18th Century in the ForceAtlas 2 layout

This phenomenon shows that Scottish vitalism was forming an elite group that tended to specialize in training. Therefore, the university and the teacher-student relationship within the university constituted the tangible channel of vitalism in Scotland in the 18th century, and the theory rapidly gained prevalence in the form of teacher-student relations through the medium of the University of Edinburgh.

3.2. Private Influences of the Prevalence of Vitalism

The personal contribution of William Cullen needs to be emphasized. When William Cullen moved to the chair of Institutes (theory) of Medicine at the University of Edinburgh in 1766, he began to be widely popular with his students and expanded his audience to include gentlemen outside the university who were interested in the subject. By 1766, of all the courses offered by members of the medical faculty in Edinburgh, only the anatomy lectures attracted more students than Cullen's chemistry course. Due to the University of Edinburgh was free for students to choose courses, and the lecture fees were paid directly to the teachers, this popularity was purely because of Cullen's style[7]. At the same time, Cullen's unequivocal opposition to the mechanism had earned vitalism plenty of attention. Cullen's lectures caused outrage when they were first held, even Edinburgh's provost warned him "that his behaviour was likely to hurt both himself and the university."[8] This controversy also led to a rapid discussion of vitalism in a way that was not seen in the experience of other vitalists.

4. Limitations and Ductility of Vitalism in Scotland in the 18th Century

4.1. A Scientific Theory: Limitations

The limitations of the vitalism as a scientific theory need to be noted. First of all, during the 18th century, mechanical philosophy always played a role as the mainstream philosophy and flourished at the same time. Vitalism could not be compared with mechanism even in its prevailing period, the number of savants who could be identified as vitalists was still less than mechanists in the 18th century, and the number would be even lower if mathematicians and physicists were included[9]. Throughout the 18th century, vitalism as a theory focused on medicine (chemistry had not yet become an independent discipline; it remained in medical schools throughout the 18th century), and to a lesser extent on natural philosophy and geology (only John Walker and James Hutton). In addition,

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Newtonism spread and developed through various channels in the 18th century which also spread mechanism as the development of Newtonism. Popular science lectures and performances became channels for the "popularization" and dissemination of Newtonism, in contrast to the refined, complex and difficult-to-understand vitalism, which spread through teacher-student relations.

4.2. A Language of Science: Ductility

The borrowing of the vital language of science became another feature of Scottish vitalism and even the Scottish Enlightenment. This phenomenon was first reflected in the moral philosophy of Scotland. The principle of sensibility appeared in the discourse of both vitalists and moral philosophers, in the theoretical foundations of David Hume(1711-1776) and Adam Smith(1723-1790), in the "social solidarity" of Adam Ferguson(1723-1816), and even in the language of Presbyterian preacher Hugh Blair(1718-1800) [10]. However, this principle was not found in the works of Plummer and Alexander Monro *Primus*, indicating that such a language did not exist in the flourishing period of mechanical philosophy. Furthermore, as a poetic language, vitalism extended to literary creation. The most obvious manifestation of this phenomenon was in German-speaking Romanticism represented by Schiller and Goethe. Still, in Scotland, John Armstrong (1709–1779) and Thomas Blacklock also used vitalism extensively as mentioned above[11]. In terms of the language of science itself, the affinity, mysterious and unobtainable principle or force that vitalism emphasizes on the body itself is inherently poetic, which is more likely to attract poets' attention, and vitalism continues its vitality as a scientific language in the field of literature. A tricky example is Thomas Blacklock (1721-1791), his educational experience was largely influenced by mechanist Colin Maclaurin, however, he became famous for his poetry, which was characterized by vitalism.

5. Conclusion

As a new scientific theory, the acceptance of vitalism must be visible and traceable, that's the aim of the usage of social network analysis. At the same time, as a language, the spread can be invisible and difficult to trace. This spread can take many forms, oral, publication, reading, lecture, re-creation and even plagiarism, and these methods are widespread. We cannot determine through strict historical analysis that a language must be influenced by a certain historical figure, but such influence existed widely in a specific historical environment. It is undeniable that vitalism in 18th-century Scotland did have a significant impact, it experienced a natural process as a scientific theory that formed and declined in a certain period of history, but this idea prevailed in the form of language in the new discipline and eventually continued to maintain vitality as the form of molecular biology and evolutionary biology nowadays.

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